State of New Mexico
Energy, Minerals and Natural Resources Department

Michelle Lujan Grisham
Governor

Melanie A. Kenderdine
Cabinet Secretary

Benjamin Shelton
Deputy Secretary (Acting)

Gerasimos Razatos, Division Director (Acting)
Oil Conservation Division

BY ELECTRONIC MAIL ONLY

August 22, 2024

Mr. Gary E. Fisher
NGL Waste Services, LLC
1008 Southview Circle
Center, Texas 75935
gfisher@popmidstream.com

RE: NGL Waste Services, LLC – Notice of an Administratively Complete Minor Modification Permit Application for NM1-66

Dear Mr. Fisher:

The Oil Conservation Division (OCD) has reviewed the minor modification permit application resubmitted to the OCD on August 14, 2024, for the North Ranch Surface Waste Management Facility (SWMF), Permit NM1-66. The minor modification permit application has been approved with the following condition of approval:

- Pursuant to 19.15.36.12.E NMAC, R360 Antelope Draw, LLC (R360) must submit the financial assurance (FA) as indicated in the approved closure and post-closure plan. The FA amount is $7,601,030.43.

The FA must be on an OCD-prescribed form, or form otherwise acceptable to the OCD, payable to the OCD. Bond forms can be found at the bottom of OCD's Form's Page located at https://www.emnrd.nm.gov/ocd/ocd-forms/. The original bond form must be submitted to the below address:

Oil Conservation Division
Attn: Rob Jackson
1220 South St. Francis Dr.
Santa Fe, NM 87505

Once R360's bond has been accepted by the OCD, the OCD will release the bonding for NGL Waste Services, LLC (NGL) and complete the transfer of Permit NM1-66 from NGL to R360. If R360 and/or NGL has any questions regarding this approval letter, please feel free to contact me at (505) 795-1722, LeighP.Barr@emnrd.nm.gov.

Take Care,

Leigh Barr

Leigh Barr
Administrative Permitting Supervisor

The application/form must be submitted via OCD's Online Permitting System at https://wwwapps.emnrd.nm.gov/OCD/OCDPermitting/Default.aspx along with any associated permit fee.

State of New Mexico
Energy Minerals and Natural Resources

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

For State Use Only:

Form C-137A
Revised October 11, 2022

APPLICATION FOR MINOR MODIFICATION TO SURFACE WASTE MANAGEMENT FACILITY

1. Operator: NGL Waste Services LLC

   Address: 1008 Southview Circle, Center, TX 75935

   Contact Person: Gary Fisher Phone: 720-315-8035

2. Location: N/A /4 N/A /4 Section 9 & 10 Township 25 South Range 34 East

3. Provide permit number NM1-66

4. Attach a description of the proposed minor modification(s) to the surface waste management facility.

5. If the Minor Modification involves changes to a treatment, remediation, or disposal method, attach engineering designs, certified by a registered professional engineer, including technical data on the design elements of each applicable treatment, remediation, and disposal method and detailed designs of surface impoundments.

6. If the Minor Modification will affect the closure and post-closure plan, attach an updated closure and post closure plan, including a responsible third party contractor's cost estimate, sufficient to close the surface waste management facility in a manner that will protect fresh water, public health, and the environment (the closure and post closure plan shall comply with the requirements contained in 19.15.36.18 NMAC).

7. If the Minor Modification will affect the contingency plan, attach an updated contingency plan that complies with the requirements of Subsection N of 19.15.36.13 NMAC and with NMSA 1978, Sections 12-12-1 through 12-12-30, as amended (the Emergency Management Act).

8. If the Minor Modification will affect the control of run-on or run-off water at the site, attach an updated plan to control run-on water onto the site and run-off water from the site that complies with the requirements of Subsection M of 19.15.36.13 NMAC.

9. If the Minor Modification will affect the best management practice plan, attach a best management practice plan to ensure protection of fresh water, public health, and the environment.

10. The division may require additional information to demonstrate that the surface waste management facility's operation will not adversely impact fresh water, public health, or the environment and that the surface waste management facility will comply with division rules and orders.

11. CERTIFICATION
I hereby certify that the information submitted with this application is true, accurate, and complete to the best of my knowledge and belief.

Name: Gary E Fisher Title: VP Operations

Signature: Gary E Fisher Date: 8/14/2024

E-mail Address: gfisher@popmidstream.com

Minor Modification For Surface Waste Management Facility

North Ranch Disposal Facility:
Surface Waste Management Facility
Lea County, New Mexico

May 2023
Project No. 35187378

Volume 1 of 3

Modified by:

NGL Waste Services, LLC
1008 Southview Circle
Center, TX 75935

Modified for:

R360 Antelope Draw LLC
476 Battle Axe Rd
Jal, NM 88252
(575) 236-1734

PROFESSIONAL ENGINEER'S CERTIFICATION

Certification for 303-Acre Surface Waste Management Facillty Design and Permit

"I, Michael P. Bradford, P.E., certify to the best of my professional judgment that this document and attachments specifically regarding the engineering design and permitting of the 303-acre Surface Waste Management Facility portion of the proposed North Ranch Disposal Facility (referred to as North Ranch Surface Waste Management Facility herein) (properly adhere to established, sound engineering practices. This certification is contingent on the fact that all information supplied to the signatory authority below, up to the date of this certification, is unquestio provided in good faith."

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
6/4/20

May 23, 2023

Environmental Permitting Group
EMNRD - Oil Conservation Division
1220 S. St. Francis Drive
Santa Fe, NM 87505

RE: North Ranch Surface Waste Management Facility Permit Modification
Sections – 9 and 10; Township – 25 South; Section - 34 East NMPM
Lea County, New Mexico
Permit No. NM1-66

NGL Waste Services, LLC (NGLWS) appreciates the opportunity to provide New Mexico's Oil Conservation Division (OCD) with this minor permit modification for the existing Commercial Surface Waste Management permit (NM1-66) at the referenced site. The facility consists of approximately 303 acres and is located in Sections 9 and 10; Township 25 South; Section 34 East NMPM, Lea County, New Mexico, approximately 16 miles west of Jal (Site). A copy of the executed OCD Form 137A and updated complete SWMF application, operating procedures and drawings are included with this modification request (Vol. 1 of 2 & Vol. 2 of 2).

Item 1. Operator Information – *See attached executed OCD Form 137A*

Item 2. Site Location – *See attached executed OCD Form 137A*

Item 3. Permit Number – *NM1-66*

Item 4. Attach a description of the proposed minor modification(s) to the surface waste management facility.

Response: *NGL Waste Services proposes to amend Permit NM1-66 as follows:*

1. *Remove all references to the Striker 4 SWD in order to "unlink" the two separate operations.*
2. *Remove operational references to 19.15.35 (Part 35), as not applicable to this SWMF*
3. *Change ownership of NM1-66 to R-360 Antelope Draw, LLC, 476 Battle Axe Rd, Jal, NM 88252.*
4. *Request the use of an alternative form C-138 (Shipping Manifests) as a regulatory compliant permanent record.*
5. *Clarify the type of perimeter fencing.*
6. *Incorporate previously requested Minor Modifications into complete document.*
7. *Recognize the design changes (increase in size) of the drying pads.*

Item 5. If the Minor Modification involves changes to a treatment, remediation, or disposal method, attach engineering designs, certified by a registered professional engineer, including technical data on the design elements of each applicable treatment, remediation, and disposal method and detailed designs of surface impoundments.

Response: *There are no proposed changes to the SWMF's approved treatment, remediation, or disposal methods. Removal of references to Striker 4 only.*

Item 6. If the Minor Modification will affect the closure and post-closure plan, attach an updated closure and post closure plan, including a responsible third party contractor's cost estimate, sufficient to close the surface waste management facility in a manner that will protect fresh water, public health, and the environment (the closure and post closure plan shall comply with the requirements contained in 19.15.36.18 NMAC).

Response: *There are no modifications that will impact the Site's approved closure or post closure plan, as the current plan does not include the Striker 4. Financial assurance will be updated at the time of the upcoming annual report, as per previous discussions with Brad Jones, NMOCD.*

Item 7. If the Minor Modification will affect the contingency plan, attach an updated contingency plan that complies with the requirements of Subsection N of 19.15.36.13 NMAC and with NMSA 1978, Sections 12-12-1 through 12-12-30, as amended (the Emergency Management Act).

Response: *The contingency plan has been updated with current emergency contacts. Included in attached Volume 1 of 2.*

Item 8. If the Minor Modification will affect the control of run-on or run-off water at the site, attach an updated plan to control run- on water onto the site and run-off water from the site that complies with the requirements of Subsection M of 19.15.36.13 NMAC.

Response: *There are no modifications that will impact the control of run-on or run-off water at the Site. Removal of references to Striker 4 only.*

Item 9. If the Minor Modification will affect the best management practice plan, attach a best management practice plan to ensure protection of fresh water, public health, and the environment.

Response: *Copy of modified SWMF management plans attached in Volumes 1 & 2, to include operational plans, contingency plans, drawings, applicable regulations, etc. as required.*

Item 10. The division may require additional information to demonstrate that the surface waste management facility's operation will not adversely impact fresh water, public health, or the environment and that the surface waste management facility will comply with division rules and orders.

Response: *There are no proposed changes to the Site's operations that would adversely impact fresh water, public health or the environment.*

Item 11. Certification - *See attached executed OCD Form 137A.*

If you have any questions or require additional information, please do not hesitate to contact me at (720) 315-8035 or gfisher@popmidstream.com.

Sincerely,

Gary E Fisher

Gary E Fisher, for NGL Waste Services LLC

List of Appendices

Volume 1 of 2

Volume 2 of 2

Appendix C

Survey, Ownership and Site Information

C-1 North Ranch Surface Waste Management Facility Information

CERTIFICATE OF ASSISTANT SECRETARY OF R360 ANTELOPE DRAW, LLC

The undersigned, being duly appointed and acting as Assistant Secretary of R360 Antelope Draw, LLC, a Delaware limited liability company, does hereby certify as follows:

R360 Antelope Draw, LLC (the "**Company**") is a Delaware limited liability company formed on May 2, 2023, and qualified to transact business in New Mexico on May 15, 2023, for oil and gas exploration and production waste processing and disposal. Mr. Ronald J. Mittelstaedt is the President and Chief Executive Officer of the Company, as well as Manager on the Company's Board of Managers. The Company has no ownership of any subsidiary entities, and no divisions.

The **ownership of the Company** is as follows:

The Company is wholly-owned by R360 Environmental Solutions, LLC ("R360") (a Delaware limited liability company and wholly-owned subsidiary of R360 ES Holdings, Inc., a Delaware corporation and wholly-owned subsidiary of R360 Environmental Solutions Holdings, Inc., a Delaware corporation and wholly-owned subsidiary of Waste Connections US, Inc., a Delaware corporation and wholly-owned subsidiary of Waste Connections US Holdings, Inc., a Delaware corporation and subsidiary of WCN Holdings, Inc., an Ontario corporation, and Waste Connections Holdings Ltd., an Ontario corporation ("Waste Connections Holdings"). Waste Connections Holdings is a subsidiary of Waste Connections of Canada Inc., an Ontario corporation and subsidiary of WCN Holdings, Inc., an Ontario corporation and subsidiary of Waste Connections, Inc., an Ontario corporation. As the sole member of the Company, R360 holds all or 100% of the Company membership units and all or 100% of the Company member voting power. Ronald J. Mittelstaedt is the President and Chief Executive Officer of R360 and is also the Sole Member of the R360 Board of Managers.

The **management of the Company** as of May 2, 2023 is as follows:

R360 Antelope Draw, LLC Board of Managers:

Mr. Ronald J. Mittelstaedt (Manager)

R360 Antelope Draw, LLC Officers:

Name	Office
Ronald J. Mittelstaedt	President and Chief Executive Officer
Darrell W. Chambliss	Executive Vice President and Chief Operating Officer
James M. Little	Executive Vice President – Engineering and Disposal
Patrick J. Shea	Executive Vice President, General Counsel and Secretary

Name	Office
Mary Anne Whitney	Executive Vice President and Chief Financial Officer
Matthew S. Black	Senior Vice President and Chief Accounting Officer
Robert M. Cloninger	Senior Vice President, Deputy General Counsel and Assistant Secretary
Jason Craft	Senior Vice President – Operations
David G. Eddie	Senior Vice President – Performance Optimization
Eric O. Hansen	Senior Vice President – Chief Information Officer
Susan R. Netherton	Senior Vice President – People, Training and Development
Andrea Click	Vice President – Tax
Keith P. Gordon	Vice President – Information Systems
Michelle Little	Vice President – Engagement Solutions
Shawn W. Mandel	Vice President – Safety and Risk Management
John Perkey	Vice President, Deputy General Counsel – Compliance and Government Affairs
Jason Pratt	Vice President – Corporate Controller
Kurt Shaner	Vice President - Engineering and Sustainability
Gregory Thibodeaux	Vice President – Maintenance and Fleet Management
Colin Wittke	Vice President – Sales and Customer Engagement
Rob Nielsen	Regional Vice President
Benson Henry	Assistant Regional Vice President
Tyler Kennedy	Regional Controller

The **management of R360** as of May 2, 2023 is as follows:

R360 Environmental Solutions, LLC Board of Managers:

Mr. Ronald J. Mittelstaedt (Manager)

R360 Environmental Solutions, LLC Officers:

Name	Office
Ronald J. Mittelstaedt	President and Chief Executive Officer
Darrell W. Chambliss	Executive Vice President and Chief Operating Officer

Name	Office
James M. Little	Executive Vice President – Engineering and Disposal
Patrick J. Shea	Executive Vice President, General Counsel and Secretary
Mary Anne Whitney	Executive Vice President and Chief Financial Officer
Matthew S. Black	Senior Vice President and Chief Accounting Officer
Robert M. Cloninger	Senior Vice President, Deputy General Counsel and Assistant Secretary
Jason Craft	Senior Vice President – Operations
David G. Eddie	Senior Vice President – Performance Optimization
Eric O. Hansen	Senior Vice President – Chief Information Officer
Susan R. Netherton	Senior Vice President – People, Training and Development
Andrea Click	Vice President – Tax
Keith P. Gordon	Vice President – Information Systems
Michelle Little	Vice President – Engagement Solutions
Shawn W. Mandel	Vice President – Safety and Risk Management
John Perkey	Vice President, Deputy General Counsel – Compliance and Government Affairs
Jason Pratt	Vice President – Corporate Controller
Kurt Shaner	Vice President - Engineering and Sustainability
Gregory Thibodeaux	Vice President – Maintenance and Fleet Management
Colin Wittke	Vice President – Sales and Customer Engagement
Rob Nielsen	Regional Vice President
Benson Henry	Assistant Regional Vice President
Tyler Kennedy	Regional Controller

Please also see attached hereto as **Exhibit A**: the Company's Organizational Structure as of May 2, 2023.

Please also see attached hereto as **Exhibit B**: a true and correct copy of Resolutions adopted on May 2, 2023 by Written Consent of the Board of Manager's of the Company electing Robert M. Cloninger as Assistant Secretary of the Company effective May 2, 2023.

IN WITNESS WHEREOF, the undersigned has executed this Certificate on behalf of the Company as of June 21, 2023.

Robert M. Cloninger,
Assistant Secretary

EXHIBIT A

Organizational Structure as of May 2, 2023

See Attached

R360 Antelope Draw, LLC Org Chart

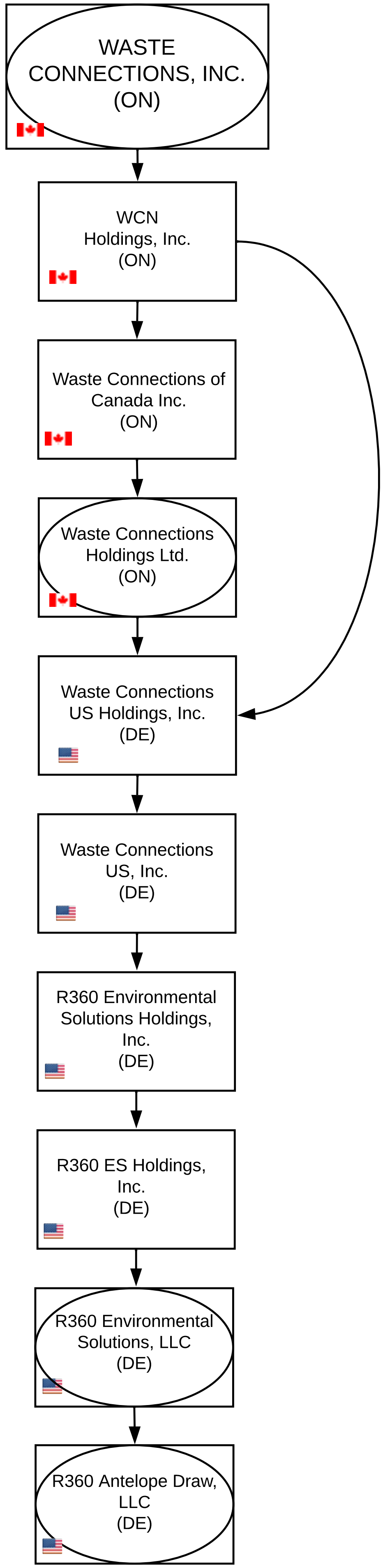


EXHIBIT B

Resolutions of the Board of Managers effective May 2, 2023

See Attached

UNANIMOUS WRITTEN CONSENT
OF
THE BOARD OF MANAGERS
OF
R360 ANTELOPE DRAW, LLC

May 2, 2023

The undersigned, being the sole member of the Board of Managers (the "Board") of R360 Antelope Draw, LLC, a Delaware limited liability company (the "Company"), hereby consents to and adopts the following resolutions pursuant to Section 18-402 of the Delaware Limited Liability Company Act and the Operating Agreement for the Company:

Election of Officers

BE IT RESOLVED that the following individuals be and they hereby are elected to the offices set forth opposite their respective names, to serve until terminated as such by the Board or until their respective successors are duly elected and qualify:

Name	Office
Ronald J. Mittelstaedt	President and Chief Executive Officer
Darrell W. Chambliss	Executive Vice President and Chief Operating Officer
James M. Little	Executive Vice President – Engineering and Disposal
Patrick J. Shea	Executive Vice President, General Counsel and Secretary
Mary Anne Whitney	Executive Vice President and Chief Financial Officer
Matthew S. Black	Senior Vice President and Chief Accounting Officer
Robert M. Cloninger	Senior Vice President, Deputy General Counsel and Assistant Secretary
Jason Craft	Senior Vice President – Operations
David G. Eddie	Senior Vice President – Performance Optimization

Name	Office
Eric O. Hansen	Senior Vice President – Chief Information Officer
Susan R. Netherton	Senior Vice President – People, Training and Development
Andrea Click	Vice President – Tax
Keith P. Gordon	Vice President – Information Systems
Michelle Little	Vice President – Engagement Solutions
Shawn W. Mandel	Vice President – Safety and Risk Management
John Perkey	Vice President, Deputy General Counsel – Compliance and Government Affairs
Jason Pratt	Vice President – Corporate Controller
Kurt Shaner	Vice President - Engineering and Sustainability
Gregory Thibodeaux	Vice President – Maintenance and Fleet Management
Colin Wittke	Vice President – Sales and Customer Engagement
Rob Nielsen	Regional Vice President
Benson Henry	Assistant Regional Vice President
Tyler Kennedy	Regional Controller

Organizational Matters

RESOLVED FURTHER that the principal office of the Company be, and it hereby is, established, and it shall be maintained, at 3 Waterway Square Place, Suite 110, The Woodlands, Texas 77380; and

RESOLVED FURTHER that the fiscal year of the Company shall end on December 31 in each year; and

RESOLVED FURTHER that Corporation Service Company, located at 251 Little Falls Drive, Wilmington, Delaware 19808, be, and it hereby is, appointed the registered agent authorized to accept service of process and notices on behalf of the Company; and

Foreign Qualification

RESOLVED FURTHER that the proper officers of the Company be and they hereby are authorized and directed, for and in the name and on behalf of the Company, to prepare, execute and file any and all applications, documents and certificates, and to pay any and all filing and license fees and initial taxes as may be necessary and proper to qualify the Company as a foreign limited liability company authorized to transact intrastate business in the State of New Mexico; and

RESOLVED FURTHER that Corporation Service Company, located at 110 E Broadway St., Hobbs, New Mexico 88240, be, and it hereby is, appointed the registered agent authorized to accept service of process and notices on behalf of the Company in the State of New Mexico; and

Establish Bank Accounts

RESOLVED FURTHER that Ronald J. Mittelstaedt, the President and Chief Executive Officer, Mary Anne Whitney, the Executive Vice President and Chief Financial Officer, Jason Pratt, the Vice President – Corporate Controller, and Matthew S. Black, the Senior Vice President and Chief Accounting Officer of the Company (the "Authorized Officers") be, and they hereby are, authorized and directed to establish bank accounts on behalf of the Company; and

RESOLVED FURTHER that the Authorized Officers of the Company, acting separately or together, are hereby authorized:

(a) To designate one or more banks, trust companies or other similar institutions as depositories of the funds, including, without limitation, cash and cash equivalents, of the Company;

(b) To open, keep and close general and special bank accounts, including general deposit accounts, payroll accounts and working fund accounts, with any such bank;

(c) To cause to be deposited in such accounts with any such bank, from time to time, such funds, including, without limitation, cash and cash equivalents, of the Company as such officers deem necessary or advisable, and to designate or change the designation of the officer or officers and agent or agents of the Company who will be authorized to make such deposits and to endorse checks, drafts or other instruments for such deposit;

(d) From time to time, to designate or change the designation of the officer or officers and agent or agents of the Company who will be authorized to sign or countersign checks, drafts or other orders for the payment of money issued in the name of the Company against any funds deposited in any of such accounts, and to revoke any such designation;

(e) To authorize the use of facsimile signatures for the signing or countersigning of checks, drafts or other orders for the payment of money, and to enter into such agreements as banks and trust companies customarily require as a condition for permitting the use of facsimile signatures;

(f) To make such general and special rules and regulations with respect to such accounts as they may deem necessary or advisable; and

(g) To complete, execute and/or certify any customary printed blank signature card forms in order to conveniently exercise the authority granted by this resolution and any resolutions printed thereon shall be deemed adopted as a part hereof; and

RESOLVED FURTHER that the Authorized Officers are hereby authorized to sign checks, make withdrawals and authorize wire transfers for and on behalf of the Company in connection with such bank accounts authorized to be established hereunder; and

RESOLVED FURTHER that the standard form of corporate resolution required by any bank with which a bank account is established be, and hereby is, approved, adopted and confirmed as a resolution of the Board, and the Secretary of the Company is hereby authorized to certify such resolutions as having been adopted by these resolutions of the Board and is directed to insert the form of such resolutions in the Minute Book; and

RESOLVED FURTHER that any such bank to which a copy of these resolutions, as certified by the Secretary of the Company, shall have been delivered shall be entitled to rely thereon for all purposes until it shall have received written notice of the revocation or amendment of these resolutions by the Board; and

RESOLVED FURTHER that any and all acts of any Authorized Officer in executing any and all documents and instruments necessary to effectuate and evidence the foregoing resolutions be, and they hereby are, further ratified, confirmed and approved; and

RESOLVED FURTHER that any Authorized Officer, acting alone, be and hereby is, authorized, empowered and directed for and on behalf of the Company, to take such further actions, negotiate, execute and deliver such instruments and documents as shall be necessary, proper or advisable in order to carry out the intent and accomplish the purposes of the foregoing resolutions; and

RESOLVED FURTHER that the authority given hereunder shall be deemed retroactive and any and all acts authorized hereunder which were performed by any officer, agent, representative or attorney of the Company or any other person acting for or on behalf of the Company, are hereby ratified, confirmed and approved as to the date such actions were taken; and

Omnibus Resolution

RESOLVED FURTHER that the proper officers be and each such proper officer hereby is authorized and directed, for and in the name and on behalf of the Company, to do and perform any and all such further acts and things and to prepare or cause to be prepared, execute, verify or acknowledge, deliver and file, publish, record or submit any and all such further agreements, notes, applications, instructions, statements, notices, certificates, instruments and other documents as it may deem necessary or advisable to implement fully the intent and purposes of each and all of the foregoing resolutions, and any actions heretofore taken to those ends be and they hereby are ratified, confirmed and approved.

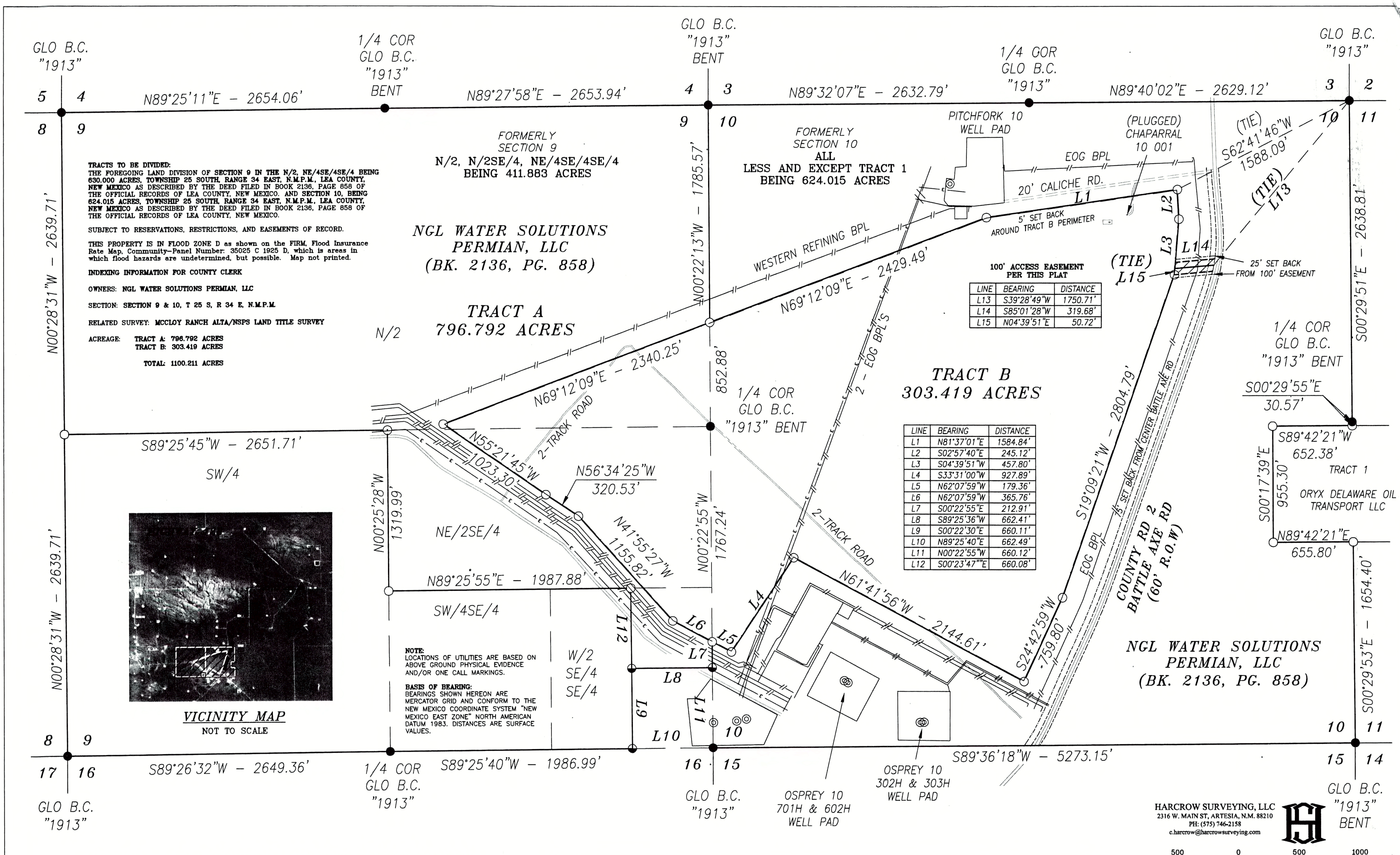
[Signature on following page.]

IN WITNESS WHEREOF, the undersigned sole member of the Board of Managers of the Company has duly executed this Unanimous Written Consent in The Woodlands, Texas as of the date first written above.

Ronald J. Mittelstaedt

Professional Survey Plat

As per NMAC 19.15.368.C(2)



TRACTS TO BE DIVIDED:
THE FOREGOING LAND DIVISION OF SECTION 9 IN THE N/2, NE/4SE/4SE/4 BEING 630.000 ACRES, TOWNSHIP 25 SOUTH, RANGE 34 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO AS DESCRIBED BY THE DEED FILED IN BOOK 2136, PAGE 858 OF THE OFFICIAL RECORDS OF LEA COUNTY, NEW MEXICO. AND SECTION 10, BEING 624.015 ACRES, TOWNSHIP 25 SOUTH, RANGE 34 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO AS DESCRIBED BY THE DEED FILED IN BOOK 2136, PAGE 858 OF THE OFFICIAL RECORDS OF LEA COUNTY, NEW MEXICO.

SUBJECT TO RESERVATIONS, RESTRICTIONS, AND EASEMENTS OF RECORD.

THIS PROPERTY IS IN FLOOD ZONE D as shown on the FIRM, Flood Insurance Rate Map, Community–Panel Number: 35025 C 1925 D, which is areas in which flood hazards are undetermined, but possible. Map not printed.

INDEXING INFORMATION FOR COUNTY CLERK

OWNERS: NGL WATER SOLUTIONS PERMIAN, LLC

SECTION: SECTION 9 & 10, T 25 S, R 34 E, N.M.P.M.

RELATED SURVEY: MCCLOY RANCH ALTA/NSPS LAND TITLE SURVEY

ACREAGE: TRACT A: 796.792 ACRES
TRACT B: 303.419 ACRES

TOTAL: 1100.211 ACRES

100' ACCESS EASEMENT PER THIS PLAT

LINE	BEARING	DISTANCE
L13	S39°28'49"W	1750.71'
L14	S85°01'28"W	319.68'
L15	N04°39'51"E	50.72'

LINE	BEARING	DISTANCE
L1	N81°37'01"E	1584.84'
L2	S02°57'40"E	245.12'
L3	S04°39'51"W	457.80'
L4	S33°31'00"W	927.89'
L5	N62°07'59"W	179.36'
L6	N62°07'59"W	365.76'
L7	S00°22'55"E	212.91'
L8	S89°25'36"W	662.41'
L9	S00°22'30"E	660.11'
L10	N89°25'40"E	662.49'
L11	N00°22'55"W	660.12'
L12	S00°23'47""E	660.08'

VICINITY MAP
NOT TO SCALE

NOTE:
LOCATIONS OF UTILITIES ARE BASED ON ABOVE GROUND PHYSICAL EVIDENCE AND/OR ONE CALL MARKINGS.

BASIS OF BEARING:
BEARINGS SHOWN HEREON ARE MERCATOR GRID AND CONFORM TO THE NEW MEXICO COORDINATE SYSTEM "NEW MEXICO EAST ZONE" NORTH AMERICAN DATUM 1983. DISTANCES ARE SURFACE VALUES.

NGL WATER SOLUTIONS PERMIAN LLC SECTIONS 9 & 10 LAND DIVISION

LEGEND

- WELL
- FOUND MONUMENT AS NOTED
- SET 1/2" STL W/ORANGE CAP MKD: "HARCROW PLS 17777"
- FOUND 1/2" STL W/YELLOW CAP MKD: "OSWALD 20666"
- LAND DIVISION
- BURIED PIPELINE
- ELECTRIC LINE W/POWER POLE
- 5' SET BACK INSIDE PERIMETER TRACT B

HARCROW SURVEYING, LLC
2316 W. MAIN ST, ARTESIA, N.M. 88210
PH: (575) 746-2158
c.harcrow@harcrowsurveying.com

500 0 500 1000
SCALE: 1"=500'

FILING AND RECORDING

LEA COUNTY, NM
KEITH MANES, COUNTY CLERK
000013101
Book 2 Page 749
1 of 2
10/25/2021 11:55 AM
BY WAYNE COLE

Cabinet H
Slide '48

SURVEY DATE: OCTOBER 4, 2021		LAND DIVISION
DRAFTING DATE: OCTOBER 8, 2021		PAGE: 1 OF 2
APPROVED BY: CH	DRAWN BY: VD	FILE: 21-833

NGL WATER SOLUTIONS PERMIAN LLC
SECTIONS 9 & 10 LAND DIVISION

OWNERS DEDICATION, STATEMENT AND AFFIDAVIT
STATE OF NEW MEXICO)
COUNTY OF LEA)

THE UNDERSIGNED BEING FIRST DULY SWORN ON OATH, STATE:

AS OWNERS AND PROPRIETORS WE HAVE OF OUR OWN FREE WILL AND CONSENT CAUSED THIS PLAT WITH ITS TRACTS AND EXISTING ROAD RIGHT-OF-WAY AND EASEMENTS TO BE PLATTED IN **SECTIONS 9 & 10, TOWNSHIP 25 SOUTH, RANGE 34 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO**. THE PROPERTY DESCRIBED ON THIS PLAT LIES WITHIN THE PLANNING AND PLATTING JURISDICTION OF LEA COUNTY, NEW MEXICO.

NGL WATER SOLUTIONS PERMIAN, LLC – DOUGLAS W. WHITE – EXECUTIVE VICE PRESIDENT

ACKNOWLEDGMENT
STATE OF COLORADO)
COUNTY OF DENVER)

THIS INSTRUMENT WAS ACKNOWLEDGED BEFORE ME ON THIS 20 DAY OF October, 2021 BY **NGL WATER SOLUTIONS PERMIAN, LLC – DOUGLAS W. WHITE – EXECUTIVE VICE PRESIDENT.**

MY COMMISSION EXPIRES:

12-17-2023

LINDA HALL
Notary Public
State of Colorado
Notary ID # 20194047003
My Commission Expires 12-17-2023

NOTARY PUBLIC

CERTIFICATE OF APPROVAL OF EXEMPTION TO SUBDIVISION REGULATIONS BY LEA COUNTY:
PURSUANT TO LEA COUNTY SUBDIVISION REGULATIONS, SECTION 7.5 (1997) THE PLAT AND CLAIM OF EXEMPTION MET THE CRITERIA FOR LEA COUNTY, NEW MEXICO

the sale, lease or other conveyance of land that creates no parcel smaller than one hundred forty (140) acres

AND IS APPROVED FOR A CLAIM OF EXEMPTION ON THIS THE 25 DAY OF OCTOBER 2021.

BY:
COREY NEEDHAM, COUNTY MANAGER DESIGNEE

ACKNOWLEDGMENT
STATE OF NEW MEXICO)
COUNTY OF LEA)

THIS INSTRUMENT WAS ACKNOWLEDGED BEFORE ME ON THIS 25 DAY OF Oct, 2021 BY COREY NEEDHAM.

MY COMMISSION EXPIRES:

06/24/2023

NOTARY PUBLIC

ZAYRA M JACOBS
NOTARY PUBLIC
STATE OF NEW MEXICO

SURVEYOR'S CERTIFICATION
I, CHAD HARCROW, A NEW MEXICO REGISTERED PROFESSIONAL SURVEYOR CERTIFY THAT I DIRECTED AND AM RESPONSIBLE FOR THIS SURVEY, THAT THIS SURVEY IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF, AND THIS SURVEY AND PLAT MEET THE MINIMUM STANDARDS FOR SURVEYING IN NEW MEXICO. IN WITNESS WHEREOF I HEREUNTO SET

HAND AND AFFIX MY OFFICAL SEAL THIS 21st DAY OF October, 2021.

CHAD L. HARCROW
NEW MEXICO
17777
LICENSED PROFESSIONAL SURVEYOR

CHAD HARCROW N.M.P.S. NO. 17777

TRACT DIVIDED:
THE FOREGOING LAND DIVISION OF **THE N/2, N/2SE/4, AND THE NE/4SE/4SE/4, IN SECTION 9, TOWNSHIP 25 SOUTH, RANGE 34 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO** AND **ALL OF SECTION 10, TOWNSHIP 25 SOUTH, RANGE 34 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO** AS DESCRIBED BY THE DEED FILED IN BOOK 2136, PAGE 858 OF THE OFFICIAL RECORDS OF LEA COUNTY, NEW MEXICO.

LEGAL DESCRIPTIONS:

TRACT A
ALL OF SECTION 10 AND THE N/2, N/2SE/4, NE/4SE/4SE/4 OF SECTION 9, LESS THE FOLLOWING TRACTS OF LAND:

TRACT B OF THIS SURVEY BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:
BEGINNING AT A POINT IN THE NE/4 OF SECTION 10, WHICH LIES S62°41'46"W 1588.09 FEET FROM THE NORTHEAST CORNER OF SECTION 10; THEN S02°57'40"E 245.12 FEET; THEN S04°39'51"W 457.80 FEET; THEN S19°09'21"W 2804.79 FEET; THEN S24°42'59"W 759.80 FEET; THEN N61°41'56"W 2144.61 FEET; THEN S33°31'00"W 927.89 FEET; THEN N62°07'59"W 179.36 FEET; THEN N62°07'59"W 365.76 FEET; THEN N41°55'27"W 1155.82 FEET; THEN N56°34'25"W 320.53 FEET; THEN N55°21'45"W 1023.30 FEET; THEN N69°12'09"E 2340.25 FEET; THEN N69°12'09"E 2429.49 FEET; THEN N81°37'01"E 1584.84 FEET TO POINT OF BEGINNING.

AND

TRACT 1 OF THAT CERTAIN NGL LAND DIVISION FILED UNDER BOOK 2, PAGE 570, LEA COUNTY RECORDS, LEA COUNTY, NEW MEXICO.

TOGETHER WITH AN 100' ACCESS EASEMENT MORE PARTICULARLY DESCRIBED:

BEGINNING A POINT IN SECTION 10 WHICH LIES S39°28'49"W 1750.71 FEET FROM THE NORTHEAST CORNER OF SAID SECTION THEN S85°01'28"W 319.68 FEET TO A POINT ON THE WEST PROPERTY LINE OF TRACT B WHICH LIES N04°39'51"E 50.72 FEET FROM NORTHEASTERLY POINT.

TRACT B
BEGINNING AT A POINT IN THE NE/4 OF SECTION 10, WHICH LIES S62°41'46"W 1588.09 FEET FROM THE NORTHEAST CORNER OF SECTION 10; THEN S02°57'40"E 245.12 FEET; THEN S04°39'51"W 457.80 FEET; THEN S19°09'21"W 2804.79 FEET; THEN S24°42'59"W 759.80 FEET; THEN N61°41'56"W 2144.61 FEET; THEN S33°31'00"W 927.89 FEET; THEN N62°07'59"W 179.36 FEET; THEN N62°07'59"W 365.76 FEET; THEN N41°55'27"W 1155.82 FEET; THEN N56°34'25"W 320.53 FEET; THEN N55°21'45"W 1023.30 FEET; THEN N69°12'09"E 2340.25 FEET; THEN N69°12'09"E 2429.49 FEET; THEN N81°37'01"E 1584.84 FEET TO POINT OF BEGINNING.

SUBJECT TO RESERVATIONS, RESTRICTIONS, AND EASEMENTS OF RECORD.

THIS PROPERTY IS IN FLOOD ZONE D as shown on the FIRM, Flood Insurance Rate Map, Community–Panel Number: 35025 C 1365 D, which is areas in which flood hazards are undetermined, but possible. Map not printed.

NOTE:
LOCATIONS OF UTILITIES ARE BASED ON ABOVE GROUND PHYSICAL EVIDENCE AND/OR ONE CALL MARKINGS.

BASIS OF BEARING:
BEARINGS SHOWN HEREON ARE MERCATOR GRID AND CONFORM TO THE NEW MEXICO COORDINATE SYSTEM "NEW MEXICO EAST ZONE" NORTH AMERICAN DATUM 1983. DISTANCES ARE SURFACE VALUES.

INDEXING INFORMATION FOR COUNTY CLERK

OWNERS: **NGL WATER SOLUTIONS PERMIAN, LLC**

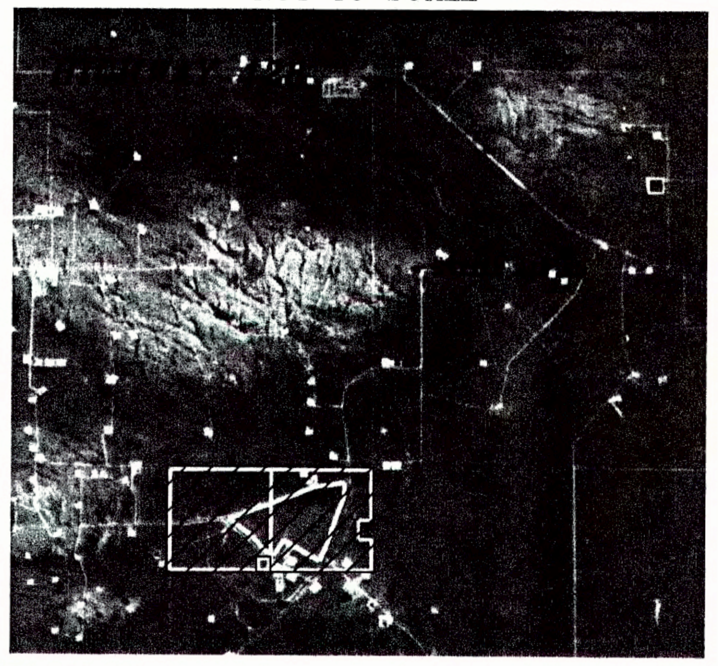
SECTION: **SECTION 9 & 10, T 25 S, R 34 E, N.M.P.M.**

RELATED SURVEY: **MCCLOY RANCH ALTA/NSPS LAND TITLE SURVEY**

ACREAGE: **TRACT A: 796.792 ACRES**
TRACT B: 303.419 ACRES

TOTAL: 1100.211 ACRES

VICINITY MAP
NOT TO SCALE



HARCROW SURVEYING, LLC
2316 W. MAIN ST, ARTESIA, N.M. 88210
PH: (575) 746-2158
c.harcrow@harcrowsurveying.com

500 0 500 1000
SCALE: 1"=500'

FILING AND RECORDING

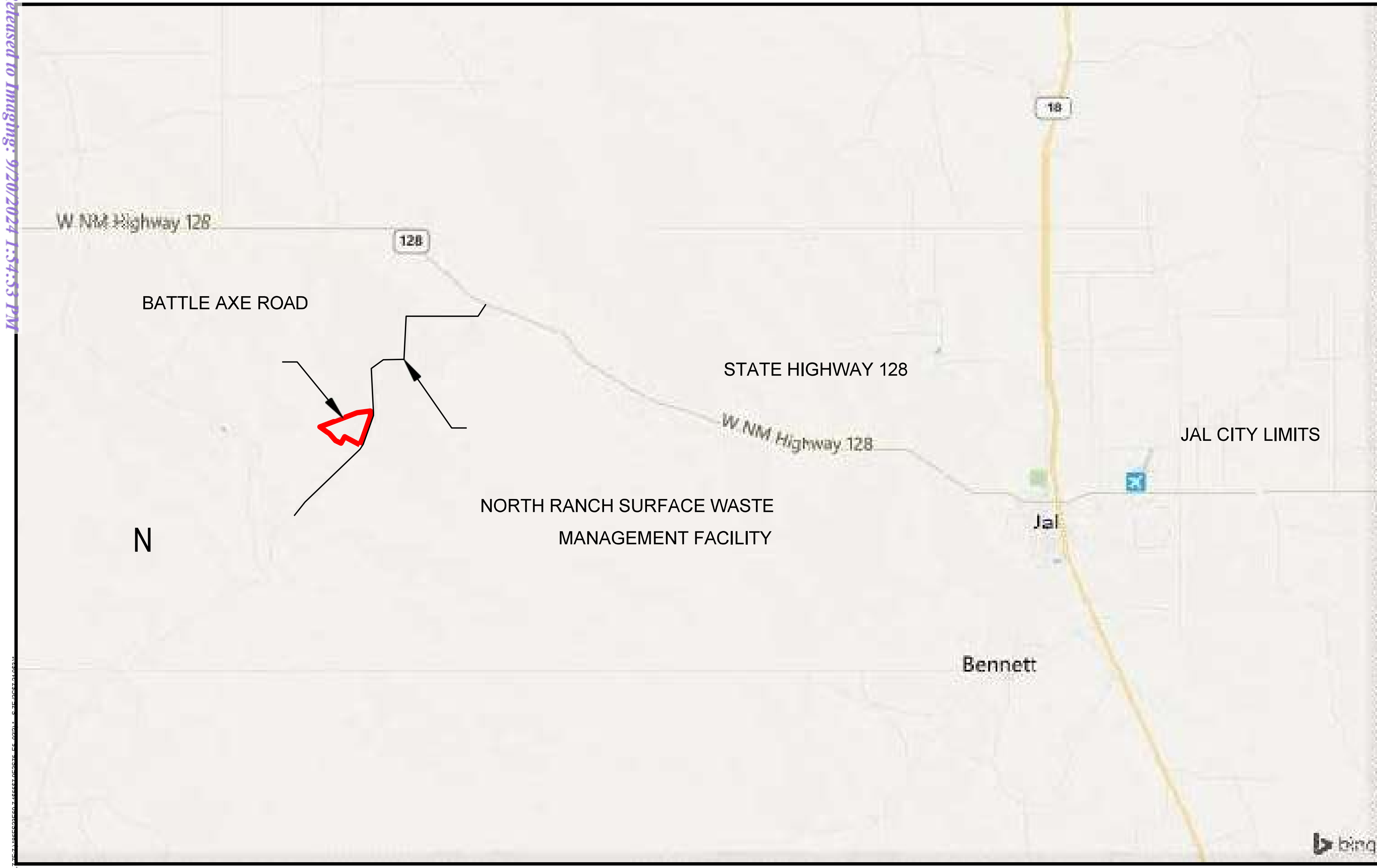
LEA COUNTY, NM
KEITH MANES, COUNTY CLERK
000013101
Book 2 Page 749
2 of 2
10/25/2021 11:55 AM
BY WAYNE COLE

Cabinet H
Slide 48

SURVEY DATE: OCTOBER 4, 2021		LAND DIVISION
DRAFTING DATE: OCTOBER 8, 2021		PAGE: 2 OF 2
APPROVED BY: CH	DRAWN BY: VD	FILE: 21-833

Figures

List of Figures



Terracon	Consulting Engineers and Scientists
25809 I-30 SOUTH	BRYANT, AR 72022
PH. (501) 847-9292	FAX. (501) 847-9210

SITE LOCATION MAP

PERMIT APPLICATION FIGURE

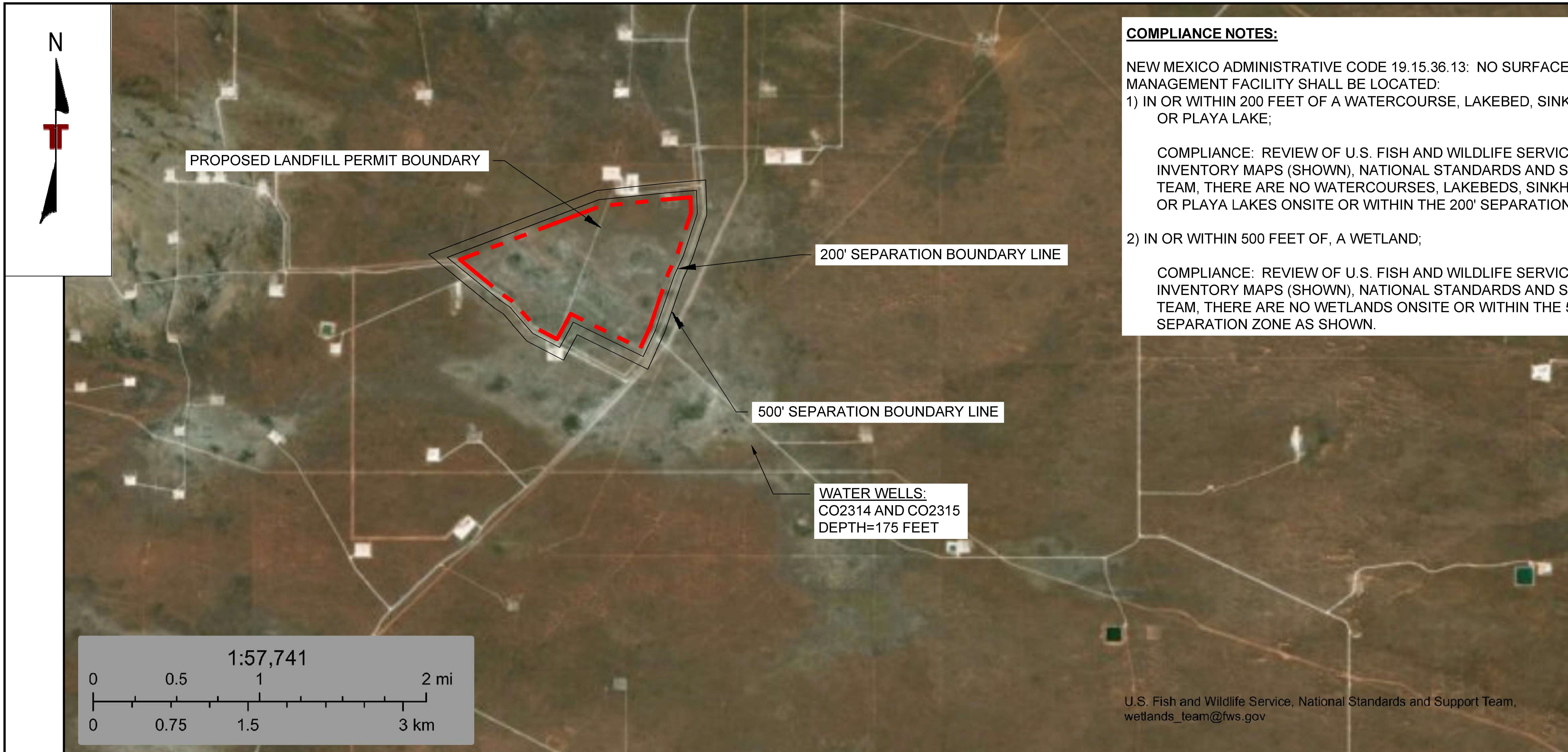
NORTH RANCH DISPOSAL FACILITY

SURFACE WASTE MANAGEMENT FACILITY LEA COUNTY

NEW MEXICO

FIG. 1

DESIGNED BY:	-
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALE BAR
DATE:	MAY 2020
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	1 OF 1



COMPLIANCE NOTES:

NEW MEXICO ADMINISTRATIVE CODE 19.15.36.13: NO SURFACE WASTE MANAGEMENT FACILITY SHALL BE LOCATED:

1) IN OR WITHIN 200 FEET OF A WATERCOURSE, LAKEBED, SINKHOLE OR PLAYA LAKE;

COMPLIANCE: REVIEW OF U.S. FISH AND WILDLIFE SERVICE INVENTORY MAPS (SHOWN), NATIONAL STANDARDS AND SUPPORT TEAM, THERE ARE NO WATERCOURSES, LAKEBEDS, SINKHOLES, OR PLAYA LAKES ONSITE OR WITHIN THE 200' SEPARATION ZONE.

2) IN OR WITHIN 500 FEET OF, A WETLAND;

COMPLIANCE: REVIEW OF U.S. FISH AND WILDLIFE SERVICE INVENTORY MAPS (SHOWN), NATIONAL STANDARDS AND SUPPORT TEAM, THERE ARE NO WETLANDS ONSITE OR WITHIN THE 500' SEPARATION ZONE AS SHOWN.

September 20, 2018

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

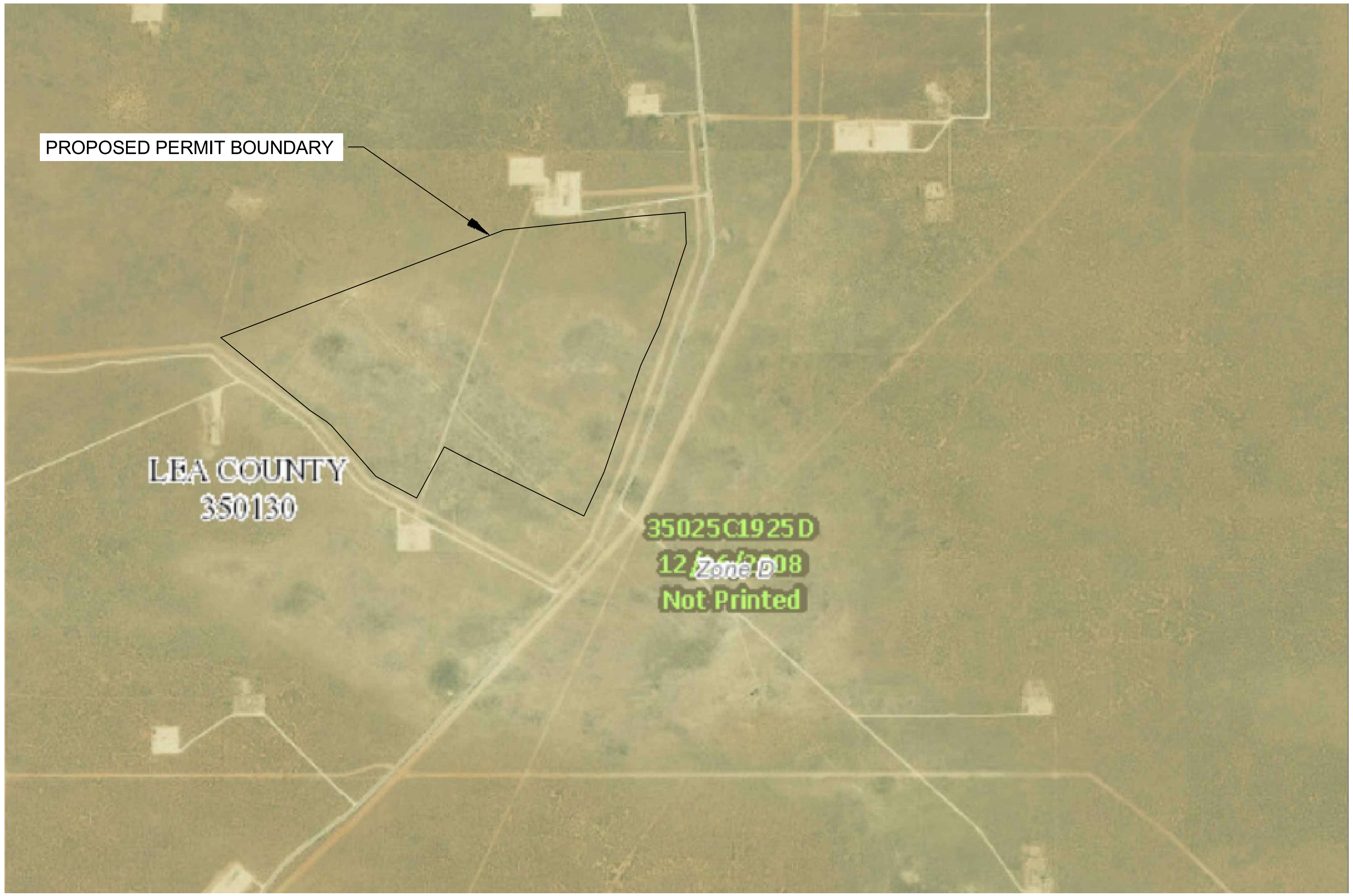
Project Mngr: MPB	Project No. 35187378
Drawn By: DEW	Scale: N.T.S.
Checked By: MPB	File No. 572-002
Approved By: FOC	Date: MAY 2020

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

NRSWMF DISTANCE TO WETLANDS AND WATERS OF THE UNITED STATES
PERMIT APPLICATION
NORTH RANCH DISPOSAL FACILITY
SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY NEW MEXICO

FIG. No. 2

N:\GECARCHIVE\CADS\572\002\MCCLOY\PERMIT TEXT FIGURES\PERMIT NARRATIVE\FIG 2 - WETLANDS MAP.DWG



CITATION: IMAGE SOURCE, FEDERAL EMERGENCY MANAGEMENT AGENCY, FLOOD MAP SERVICE CENTER FIRMETTE FOR MAP 350251925D

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

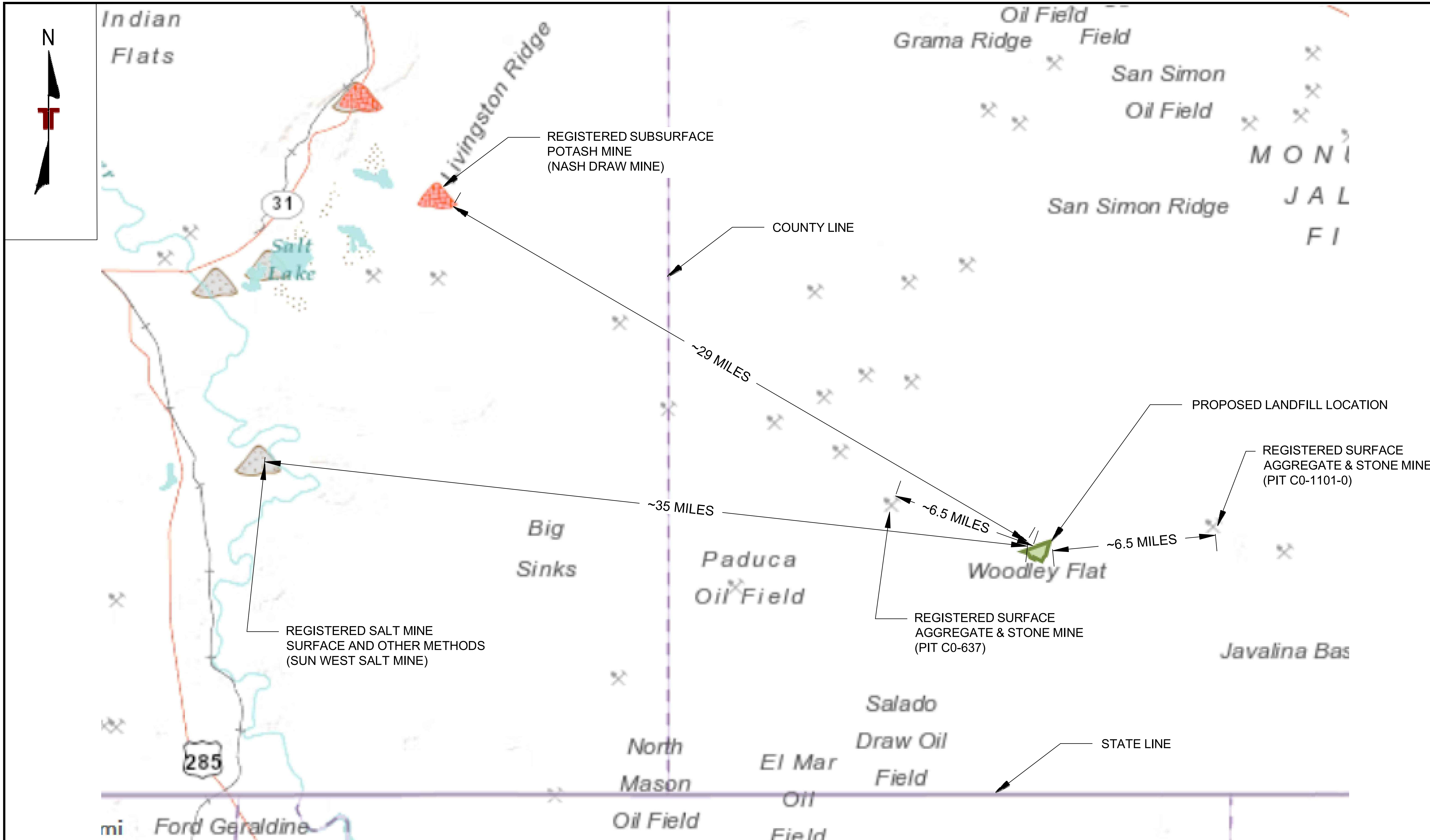
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/8/2019 at 1:00:10 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Project Mngr: MPB	Project No. 35187378	Terracon Consulting Engineers and Scientists	NRSWMF - FEMA FLOOD INSURANCE RATE MAP
Drawn By: DEW	Scale: N.T.S.	25809 I-30 SOUTH, BRYANT, AR 72022	PERMIT APPLICATION
Checked By: MPB	File No. 572-002	PH. (501) 847-9292, FAX. (501) 847-9210	NORTH RANCH DISPOSAL FACILITY
Approved By: FOC	Date: MAY 2020		SURFACE WASTE MANAGEMENT FACILITY LEA COUNTY — NEW MEXICO

FIG. No. 3



COMPLIANCE NOTES:

NEW MEXICO ADMINISTRATIVE CODE 19.15.36.13: NO SURFACE WASTE MANAGEMENT FACILITY SHALL BE LOCATED

4) WITHIN THE AREA OVERLYING A SUBSURFACE MINE.

COMPLIANCE: IMAGES SHOWN ARE FROM REGISTERED MINED WEB MAP PROVIDED BY NEW MEXICO MINING AND MINERALS DIVISION. NEAREST REGISTERED MINE IS A SURFACE AGGREGATE MINE LOCATED APPROXIMATELY 6.5 MILES BOTH EAST AND WEST OF THE PROPOSED LANDFILL. THE NEAREST REGISTERED SALT MINE IS LOCATED APPROXIMATELY 35 MILES NORTHWEST OF THE PROPOSED LANDFILL. THE NEAREST REGISTERED SUBSURFACE MINE IS A POTASH MINE LOCATED APPROXIMATELY 29 MILES NORTH WEST OF THE PROPOSED LANDFILL.

Project Mngr: MPB	Project No. 35187378	Terracon Consulting Engineers and Scientists	NRSWMF - SUBSURFACE MINE DISTANCE COMPLIANCE
Drawn By: DEW	Scale: N.T.S.	25809 I-30 SOUTH, BRYANT, AR 72022	PERMIT APPLICATION FIGURE
Checked By: MPB	File No. 572-002	PH. (501) 847-9292 FAX. (501) 847-9210	NORTH RANCH DISPOSAL FACILITY, SURFACE WASTE MANAGEMENT FACILITY
Approved By: FOC	Date: MAY 2020		LEA COUNTY, NEW MEXICO

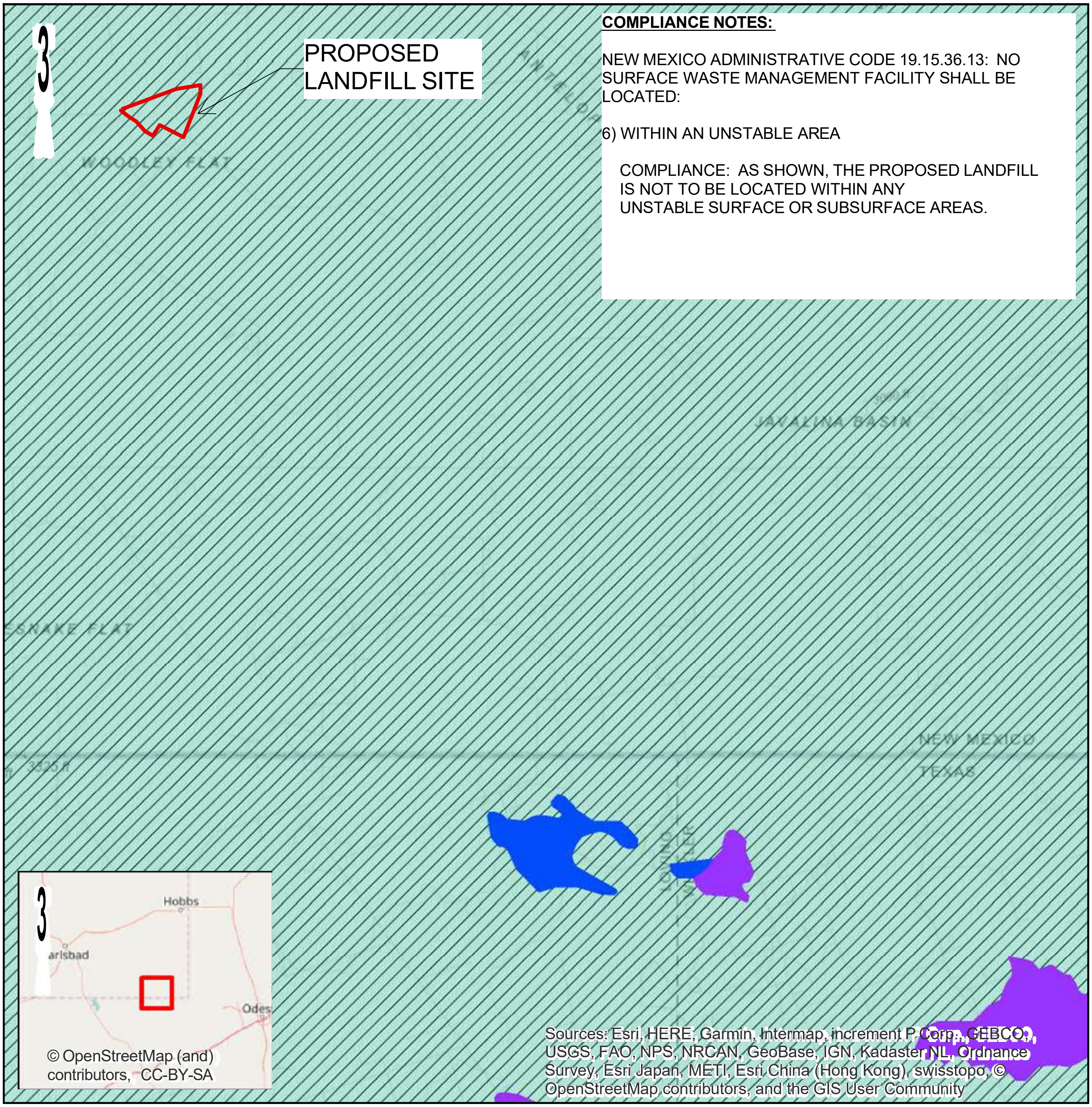
FIG. No. 4

COMPLIANCE NOTES:

NEW MEXICO ADMINISTRATIVE CODE 19.15.36.13: NO SURFACE WASTE MANAGEMENT FACILITY SHALL BE LOCATED:

6) WITHIN AN UNSTABLE AREA

COMPLIANCE: AS SHOWN, THE PROPOSED LANDFILL IS NOT TO BE LOCATED WITHIN ANY UNSTABLE SURFACE OR SUBSURFACE AREAS.



North Ranch SWMF

Carbonate rocks at or near the land surface in a dry climate

Evaporite rocks at or near the land surface in a dry climate

Evaporite basins

Gypsum extent

Feet: 0, 7,000, 14,000, 28,000

DATA SOURCES:
ESRI WMS - World Aerial Imagery, OpenStreetMap

Project No.:	35187378
Date:	MAY 2020
Drawn By:	CG
Reviewed By:	GH

Terracon
11555 Clay Road, Suite 100 Houston, TX 77043
PH. (713) 690-8989 terracon.com

NRSWMF - Karst Topography

North Ranch Disposal Facility

Surface Waste Management Facility

Lea County, New Mexico

FIGURE

5

N

LEGEND

SITE LOCATION

IMAGE SOURCE: GOOGLE EARTH WITH USGS, QUATERNARY FAULTS & FOLDS IN THE US KMZ FILE OVERLAIN

REV.	DATE	BY	DESCRIPTION

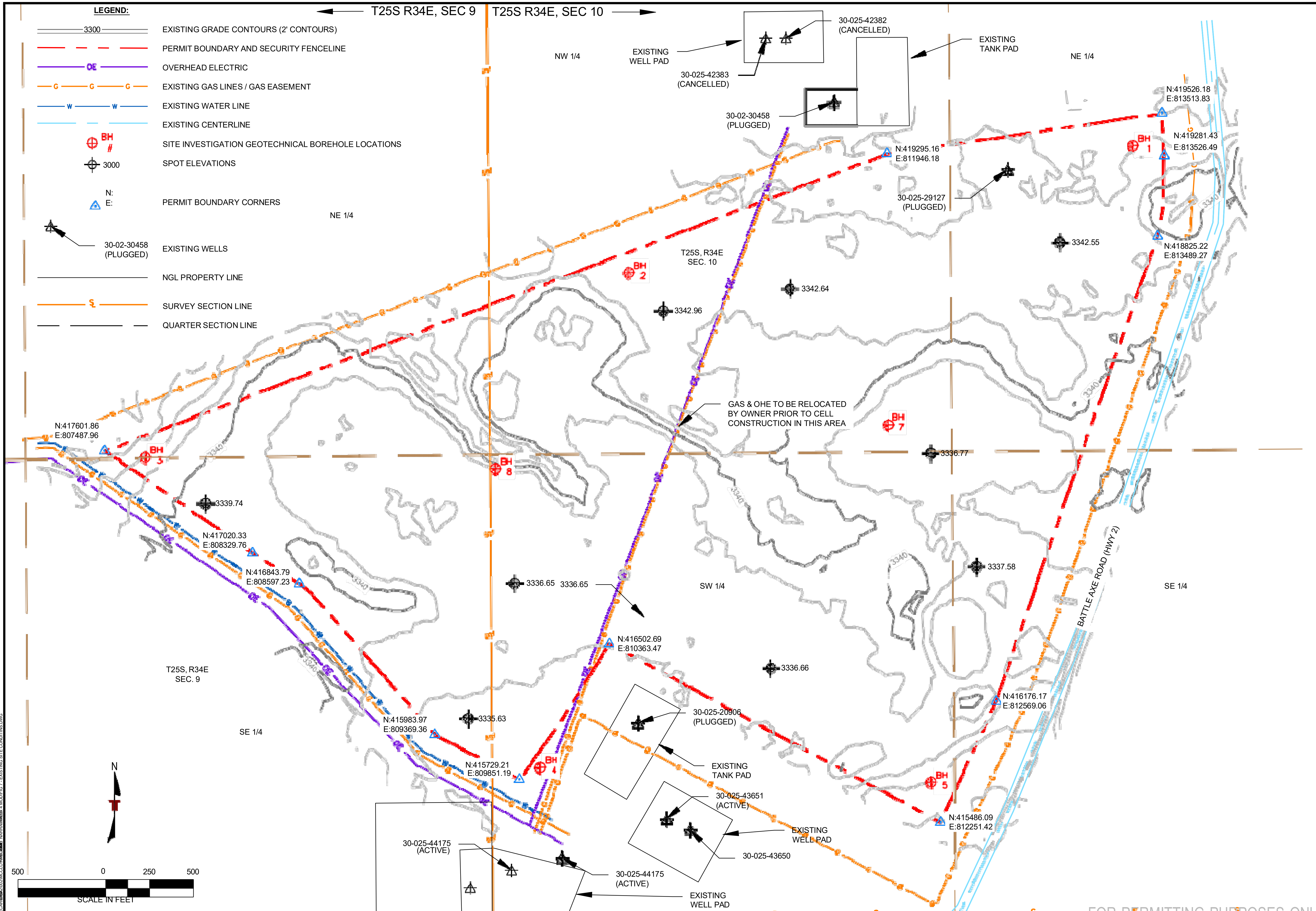
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

RECENT FAULTS MAP
PERMIT APPLICATION FIGURE
NGL WASTE SERVICES, LLC
NORTH RANCH DISPOSAL FACILITY
LEA COUNTY NEW MEXICO

FIG. 6

DESIGNED BY:	DEW
DRAWN BY:	DEW
APPVD. BY:	FOC
SCALE:	1" = 100'
DATE:	APRIL 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

N:\GECARCHIVE\CAD\572\002\MCCLOY\PERMIT TEXT FIGURES\PERMIT NARRATIVE\FIG 6 - RECENT FAULTS MAP.DWG



REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

NGL

NRSWMF - EXISTING SITE CONDITIONS

PERMIT APPLICATION FIGURE

NORTH RANCH DISPOSAL FACILITY

SURFACE WASTE MANAGEMENT FACILITY

LEA COUNTY

NEW MEXICO

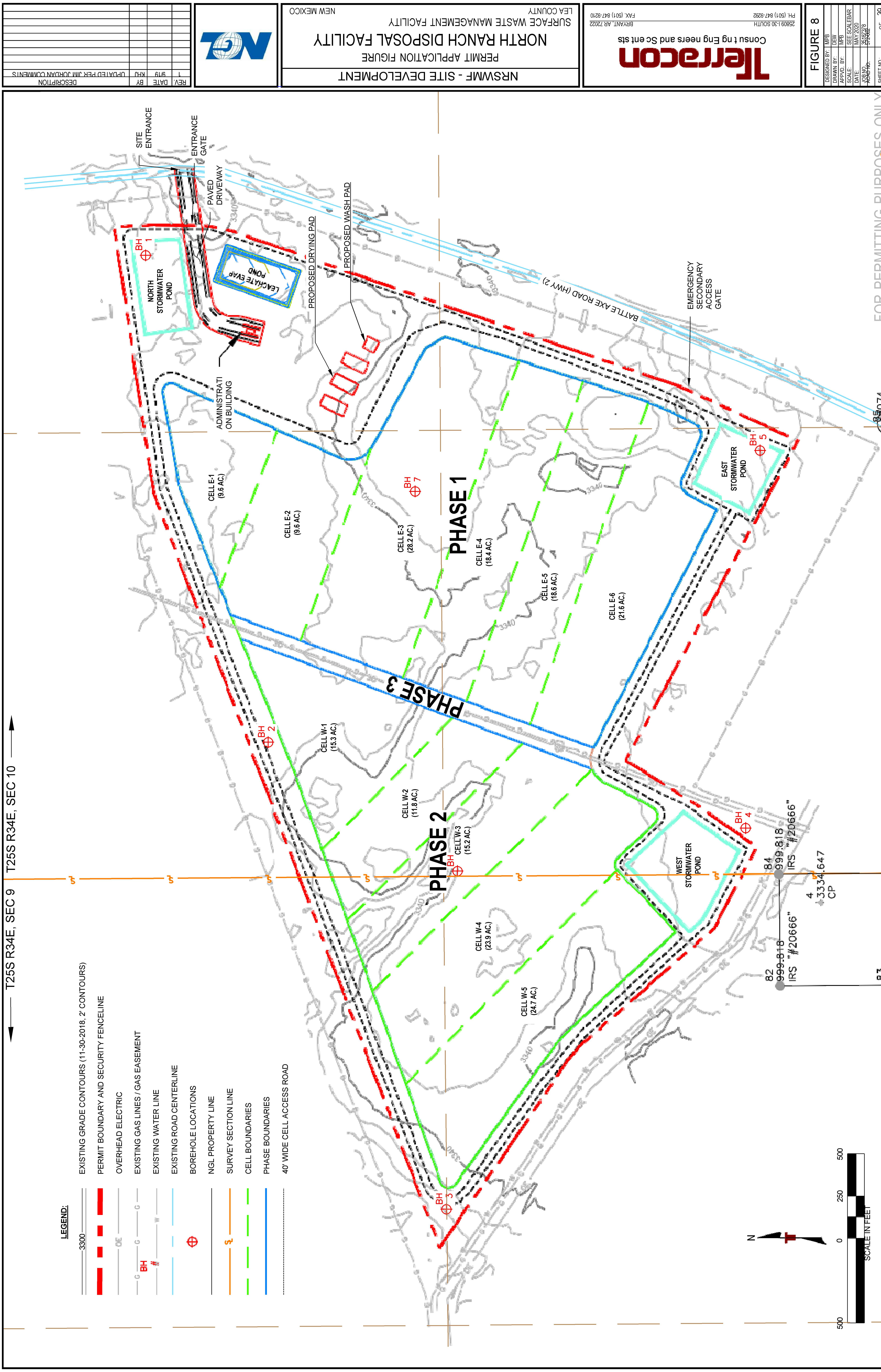
Terracon

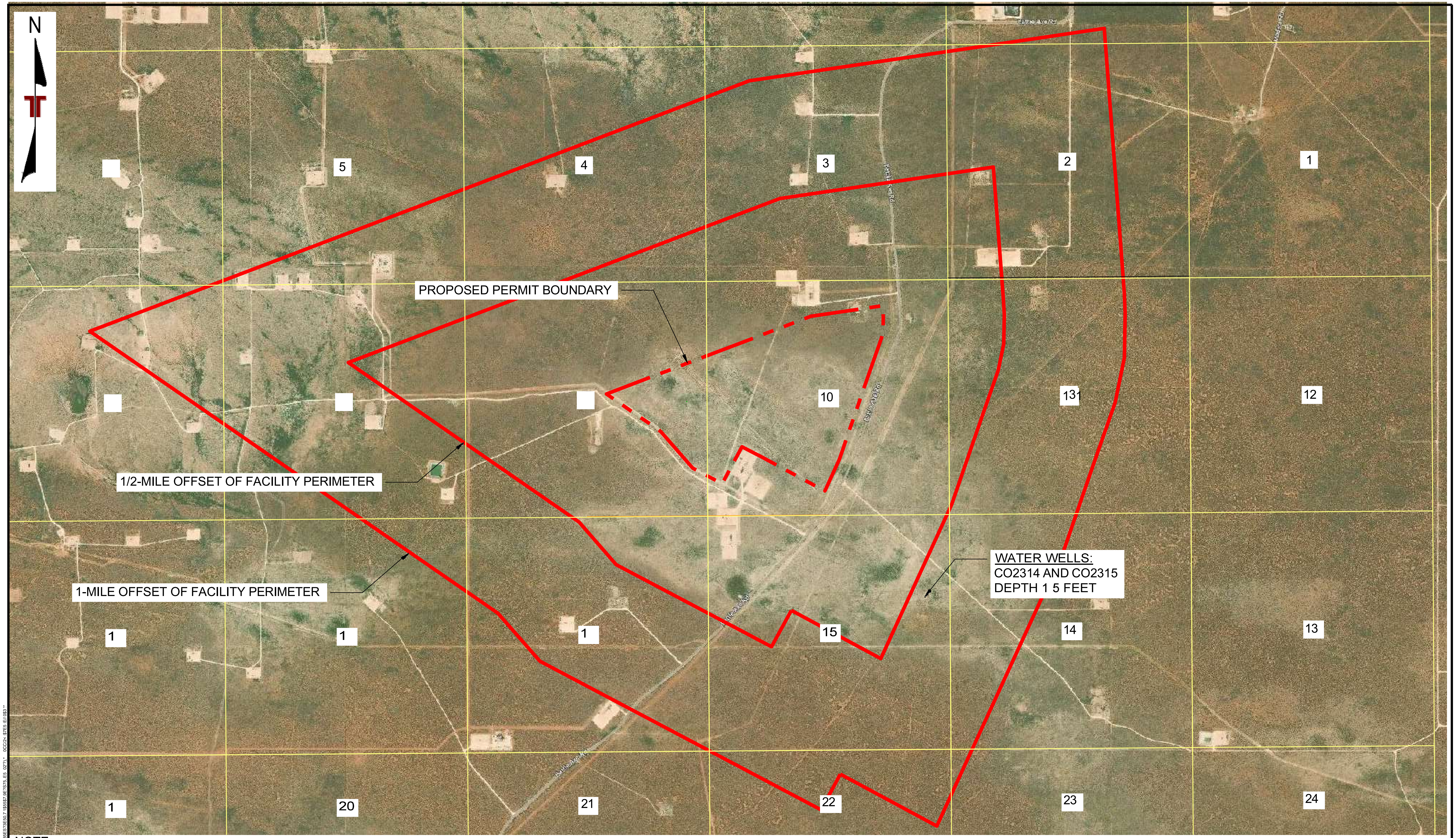
Consulting Engineers and Scientists

25809 I-30 SOUTH
BRYANT, AR 72022
PH. (501) 847-9292
FAX. (501) 847-9210

FIG 7

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2020
JOB NO. / ACAD NO.:	35187378 / 372-002
SHEET NO.:	OF 39


NRSWMF - SITE DEVELOPMENT
PERMIT APPLICATION FIGURE
NORTH RANCH DISPOSAL FACILITY
SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 8
REV. DATE BY DESCRIPTION
1 9/19 KHD UPDATED PER JIM JORDAN COMMENTS
FOR PERMITTING PURPOSES ONLY
T25S R34E, SEC 9
T25S R34E, SEC 10
SITE ENTRANCE
ENTRANCE GATE
PAVED DRIVEWAY
NORTH STORMWATER POND
LEACHATE EVAP POND
ADMINISTRATION BUILDING
PROPOSED DRYING PAD
PROPOSED WASH PAD
BATTLE AXE ROAD (HWY 2)
EMERGENCY SECONDARY ACCESS GATE
EAST STORMWATER POND
WEST STORMWATER POND
PHASE 1
PHASE 2
PHASE 3
CELL E-1 (9.6 AC.)
CELL E-2 (9.6 AC.)
CELL E-3 (28.2 AC.)
CELL E-4 (18.4 AC.)
CELL E-5 (18.6 AC.)
CELL E-6 (21.6 AC.)
CELL W-1 (15.3 AC.)
CELL W-2 (11.8 AC.)
CELL W-3 (15.2 AC.)
CELL W-4 (23.9 AC.)
CELL W-5 (24.7 AC.)
BH 1
BH 2
BH 3
BH 4
BH 5
BH 7
3340
84
999.818
IRS "#20666"
82
999.818
IRS "#20666"
4
3334.647
CP
83
LEGEND:
EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
PERMIT BOUNDARY AND SECURITY FENCELINE
OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
EXISTING ROAD CENTERLINE
BOREHOLE LOCATIONS
NGL PROPERTY LINE
SURVEY SECTION LINE
CELL BOUNDARIES
PHASE BOUNDARIES
40' WIDE CELL ACCESS ROAD
N
0
250
500
SCALE IN FEET



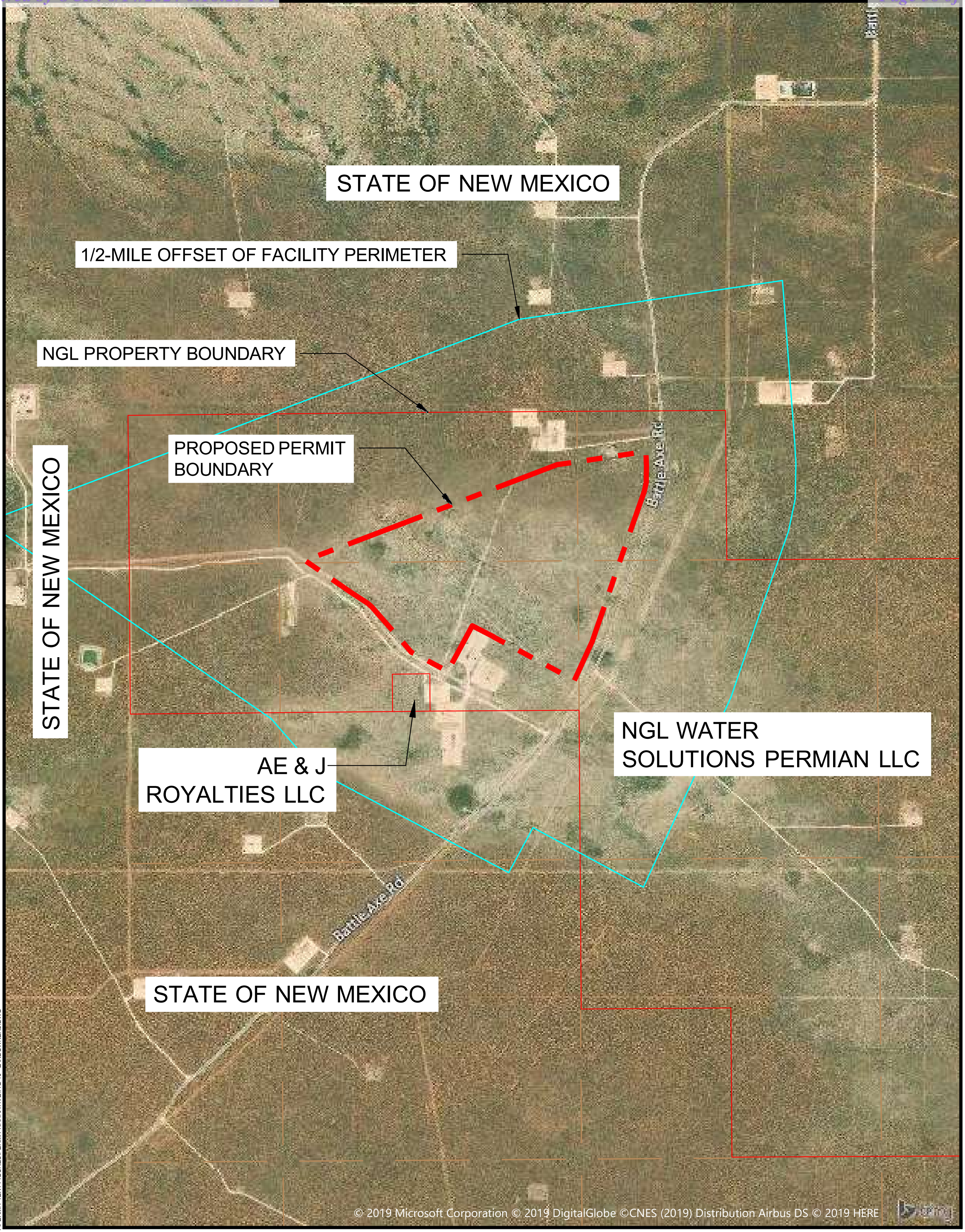
NOTE:
1. WATER WELL INFORMATION OBTAINED FROM NEW MEXICO OFFICE OF THE STATE ENGINEER POD LOCATION GIS APPLICATION.
2. NO PERMANENT RESIDENCE, SCHOOL, HOSPITAL, INSTITUTION OR CHURCH EXIST WITHIN 200-FEET OF THE PROPOSED FACILITY.
3. SHOWN TOWNSHIP 25S RANGE 34 E, SECTIONS AS LABELED

Project Mngr:	MPB	Project No.	35187378
Drawn By:	JBM	Scale:	1"=2000'
Checked By:	MPB	File No.	572-002
Approved By:	MPB	Date:	MAY 2020

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

WATER WELLS AND DWELLINGS WITHIN 1/2 MILE
PERMIT APPLICATION FIGURE
NORTH RANCH DISPOSAL FACILITY
SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY NEW MEXICO

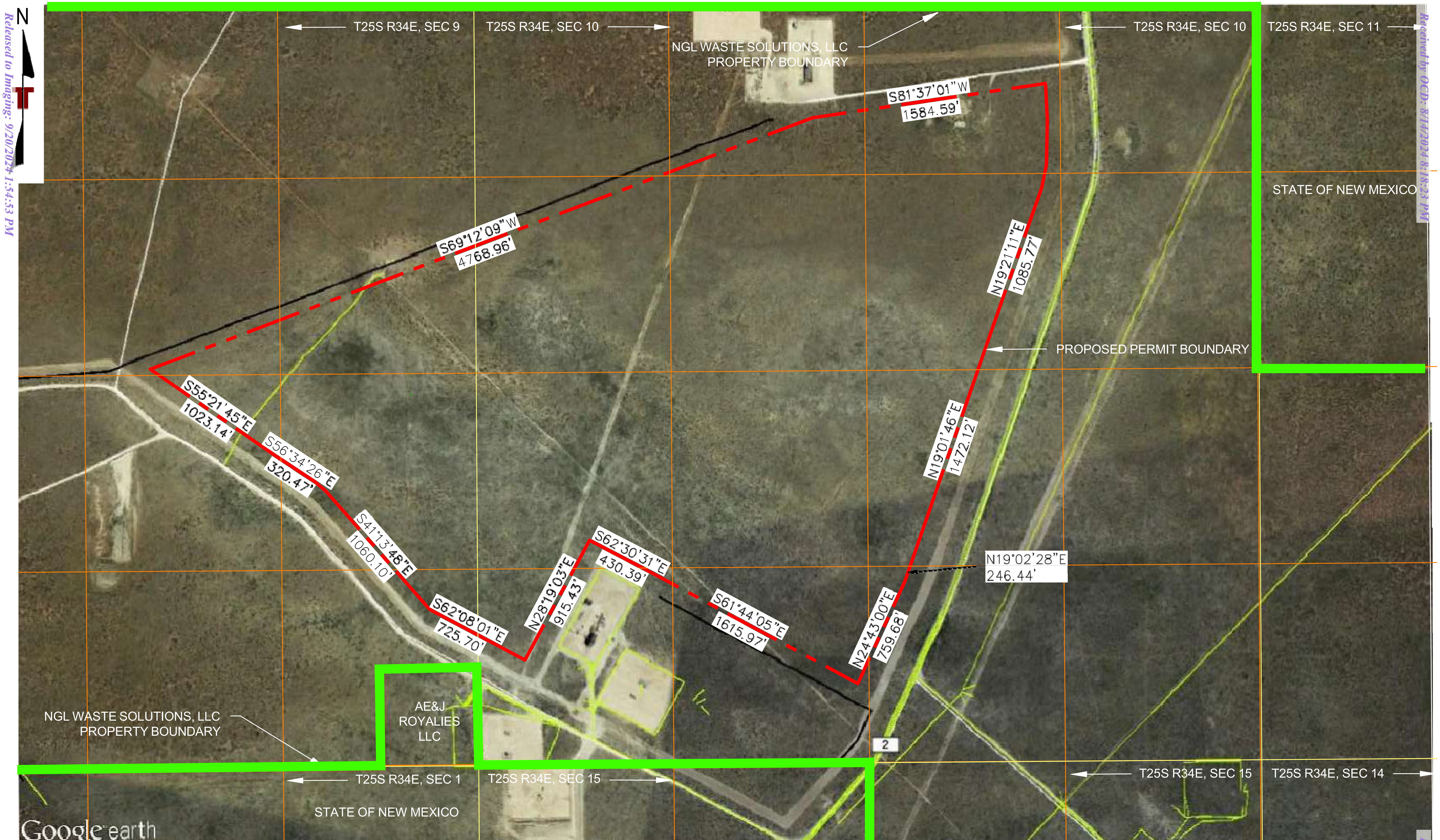
FIG. No.
9



GECARCHIVE\CAD\572002\MCCLOY\PERMIT TEXT FIGURES\PERMIT NARRATIVE\FIG 10 - LANDOWNERS.DWG

Project Mngr: MPB	Project No. 35187378	Terracon Consulting Engineers and Scientists 25809 INTERSTATE 30 S BRYANT, ARKANSAS 72022 PH. (501) 847-9292 FAX. (501) 847-2910	NRSWMF - LANDOWNERS WITHIN 1/2 MILE PERMIT APPLICATION FIGURE SURFACE WASTE MANAGEMENT FACILITY NORTH RANCH LEA COUNTY NEW MEXICO
Drawn By: DEW	Scale: NTS		
Checked By: MPB	File No. 572/002		
Approved By: FOC	Date: JANUARY 2019		

FIG. No. 10



Project Mngr:	MPB	Project No.	35187312
Drawn By:	MPB	Scale:	1"=600'
Checked By:	MPB	File No.	572-002
Approved By:	MPB	Date:	SEPTEMBER 2019

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

PERMIT BOUNDARY PLAT MAP
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG No.
1

Appendix D

North Ranch Disposal Facility Operating Plan

Surface Waste Management Facility Operation Plan

North Ranch Disposal Facility:
Surface Waste Management Facility
Lea County, New Mexico

Minor Modification Request, May 2023
Project No. 35187378

Modified by:

NGL Waste Services, LLC
1008 Southview Circle
Center, Texas 75935
(936) 598-8587

Table of Contents

List of Figures

List of Tables

List of Attachments

1.0 INTRODUCTION

1.1 Purpose, Scope, and Applicability

The following document comprises the Operating Plan for the NGL Waste Services, LLC (NGL) North Ranch Surface Waste Management Facility (Facility) located near Jal, Lea County, New Mexico. The site was formerly known as McCloy Ranch in relevant correspondence with the Energy, Minerals and Natural Resources Department, Oil Conservation Division (NMOCD or Division). Throughout this Operating Plan the references to *New Mexico Administrative Code (NMAC)* are noted as **19.15.36.XX**. This document is intended to comply with applicable requirements of **19.15.36.13** through **13.15.36.17** of the rules. This Operating Plan presents site specific methods and procedures by which the Facility will maintain and document compliance, and address the regulatory requirements applicable to the construction, operation and maintenance of the North Ranch Landfill and associated Leachate Evaporation Pond.

This Operating Plan has been prepared to assist in the operation and maintenance of the Oil Field Waste Landfill and Evaporation Pond Facility. This document discusses and/or includes documentation and procedures for the following:

- Site development;
- Waste disposal, and if needed dry out;
- Operating requirements & procedures;
- Surface water management;
- Groundwater, Vadose Zone, & Explosive Gas Monitoring
- Leachate Collection & Transmission
- Inspection and maintenance;
- Health and safety;
- Emergency response and contingency action; and
- Recordkeeping and reporting.

1.1.1 Relationship to Other Facility Documents

This document and its attachments, including the Management Plan of Approved Oil Field Wastes and the Hazardous and Unauthorized Waste Exclusion Plan, will serve as a guide for the construction, operation and maintenance of the Oil Field Waste Landfill, waste drying pad, Evaporation Pond. It should be used in conjunction with the following supporting documents to ensure efficient and effective operation of the Oil Field Waste Landfill and Evaporation Pond:

- Current *New Mexico Administrative Code Rules* (Energy, Minerals and Natural Resources Department, Oil Conservation Division (NMOCD or Division), effective date June 30, 2016)

- Permit Narrative **Appendix E** Inspection and Maintenance Plan
- Permit Narrative **Appendix F** Contingency Plan
- Permit Narrative **Appendix G** Leachate Management Plan
- Permit Narrative **Appendix H** Closure and Post-Closure Care Plan

1.1.2 Existing Operating Documentation

The NMOCD issued an approval letter regarding the Siting and Subsurface Investigation Work Plan proposed for the North Ranch Surface Waste Management Facility (formerly known as McCloy Ranch Landfill Site) dated October 24, 2018. Personnel representing the New Mexico Abandoned Mine Land Program issued a statement regarding no known underground mines in the vicinity of the Facility. Project correspondence is included in **Appendix B** of the permit narrative.

1.2 Facility Description and Design

The North Ranch Landfill and Evaporation Pond Facility ownership consists of approximately 303 total acres. The combined property includes designated areas for combined Oil Field Waste and fluids disposal, waste handling, and administrative facilities.

1.2.1 Waste Disposal Area

The Oil Field Waste landfill area will be developed in phases as shown on the Permit Drawings. The landfill, as permitted, will consist of a 205-acre landfill footprint resulting in a design minimum waste capacity of 40,264,324 cubic yards (cy)

2.0 LANDFILL OPERATING PROCEDURES

This Operating Plan presents site specific methods and procedures by which the Facility will maintain and document compliance, and address the regulatory requirements applicable to the construction, operation and maintenance of the Facility. The Operating Plan will be updated as required to reflect current operations and regulations. This Operating Plan for the Facility is prepared in accordance with the requirements of **NMAC 19.15.36**.

2.1 General Operating Requirements

All operations at the landfill Facility shall be conducted in accordance with the Operating Plan for the Facility, the permit drawings/specifications, the surface waste management Facility permit conditions, and the operational standards outlined in **19.15.36**. The following sections address the specific requirements of Sections **8, 13, 14 and 17** of **NMAC 19.15.36** in relation to the Landfill and the associated leachate evaporation pond. Oil Field Waste will be disposed of within the North Ranch Oil Field Waste Landfill as described in the permit application (PA).

2.1.0 Conformance with Permit Documents

The operations that are proposed by this Operating Plan are in accordance with the requirements of **NMAC 19.15.36**, except where alternates/exceptions are approved in this

Operating Plan and the permit narrative. Changes or deviations from the design and/or operational standards described herein may require approval from the NMOCD. Depending on the extent of the changes and/or improvements, the NMOCD may require notification and a permit modification.

2.1.1 Working Face Size

In accordance with **19.15.36.14.A(1)** the Facility will limit waste disposal to the smallest practical area and compact the oil field waste to the smallest practical volume. The operator will supervise the unloading and dumping at the site. One working face will be used for the placement of wastes. The operator shall not use equipment that may damage the integrity of the liner system in direct contact with a geosynthetic liner.

2.1.2 Access Requirements

19.15.36.14.A(2) outlines specific requirements and standards for landfill operations in relation to public and large animal access control. Specifically, owners and/or operators of surface waste management facilities must prevent unauthorized access by the public and entry by large animals to the landfill's active portion through the use of fences, gates, locks, cattle guards, or other means that attain equivalent protection. The North Ranch landfill has only one public access for vehicular traffic located at the northeastern corner of the site. The entrance gate is locked during non-operating hours to prevent illegal access to the Facility. At the entrance gate, a sign (**Figure 1**) that is readable from a distance of 50 feet will be posted indicating the operator's name; surface waste management Facility permit or order number; surface waste management Facility location by unit letter, section, township and range; and emergency telephone numbers.

As required by **19.15.13.I** a fence has been installed around the perimeter of the landfill site to control unauthorized access to the premises. A manually locked gate, at the entrance to the site can only be opened by North Ranch Landfill personnel and local Emergency Departments. Public traffic is prohibited from entering the property. **Appendix C** of the Permit Narrative provides a plat map of the permit boundary, the security fence will be placed along and parallel to this boundary.

2.1.3 Fire Prevention

As required by **19.15.36.14.A(3)**, the Landfill shall be operated in a manner that does not pose a fire hazard to personnel or property. However, in the event that a fire does occur, stockpiles of soil are readily accessible on the north side and near the working face of the Landfill. Portable fire extinguishers are kept in the administration building, on landfill operating equipment and one by the diesel storage tank which will be located near the facility entrance and scale house. In the event a fire cannot be contained by onsite personnel, Emergency numbers are posted on the Landfill sign (**Figure 1**) at the Facility entrance and in the administration building. Refer to **Appendix F** Contingency Plan of the PA narrative.

2.1.4 Litter, Odor, and Dust Control

The Facility does not expect to accept waste which will cause blowing litter. In accordance with **19.15.36.14.A(4)**, the Facility will maintain litter control provisions at all times. If applicable, the incoming waste will be properly managed to assure that litter is picked up and the Facility is kept in a neat and orderly fashion. The nature of the waste to be accepted and the application of periodic cover material is generally an adequate means of on-site litter control. In the event that blowing litter causes a problem, the following measures may be taken:

- Installation of litter fences (portable and/or permanent);
- Utilization of temporary litter crews to collect litter which has left the active disposal area.

Prior to oil field waste acceptance vehicles will be screened for the presence of hydrogen sulfide (H_2S). If H_2S is detected above 10 parts per million (ppm), the load will be treated with calcium hypochlorite [$Ca(ClO)_2$] to lower the H_2S to acceptable levels prior to unloading. In addition, chemicals will be maintained onsite to control H_2S and its associated odors originating from the evaporation pond or disposal units. Surrounding land use is vacant oil-field industry land, it is not anticipated that odors generated at this Facility will adversely affect the public.

The access roads and active areas within the Facility will be treated with water, as needed, from a water truck to reduce dust generation. The posted speed limit will be 15 miles per hour (mph) inside the property which will assist in limiting the amount of dust generated by onsite traffic. Routine operations listed below are the most likely sources of dust along with recommended primary and secondary control measures"

- Disposal Operations
  - Primary Control Measure; apply water to unpaved roads as necessary, enforce posted speed limits
  - Secondary Control Measure; apply dust palliatives to unpaved portions of the facility.
- Excavations
  - Primary Control Measure; water areas prior to and during excavation. Water areas of excavation and haul roads during and at the end of each day to form a dust binding soil crust.
  - Secondary Control Measure; Phase work to reduce the amount of disturbed surface, apply additional water, work at lower elevations when wind velocity is high.
- Stockpiles
  - Primary control measure; water areas prior to excavation. Apply water to short term stockpiles when transporting soils, stockpile below grade or behind berms.

   - Secondary Control Measure; control vehicle access to the area. Apply dust surfactant to long-term stockpiles or apply seed/mulch or proven stabilization measures to prevent erosion.
- Track out extending onto public roadways
   - Primary Control Measure; Sweep as necessary.
   - Secondary Control Measure; Apply recycled asphalt, caliche/gravel pads or similar materials at the transition from paved to unpaved roadways.
- Unpaved roadways and parking areas
   - Primary Control Measure; limit vehicle speed via post signage, apply water, use aggregate or caliche.
   - Secondary Control Measure; Apply water or surfactants to unpaved roads and parking lots, as needed..

Litter and odor will be further controlled by insuring that waste is processed and disposed of as quickly as it is received so that no waste accumulation occurs. All waste that is processed during the day is properly transported to the landfill active face. The Facility will cover disposed waste in the active working area as necessary to control fires, dust, debris, odors, blowing litter, and to limit the generation of leachate. Additional compacted soil approved by the Division will be applied to surfaces that will not receive an additional application of oil field waste or final cover for one month or more.

2.1.5 Prohibited Activities

As required under **19.15.36.14.A(5)**, the following activities will be prohibited at the Facility except as approved by the Division:

- Excavation of a closed cell by Facility personnel;
- Excavation of a closed cell by others.

2.1.6 Periodic Cover

19.15.36.14.A(6) requires that the operator shall provide adequate cover for the landfill's active face as needed to control dust, debris, odors or other nuisances, or as otherwise required by the Division. The facility will utilize water trucks for dust control. The water used will either come from the non-contact stormwater basins or an onsite fresh water well. Waste will be covered periodically with at least six inches of soil or an NMOCD approved alternative cover material as necessary to control the undesirable conditions. Cover soil material will be obtained from on-site borrow areas or excavated material stockpiles located throughout the landfill property. **19.15.36.14.A(7)** requires that any active area that does not receive waste or final cover for more than one month will be covered with an intermediate cover that consists of at least 12 inches of compacted onsite soils in accordance with Section 2.1.7 below.

2.1.7 Intermediate Cover

For areas of the landfill that will not receive additional oil field waste for one month or more, but have not reached the final waste elevation, **19.15.36.14.A(7)** requires that the operator shall provide intermediate cover that shall be:

- approved by the Division;
- stabilized with vegetation; and
- inspected and maintained to prevent erosion and manage infiltration or leachate during the oil field waste deposition process.

Operators at the Facility will place a minimum of 12-inches of soil from onsite sources over both intermediate slopes that will remain inactive for a month or more, and slopes that have reached final grade. Slopes that have reached final grade will utilize the intermediate cover soil as the lower most layer of the proposed final cover system.

Due to the arid climate of the Facility's location, wastes underlying the intermediate cover, and site soil types it is unlikely that vegetation will grow and establish over intermediate slopes. The Facility proposes to maintain the intermediate soil cover on temporary slopes via routine inspection and erosion repair. Intermediate slopes will be graded for positive drainage to promote run-off and minimize surface water infiltration and leachate generation/percolation.

Where available, relatively low permeable soils will be used for intermediate cover on temporary slopes. The intermediate cover over final grade slopes shall have a permeability of $1x10^{-5}$ cm/s or less. **Appendix E** of the permit application provides an inspection and maintenance plan for the Facility, which includes directives for inspection and maintenance of areas having received intermediate cover.

2.1.8 Landfill Cell Closure

19.15.36.14.A(8) indicates that when the operator has filled a landfill cell to final waste grades, the operator shall close it pursuant to the conditions contained in the surface waste management Facility permit and the requirements of **19.15.36.18.C(2)**. The operator shall notify the Division's Environmental Bureau at least three working days prior to a landfill cell's closure.

As required by **19.15.36.18.C(2)**, the operator shall properly close landfill cells, covering the cell with a top cover of soil contoured to promote drainage of precipitation. Side slopes shall not exceed a 25 percent grade (4:1 H:V), such that the final cover of the landfill's top portion has a gradient of two percent to five percent, and the slopes are sufficient to prevent the ponding of water and erosion of the cover material. The operator shall re-vegetate the area overlying the cell with native grass covering at least 70 percent of the landfill cover and surrounding areas, consisting of at least two grasses and not including noxious weeds or deep-rooted shrubs or trees, and maintain that cover through the post closure period.

2.1.9 Equipment Requirements

The Facility will be equipped with suitable equipment associated with the daily operation of the landfill, as well as provisions for routine maintenance of the equipment. The types and amounts of equipment and quantity of personnel required to operate the Oil Field Waste Landfill and Evaporation Pond will vary depending on the types and quantities of waste requiring disposal. **Table 2** below lists the typical equipment and personnel associated with the operation of the Landfill and Evaporation Pond. Additional equipment may be obtained from outside sources as needed to support the construction, operation, and maintenance needs of the Landfill and Evaporation Pond.

TABLE 2
EQUIPMENT AND PERSONNEL REQUIREMENTS

EQUIPMENT/PERSONNEL	TYPICAL QUANTITY	PURPOSE/USE
Equipment		
Excavator, bulldozers, scrapers, backhoes, graders, tractors and pans or front-end loaders	2-4	Used for excavation of future waste areas, borrow areas, and general site earthwork. Excavators load trucks from borrow areas and deliver cover soils to the landfill operating area.
Dump Truck(s), Water Truck(s)	2	Used to deliver soils and gravel to the landfill, water Facility roads, etc.
Personnel		
Landfill Manager / Supervisor	1	Manages operations of the Oil Field Waste Landfill. Completes the required paperwork associated with management of the Facility
Equipment Operators	1 to 2 or as needed for proper operations	Perform operations of the Oil Field Waste Landfill including directing waste placement, earthwork, and general Facility maintenance.
Truck/Tractor Drivers	2 to 3	Haul waste/cover soil to landfill. Will include but may not be limited to the Oil Field Waste Landfill Operators.

The equipment will be inspected on a regular basis to ensure the equipment is in good operating condition. Adequate back-up equipment will be leased or borrowed within 24 hours in the event of equipment breakdowns.

2.1.10 Ancillary Facilities

Employee facilities are provided at the administration building. Sanitary facilities and potable water are accessible to all landfill personnel.

2.1.11 Nuisance Avoidance

To prevent the Facility from becoming a public nuisance or public health hazard, procedures will be implemented to ensure compliance with **19.15.36.14.A(6)** and **19.15.36.17.A**. These procedures include dust and odor control, application of cover material, litter control, maintaining stormwater control structures, and general Facility maintenance.

2.1.12 Cover Maintenance Systems

The owner or operator shall be responsible for maintaining the cover system integrity and shall promptly repair erosion, washout, tracking, or other defects that result in exposed waste in either weekly or intermediate cover, or exposure of the barrier system of the final cover. Areas of liquids seepage, or areas exhibiting evidence of liquids seepage such as staining and discoloration of the cover system shall also be promptly repaired."

The integrity of the cover system for the landfill will be maintained throughout the active life of the Landfill and during the post-closure care period. Erosion, washouts, tracking and other cover system defects will be repaired as soon as weather allows. If liquids seepage should develop, the Facility will repair the area by the placement of additional cover material. If additional cover does not stop a seep, a case specific repair/mitigation measure will be developed and implemented.

The Facility will cover disposed waste in the active working area periodically as needed to control dust, debris, odors or other nuisances, and to limit the generation of leachate. A minimum of 12 inches of compacted soil (or suitable equivalent material approved by the NMOCD) will be applied to surfaces that will not receive an additional application of waste or final cover within 30 days. The intermediate cover shall be inspected and maintained to prevent erosion and manage surface water infiltration during the oil field waste deposition process, in accordance with **19.15.36.14.A(7)**.

2.1.13 Wet Weather Repairs

In the event that repairs to the landfill cover system are needed during inclement weather conditions, precautions will be exercised to prevent the creation of additional cover defects. Temporary measures shall be implemented until permanent repairs can be executed. Installation of final cover and establishment of permanent vegetative cover on closed waste disposal cells will be scheduled so as to minimize the impacts to the Facility of performing work during wet weather.

2.2 Management of Approved Oil Field Wastes

Approved oil field wastes to be handled at the Facility will be managed in accordance with this Operating Plan and the Management Plan - Approved Oil Field Wastes included in **Attachment A** to this Operating Plan.

2.3 Emergency Response Contingency Plan

Pursuant to **19.15.36.8.C(10)**, the applicant is required to develop and implement a contingency plan in the event of fire or other emergency situations. The North Ranch Landfill has developed an emergency response contingency plan that is included in **Appendix F** of the PA narrative.

2.4 Procedures for Excluding the Receipt of Hazardous Waste & Unauthorized Waste

In accordance with **19.15.36.13.F** the North Ranch Landfill must implement a program to detect and prevent the disposal of regulated hazardous wastes, NORM, and additional unauthorized wastes. The Facility has developed a site-specific Hazardous and Unauthorized Waste Exclusion Plan (HUWEP) for the Landfill in accordance with the requirements of the NMAC.

The HUWEP includes the following:

- Purpose of monitoring and roles of landfill personnel;
- Types of wastes to be excluded;
- A written protocol that describes the methods to identify and screen potentially hazardous waste and other unauthorized wastes before it enters the landfill including the review of industrial customer's procedures for separating hazardous waste and other unauthorized wastes from other wastes. The written protocol shall describe the procedures, evaluation criteria, testing requirements, and decision making process that will be followed to determine whether to accept or reject industrial or process waste for disposal before it enters the landfill;
- Sampling and analysis procedures to be followed for new customers and for periodic re-testing of existing customer wastes. Testing laboratories shall be acceptable to the NMOCD;
- Random inspection procedures and documentation;
- Personnel training to be provided;
- Recordkeeping requirements; and
- A contingency plan, which includes notification procedures, and remedial actions to be taken when hazardous waste and other unauthorized wastes are identified.

The North Ranch Landfill maintains permanent operating records associated with the hazardous waste exclusion program, including all dates, procedures, and final waste disposition. The Facility HUWEP is included as **Attachment B** to this Operating Plan.

2.5 Gas Safety Management Plan

19.15.36.13.O states that each operator of a surface waste management facility that includes a landfill shall have a gas safety management plan that describes in detail procedures and methods that will be used to prevent landfill-generated gases from interfering or conflicting with the landfill's operation and protect fresh water, public health, safety and the environment. The plan shall address anticipated amounts and types of gases that may be generated, an air monitoring plan that includes the vadose zone and measuring, sampling, analyzing, handling, control and processing methods. The plan shall also include final post closure monitoring and control options. Section 5.3 below discusses the anticipated generation rate of landfill gas. Gas Safety is addressed in **Appendix F** of the PA narrative.

2.8 Run-On/Runoff Control Systems

19.15.36.13.M states that each operator shall have a plan to control run-on water onto the site and run-off water from the site, such that:

- the run-on and run-off control system shall prevent flow onto the surface waste management facility's active portion during the peak discharge from a 25-year storm; and
- run-off from the surface waste management facility's active portion shall not be allowed to discharge a pollutant to the waters of the state or United States that violates state water quality standards.

All stormwater control systems including ponds, ditches, dikes, and berms utilized to manage run-on and run-off for the North Ranch landfill are designed to handle the run-off from a 25-year/24-hour storm event. The Run-on/Run-off Control System and stormwater management are addressed in **Appendix J** of the permit narrative.

2.9 Surface Water Requirements

The landfill and associated surface water management infrastructure is designed to protect fresh water, public health and the environment. The Oil Field Waste landfill and associated facilities will implement and maintain best management practices (BMPs) to minimize erosion and control sediment to protect surface water quality during storm events. BMPs will include the construction of three area specific stormwater detention ponds designed to handle the 25-year, 24-hour design storm. The Oil Field Waste landfill and associated facilities shall not:

- Deposit waste in standing water; and shall not
- Allow the discharge of leachate from the landfill unit unless the discharge is permitted within a valid liquids disposal system or permitted under the NPDES system.

Stormwater run-off from the waste disposal areas that have not undergone final approved closure will be collected and diverted to detention basins as shown on the Permit Drawings in **Appendix K**. Stormwater that accumulates in the detention basins will evaporate and/or be contained within the facility perimeter berms. Although no discharge is expected, if the Multi-sector General Permit for stormwater discharges is required, then any stormwater discharges shall be in accordance with the Facility permit. The design of the landfill shall include provisions for let-down structures and mid-slope terraces as needed to minimize and control soil erosion. Also, all run-on and run-off control systems are designed to control a 25-year, 24-hour storm event.

2.10 Liquids Restrictions

In accordance with **19.15.36.13.E,** oil field waste containing free liquids will not be placed within the landfill. The operator will use random paint filter tests as prescribed by the EPA (EPA SW-846, method 9095) to determine conformance of the oil field waste to this criterion. Oil field waste containing free liquids may be placed on drying pads, for evaporation of liquids and/or mixing with a soil or similar bulking agent, as indicated in the Permit Drawings in **Appendix K**. Absence of free liquids will be confirmed using visual inspection and random paint filter tests prior to landfill disposal of the materials from the drying pads.

2.11 Recordkeeping Requirements

Sections **19.15.36.13.F(1-3), 19.15.36.13.G**, **19.15.36.13.L**, **19.15.36.13.P**, **19.15.36.14.C.8, 19.15.36.14.B**, **19.15.36.14.G**, **19.15.36.17.C.2**, and **19.15.36.17.D.2** outline specific recordkeeping requirements for surface waste management facilities. In particular, the Facility permanent operating record (POR) system will include:

- The North Ranch commercial facility shall maintain records reflecting the generator, the location of origin, the location of disposal within the commercial facility, the volume and type of oil field waste, the date of disposal and the hauling company for each load or category of oil field waste accepted at the commercial facility. The operator shall maintain such records for a period of not less than five years after the commercial facility's closure, subject to Division inspection; The Shipping Manifest form can be found in Exhibit A of Attachment A, incorporating this information as per NMOCD form C-138.
- The Facility Inspection and Maintenance Plan (see **Appendix E** of the permit narrative) requires monthly inspections of leak detection sumps, including sampling if fluids are present, with analyses of fluid samples furnished to the Division. Records are required to be maintained for inspection dates, the inspector and the leak detection system's status. The Plan also requires records be kept of semi-annual inspection and sampling of monitoring wells events, if required, with analyses of ground water furnished to the Division, and maintenance of records of inspection dates, the inspector and ground water monitoring wells' status. Records are also kept for inspections of the berms and the outside walls of pond levees (quarterly and

after a major rainfall or windstorm) and maintenance of berms in such a manner as to prevent erosion. Inspection forms are provided in **Appendix E** of the permit narrative;

- The operator shall maintain records of the Facility training program, subject to Division inspection, for at least five years. Each operator shall conduct annual training for key personnel that includes general operations, permit conditions, emergencies, site safety, proper sampling methods and identification of exempt and non-exempt waste and hazardous waste;
- The operator shall monitor leak detection systems pursuant to the approved surface waste management facility permit conditions regarding the leachate evaporation pond(s), landfill cells, drying pads and truck wash. Monitoring records will be maintained in a form readily accessible for Division inspection and the Facility will report discovery of liquids in the leak detection system to the Division within 24 hours, obtain a sample and provide the laboratory analysis to the Division. Inspection forms are provided in **Appendix E** of the permit narrative;
- The operator shall seal a solid drainage pipe from the landfill leak detection system to convey collected liquids to a corrosion-proof sump or sumps located outside the landfill's perimeter for observation, storage, treatment or disposal. The operator may install alternative designs as approved by the Division. The operator shall test sumps' integrity annually and shall promptly repair or replace a sump that does not demonstrate integrity. The operator may test sumps that can be removed from their emplacements by visual inspection. The operator shall test other sumps by appropriate mechanical means. The operator shall maintain records of sump inspection and testing and make such records available for Division inspection. Inspection forms are provided in **Appendix E** of the permit narrative.
- Upon achieving the final landfill cell elevation, the date shall be recorded in the Construction Log Form and the final landfill cell cover of the working face shall be achieved within 1 year and also recorded on the Field Construction Log Form. The Construction Log Form is provided in Appendix E of the permit narrative.
- Inspection records; and
- Retention Period record.

The North Ranch Landfill maintains a record keeping filing system to comply with these sections of the NMAC (Permanent Operating Record or POR). All records will be maintained at the Facility during the active life of the landfill and through the 30-year post-closure care period at which time the NMOCD Director may authorized destruction of the records. The Facility may develop an electronic POR record keeping system and enter newly acquired electronic records into the file storage directory. The electronic record shall be made available to Division personnel for inspection. (see also Section 9.0 below)

2.12 Survey Control

The North Ranch will establish a survey control system. The survey control system is used to insure and document that the Facility is developed in accordance with the approved permit drawings. A site coordinate system has been established at the Facility. The site coordinate system has been tied to the New Mexico East Zone State Plane Coordinate System and provides the basis and reference for all construction and waste disposal operations at the Facility.

Grid markers shall be established, as needed, at positions to allow visual inspection of the progression of the fill and other features. The markers shall be mounted on steel or wooden posts, brightly painted, and placed in areas where they are not likely to be damaged or destroyed. Markers shall be identified consistent with permit drawing notations.

19.15.36.14.A.1 states that solid waste shall be spread and compacted in the smallest practical area as soon as it is unloaded for disposal. Spreading and compaction of the waste material is important as it maximizes the density and/or amount (tons) of waste that can be placed in a given area. Increasing the density and/or the amount (tons) of waste in a given area maximizes the useful life of the Facility. Compaction of the waste in layers also minimizes settling which can result in ponding of stormwater and/or damage to the final cover system.

2.13 Waste Filling Operations

2.13.1 Placement of Waste

The Oil Field Waste Landfill and Evaporation Pond at the Facility are to be developed in a sequence of phases in general accordance with the Permit Drawings in **Appendix K**. However, the landfill may be developed in areas contiguous with operating landfill areas, whether in the subsequent order or not, if operating conditions or engineering judgment necessitate it. Typically, waste disposal and fill progression in the Oil Field Waste Landfill will proceed from the lowest point in each cell or prepared area to the highest. A prepared area will be filled in lifts until the maximum design grades and/or slopes are reached (minus the final cover thickness). Waste will be spread and compacted per **19.15.36.14.A.1**. Normally, waste will be deposited in layers or lifts that generally will not exceed 10-15 feet in compacted thickness. Interior waste slopes will generally not exceed 3:1 (horizontal: vertical) with final slopes not exceeding 4:1. The top of each lift shall be graded to drain to the perimeter run-off control system at a minimum grade of 4%.

Waste loads and cover soils will generally be deposited at or near the top or toe of the active working face, except as indicated below for the case of waste placement in a new cell. Scrapers or dump trucks may deliver cover soil from the borrow area. A waste compactor or large bulldozer will push the waste or soil up or down the working face slope while evenly spreading the material. The waste compactor or dozer will then traverse the waste slope (both parallel and perpendicular to the slope if feasible) several times until the waste is compacted to the extent possible and practical. The number and orientation of compactor or dozer passes will vary depending on the type of compactor or dozer used, slope of the active working face, type of waste, and other factors. Cover soil will only be place as needed to control odors, dust, debris, and other nuisances, intermediate soil will be place over areas that will remain inactive for a period of 1-month or longer.

The operator shall not use equipment that may damage the integrity of the liner system in direct contact with a geosynthetic liner. The design of the Oil Field Waste Landfill includes a leachate collection and removal system and a protective layer designed to provide separation and protection for the critical underlying liner/leachate collection system components. Stress calculations demonstrating that a CAT 657 Scraper, or equivalent, may drive over the protective cover are provided in **Attachment E2** of **Appendix J** of the permit narrative.

The placement of the initial waste or first lift in a prepared area requires additional care and caution to avoid damage to the underlying liner and/or leachate collection systems. Generally, the only vehicles that should travel on the working surface/protective cover surface are pickup trucks, waste collection vehicles, trucks/trailers, and low ground pressure equipment. At no time shall waste compactors, dozers, excavators, loaders, or scrapers be allowed directly on the protective cover/working surface. Waste loads placed during initial development of a new cell will always be from the toe upward to the crest over the top of the leachate collection system protective cover. Once the initial 10-15 feet thick lift is placed and compacted over the protective cover, waste may be placed from the top or toe as indicated above.

2.13.2 Configuration and Development of Landfill

The Landfill is being developed in general accordance with the Permit Drawings in **Appendix K** of the permit narrative. The Landfill will be closed in accordance with the Facility closure in **Appendix H** of the permit narrative.

The side slopes of the completed cells will be graded to 4:1 (horizontal to vertical). The top of the Landfill will be graded to a minimum of 4% slope to promote runoff. A perimeter, all-weather access road will surround the Landfill.

In general, a typical waste cell is developed by the following steps:

- Preparing a new waste disposal area to the depths and dimensions shown on the Construction Drawings and stockpiling excavated soils on-site.
- Constructing a bottom liner system to the dimensions shown on the Construction Drawings and in accordance with the plans and specifications for the construction project. A typical detail of the bottom liner system is shown on the Permit Drawings.
- Grading the area around the waste cell and constructing diversion berms to minimize run-on into the waste cell.
- Placing the initial lift (approximately 10-ft thick) across bottom of new cell. The placement of the initial lift requires additional care and caution to avoid damage to the underlying liner system. At no time will waste compactors or other high ground pressure equipment be allowed directly on the protective cover.
- Moving disposal activities to top of previously completed and covered waste, progressing on each new lift to give the site positive drainage at all times.
- Starting the cycle over in subsequent waste areas.

Future waste cells will be developed sequentially in general accordance with the Facility cell progression plan shown on the Permit Drawings. The Facility may alter the sequence based on engineering planning of future development areas and economic considerations at the time of cell construction.

2.13.3 Site Capacity and Service Life

The estimated minimum operational waste capacity (waste and routine/intermediate soil cover) of the Landfill is 40,264,324 CY. Annual airspace consumption/disposal rate is unknown at the time of the PA preparation, therefore a range of potential site life is provided in Table 1.2 below.

TABLE 1 RANGE OF POTENTIAL SITE LIFE		
Annual Disposal Rate (cy/year)	**Design Capacity (cy)**	**Estimated Site Life (Years)**
250,000	40,264,324	161.0
500,000	40,264,324	80.5
750,000	40,264,324	53.6
1,000,000	40,264,324	40.3

2.13.4 Eligible Wastes

The North Ranch Oil Field Waste landfill is permitted for the disposal of all eligible Oil Field Wastes as outlined in **19.15.36.13**. Eligible Oil Field Wastes means exempt or non-hazardous oil field wastes containing no free liquids. The operator shall not accept hazardous waste or waste containing regulated NORM. A solid waste is hazardous if it has been specifically listed as hazardous by the EPA or if it is hazardous by Ignitability, Reactivity and Corrosivity (IRC) characteristics.

The operator shall require documentation for accepting eligible oil field wastes in accordance with the Management Plan - Approved Oil Field Wastes included in **Attachment A** to this Operating Plan. Exempt and non-exempt Oil Field Wastes are further defined below:

- Exempt oil field wastes. EPA provided an exemption for oil field wastes that are codified in 40CFR Section 261.4 (b)(5) Exclusions. Therefore, most Oil Field Wastes are regulated as solid wastes rather than hazardous wastes. EPA identified criteria for these wastes to be exempt from RCRA Subtitle C regulations. For a waste to be exempt, it must satisfy the following:
  - Must be associated with operations to locate or remove oil or gas from the ground or to remove impurities from such substances and it must be intrinsic to and uniquely associated with oil and gas exploration, development or production operations (commonly referred to simply as exploration and production or Oil Field Waste). The waste must not be generated by transportation or manufacturing operations;
  - Must be waste from primary field operations;
- Excerpts from EPA's report entitled "Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations," regarding Exempt and Non-exempt Wastes are below:
  - **Exempt Oil Field Wastes**
    - Produced water
    - Drilling fluids
    - Drill cuttings
    - Rig wash
    - Drilling fluids and cuttings from offshore operations disposed of onshore
    - Geothermal production fluids
    - Hydrogen sulfide abatement wastes from geothermal energy production
    - Well completion, treatment, and stimulation fluids
    - Basic sediment, water, and other tank bottoms from storage facilities that hold product and exempt waste

- Accumulated materials such as hydrocarbons, solids, sands, and emulsion from production separators, fluid treating vessels, and production impoundments
- Pit sludges and contaminated bottoms from storage or disposal of exempt wastes
- Gas plant dehydration wastes, including glycol-based compounds, glycol filters, and filter media, backwash, and molecular sieves
- Workover wastes
- Cooling tower blowdown
- Gas plant sweetening wastes for sulfur removal, including amines, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge
- Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream)
- Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation
- Produced sand
- Packing fluids
- Hydrocarbon-bearing soil
- Pigging wastes from gathering lines
- Wastes from subsurface gas storage and retrieval, except for the non-exempt wastes listed on page 11 (of the EPA publication)
- Constituents removed from produced water before it is injected or otherwise disposed of
- Liquid hydrocarbons removed from the production stream but not from oil refining
- Gases from the production stream, such as hydrogen sulfide and carbon dioxide, and volatilized hydrocarbons
- Materials ejected from a producing well during blowdown
- Waste crude oil from primary field operations
- Light organics volatilized from exempt wastes in reserve pits, impoundments, or production equipment

- **Non-Exempt Wastes**
  - Unused fracturing fluids or acids
  - Gas plant cooling tower cleaning wastes
  - Painting wastes
  - Waste solvents
  - Oil and gas service company wastes such as empty drums, drum rinsate, and blast media, painting wastes, spent solvents, spilled chemicals, and waste acids
  - Vacuum truck and drum rinsate from trucks and drums transporting or containing non-exempt waste

- Refinery wastes
- Liquid and solid wastes generated by crude oil and tank bottom reclaimers
- Used equipment lubricating oils
- Waste compressor oil, filters, and blowdown
- Used hydraulic fluids
- Waste in transportation pipeline related pits
- Caustic or acid cleaners
- Boiler cleaning wastes
- Boiler refractory bricks
- Boiler scrubber fluids, sludges, and ash
- Incinerator ash
- Laboratory wastes
- Sanitary wastes
- Pesticide wastes
- Radioactive tracer wastes
- Drums, insulation, and miscellaneous solids

Additional eligible Oil Field Wastes that may be disposed of in the North Ranch Landfill include non-exempt, non-hazardous, oil field wastes. The operator shall require a shipping manifest, incorporating the information required as per form C-138, oil field waste document, completed by the generator or its authorized agent. This form shall be accompanied by acceptable documentation to determine that the oil field waste is non- hazardous. Also eligible for disposal at the Facility are "emergency non-oil field wastes." The operator may accept non-hazardous, non-oil field wastes in an emergency if ordered by the department of public safety. The generator shall complete a shipping manifest, incorporating the information requires as per form C-138, oil field waste document, describing the waste, and maintain the same, accompanied by the department of public safety order, subject to Division inspection. In any case, the operator must sign the shipping manifest form prior to acceptance and disposal of any waste.

2.14 Bottom Liner System Construction

In accordance with **19.15.36.14.C**, the bottom liner system associated with the Oil Field Waste Landfill has been designed and will be constructed using a double composite liner system. The purpose of the double composite liner system is to contain the waste mass while preventing liquids infiltration into the subsurface while also providing a mechanism for leak detection.

The bottom liner system for the Oil Field Waste disposal areas will begin with a geosynthetic clay liner (GCL), as an alternative base layer. A 60-mil textured High Density Polyethylene (HDPE) geomembrane will overly the base layer to form the composite barrier below the leak detection system. The leak detection system will consist and alternative 200-mil geocomposite drainage net that will blanket the entire cell floor. Ultimately, leaked fluids if any, will collect in a central collection sump which will have an inspection riser. The primary (upper) 60-mil textured HDPE geomembrane will be placed over the leak detection system. A leachate collection and removal system will consist of an alternative 200-mil geocomposite drainage net that will blanket the entire cell floor and transmit leachate to 6-inch central collection pipe trench. Ultimately, the leachate system will convey leachate to a central collection sump where it will be pumped to the leachate evaporation by automatic pumps. The Leachate system will be overlain by 2-feet of protective cover soil. The cell floor shall be sloped at 2% in the lateral direction toward the main collection trench and 2% along the main collection trench toward the central collection sump. **Appendices J and K** of the permit narrative describe more detailed information on bottom liner construction.

2.15 Periodic and Intermediate Cover Placement

Waste will be covered as frequently as necessary with at least 12 inches of soil or an NMOCD approved alternative cover material. Cover soil material will be obtained from on-site borrow areas located throughout the landfill property. Any active area that does not receive waste or final cover for more than 30 days will be covered with an intermediate cover system that consists of at least 12 inches of onsite soils (including periodic cover). More information on daily/intermediate cover can be found in Section 2.1.6 of this Operating Plan.

2.16 Final Cover Placement

The proposed soil only, evapotranspiration (ET), alternative final cover system for the Landfill has been designed to prevent infiltration into the waste mass. The various components of the final cover system permitted for the Landfill are listed below and include the following from top to bottom:

- A soil erosion/vegetation layer composed of at least 12-inches of vegetated soil with a permeability of 1x10-5 cm/s or less. A 70% coverage of at least two native grasses shall be maintained in accordance with the post closure provisions of **19.15.36.18.C.2.b**. The seed list shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains.
- A compacted soil infiltration barrier layer composed of at least 36-inches of soil with a permeability of $1x10^{-5}$ cm/s or less.
- A compacted soil intermediate cover layer composed of at least 12-inches of soil with a permeability of $1x10^{-5}$ cm/s or less.

Design calculations demonstrating the performance equivalence to that of the regulatory prescriptive final cover system are provided in Appendix J of the permit application document.

The operator shall install the top landfill cover within one year of achieving the final landfill cell waste elevation. The operator shall ensure that the final landfill design elevation of the working face of the oil field waste is achieved in a timely manner with the date recorded in a field construction log. The operator shall also record the date of top landfill cover installation to document the timely installation of top landfill covers. The operator shall provide a minimum of three working days' notice to the NMOCD in advance of the top landfill cover's installation to allow the Division to witness the top landfill cover's installation.

3.0 LANDFILL EVAPORATION POND OPERATING PROCEDURES

19.15.36.17 provides specific requirements that apply to the leachate evaporation pond. The evaporation pond will be the primary mechanism for the disposal of leachate resulting from landfilling operations. Secondary disposal options are discussed in the Leachate Management Plan presented in **Appendix G** of the permit narrative.

3.1 Evaporation Pond(s) Operations

3.1.1 Acceptable Liquids

19.15.36.17.C.1 requires the operator to ensure that only produced fluids or non-hazardous waste are discharged into or stored in the evaporation pond(s); and that no measurable or visible oil layer is allowed to accumulate or remain anywhere on the pond surface. Leachate discharging to the evaporation pond is not expected to contain measurable or visible oil due to its collection through the landfill's leachate collection and recovery system. Wet wastes placed in the landfill will be dried out prior to placement and due to the nature of the wastes accepted at this facility, minimal natural leachate generation is expected. Therefore, the leachate collected will primarily be from precipitation (which is minimal in the local arid climate) that must filter through the waste mass and the liner system's protective cover before arriving at the landfill sump. However, the oil absorbent booms located at the administration building will be used if necessary to clean oil from the evaporation pond surface.

3.1.2 Evaporation Pond Leak Detection

Pursuant to 19.15.36.17.C.2, the operator shall monitor leak detection systems pursuant to the approved surface waste management facility permit conditions, maintain monitoring records in a form readily accessible for Division inspection and report discovery of liquids in the leak detection system to the Division within 24 hours. Inspection forms for the leachate evaporation pond are provided in **Appendix E of the Permit Application.**

3.1.3 Evaporation Pond Access and Migratory Bird Protection

19.15.36.13.I and 19.15.36.17.C.3 sets forth requirements for fencing, screening, netting and covering the proposed leachate evaporation pond to prevent unauthorized access to the pond and to protect migratory birds. The Facility will have a perimeter chain link fence and pond specific fences are not required if there is an adequate perimeter fence surrounding the surface waste management facility. In lieu of screening, netting or covering the pond as a protection measure for migratory bird, the Facility proposes alternate means of bird protection and control around the pond area. The following subsections provides proposed alternative measures for controlling and protecting migratory birds.

NGL is proposing alternate procedures that have proven historically effective in discouraging bird propagation for comparable protection of migratory birds. There is a significant absence of habitat (i.e. wetlands) or food for migratory birds which will naturally deter migratory birds from congregating or landing in the proposed evaporation pond. In addition, Facility operations will not deposit wet waste or free liquids into a disposal cell. All accepted wet waste will be dried on a concrete drying pad to the point that it can pass a paint filter test prior to disposal, thus, accumulation of oil is not anticipated into the leachate collection system. Therefore, leachate conveyed to the evaporation pond is not likely to contain oil. This eliminates the concerns typically associated with migratory birds being endangered if the land on the evaporation ponds.

To prevent oil sheen accumulation on the surface of the ponds (19.15.36.17.C(1) NMAC), Facility personnel will work routinely during each day inspect the pond for a visible sheen. In the unlikely event that a sheen or oil is found on the evaporation pond, the following actions will be implemented. Booms will be used to bring the oil sheen to the banks of the ponds where the oil will be removed by vacuum trucks and disposed at a nearby process water treatment facility. The Facility Manager, operators and employees will conduct periodic (every fifteen minutes) inspection rounds making note of migratory bird activity in or surrounding the evaporation pond during draining. Should migratory bird activity be discovered at the Facility, inspection and scare tactic frequency will be increased to alleviate the roosting of the birds.

Operations will not lend the Facility to migratory bird congregation, with proposed operations 24 hours per day, 7 days per week, and 365 days per year. During this time truck traffic will be consistently entering and leaving the Facility, and pumps will be intermittently transferring waters to the evaporation ponds. General activities at the site will involve human and truck motion, a natural deterrent to wildlife.

In the unlikely event that a bird lands on the pond and becomes contaminated, Facility employees will immediately make efforts to retrieve the bird. Upon retrieval, Facility employees will transport the bird to a local veterinary clinic for treatment. Bird rescue procedures adapted from those of the International Bird Rescue Research Center (www.bird-rescue.org) are provided in **Attachment D.**

3.1.4 Evaporation Spray Systems

19.15.36.17.C.4 indicates that the Division may approve spray systems to enhance natural evaporation. NGL is not proposing the use of spray systems at the evaporation pond. However, should the operator decide spray systems are necessary, engineering designs for spray systems shall be submitted to the Division's environmental bureau for approval prior to installation. If used, the operator shall ensure that spray evaporation systems are operated so that spray-borne suspended or dissolved solids remain within the perimeter of the pond's lined portion.

3.1.5 Oil and Solids Separation

19.15.36.17.C.5 requires that the operator shall use skimmer pits or tanks to separate oil from leachate prior to water discharge into the evaporation pond. However, leachate discharging to the evaporation pond is not expected to contain measurable oil due to its collection through the landfill's leachate collection and recovery system. Wet wastes placed in the landfill will be dried out prior to placement and due to the nature of the wastes accepted at this facility, minimal natural leachate generation is expected. Therefore, the leachate collected will primarily be from precipitation (which is minimal in the local arid climate) that must filter through the waste mass and the liner system's protective cover before arriving at the landfill sump. If additional leachate evaporation ponds are constructed in the future, the operator shall also install a trap device in connected ponds to prevent solids from transferring from one pond to another unless approved in the surface waste management facility permit.

3.3 Below-Grade Tanks and Sumps

19.15.36.17.D(1) requires that below grade tanks be constructed with secondary containment and not be allowed to overflow. The tank materials shall be made from materials resistant to the tank's contents and sunlight. The Facility will comply with this regulation if and when a below grade tank is installed.

19.15.36.17.D(1) requires that sump integrity shall be tested annually and be repaired or replaced as necessary. The leachate evaporation pond's leak detection sump will be inspected as described in **Appendix E** of the Permit Narrative. If it is found that the sump requires repair or replacement, the operator shall pump all leachate from the landfill to a liquid waste disposal truck and taken to a permitted liquid waste treatment and disposal facility or salt water disposal well for the duration of the repair and certification.

3.4 Closure Required

19.15.36.17.E requires that the operator shall properly close pits, ponds and below-grade tanks within six months after cessation of use. The operator shall ensure that:

- Liquids are removed and disposed of in a permitted SWD for injection. Sludges and residual sediments in the ponds or pits are removed, stabilized with dry soils to pass the paint filter test, documented on a paint filter test form, and disposed of in a permitted and lined oil field waste management facility. If transported offsite, an OCD approved C-133 hauler will be used to transport any liquid, sludge or solid oilfield waste, documented with a C-138 manifest.;
- Liners can be shredded disposed of in a permitted and lined oilfield waste management facility.;
- Concrete, piping, tanks, and appurtenances shall be removed and disposed of at a permitted and lined oilfield waste management facility;
- For clarity, it is intended that all stabilized sludge and sediments, solids, liners, concrete, piping, tanks and appurtenances shall be disposed of at this permitted facility just prior to final cell closure so that transportation offsite is not required.
- Equipment associated with the surface waste management facility is removed;
- The pond subgrade is sampled, in accordance with the procedures specified in chapter nine of EPA publication SW-846, test methods for evaluating solid waste, physical/ chemical methods for TPH, BTEX, metals and other inorganics listed in Subsections A and B of **20.6.2.3103**, in accordance with a gridded plat of the pond containing at least four equal sections per Figure 3 of Appendix H of the permit application document. ; and

- Sample results are submitted to the environmental bureau in the Division's Santa Fe office.

The post-closure care period for a pond or pit shall be three years if the operator has achieved clean closure. During that period the operator or other responsible entity shall regularly inspect and maintain required re-vegetation. If there has been a release to the vadose zone or to ground water, then the operator shall comply with the applicable requirements of **19.15.29** and **19.15.30** (see Section 4.5 below).

4.0 LANDFILL SURFACE WATER MANAGEMENT

19.15.36 outlines specific requirements for run-on and run-off control systems associated with Oil Field Waste disposal areas. Landfills are required to design, construct, and maintain run-on and run-off control systems that include the following:

1. A run-on control system to prevent the flow onto the active portion of the landfill or waste processing area during the peak discharge from a 25-year, 24-hour storm;

2. A run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 25-year, 24-hour storm.

The North Ranch Oil Field Waste Landfill and Evaporation Pond (Facility) have been designed with a series of berms, ditches, and drainage conveyances to direct storm water away from and around the active disposal area. Stormwater diversion is necessary and desirable to minimize contact with waste while limiting the potential for leachate production.

The surface of the landfill will be shaped and contoured to promote proper drainage away from the landfill. A series of intermediate and internal ditches will be necessary to divert stormwater run-off from the landfill to the perimeter ditches. The final cover system will also include a series of mid-slope drainage conveyances designed to control drainage off the landfill surface while minimizing erosion. All surface water run-off will be directed to area specific no-discharge stormwater sedimentation ponds located outside the active disposal area.

4.1 Seeding

Seeding of the landfill cover on recently completed waste cells shall be conducted as per **19.15.36.18.C(2)(b).** The seed list shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains. Final cover re-vegetated with three native plant species, including at least one grass and shall be established such that at least 70% of the area is covered at the 2-year mark and then maintained through two successive growing seasons.

Upon facility closure, seeding of the pond, drying pads, truck wash, office area and remainder of site shall be conducted as per **19.15.36.18.A(6).** The seed list shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains. Final cover re-vegetated with two native grasses and shall be established such that at least 70% of the area is covered at the 2-year mark and then maintained throughout the post closure period.

Seed mixtures used in conjunction with the closure of the landfill will be applied using hydro mulching or other suitable technologies. Rolled erosion control products and other stabilization measures will be installed as needed in support of establishment of vegetation at the site.

4.2 Erosion Control Measures

Because exposed earth fill is subject to erosion, temporary and permanent erosion control measures are used to mitigate the potential for severe erosion and are part of the active maintenance program at the Landfill. In addition to seeding, other erosion control measures include, but may not be limited to, the following:

- Terracing;
- Slope drains;
- Rock-lined ditches and swales; and
- Grass-lined ditches and swales.

Temporary erosion control measures are used as necessary to reduce erosion of exposed slopes on waste disposal areas, berms, or stockpiles. Temporary erosion control measures include the following (use will depend on the time of year and the length of time it is anticipated the soil will remain exposed):

- Seeding;
- Tracking slopes perpendicular to the fall line;
- Covering with mulch;
- Terracing; and
- Diversion ditches and slope drains.

Tracking of slopes (bulldozer tracks made perpendicular to the fall line of the slope) is completed as soon as the slope is finished, regardless of the time of year. Mulching of exposed slopes is done during wet weather conditions when seeding is not possible, or in conjunction with seeding as necessary to establish vegetation. Diversion ditches and slope drains will be constructed as necessary to prevent surface water flow from eroding exposed and covered slopes as well as preventing runoff generated on surrounding land from running into the active areas of the landfill.

4.3 Sedimentation Control

The erosion control measures described in Section 4.4 will mitigate offsite sedimentation by reducing the amount of soil carried away in the runoff. Additional sedimentation controls include sediment barriers and the sediment basins discussed in Section 4.2.

4.3.1 Sediment Barriers

Sediment barriers include straw sediment logs and silt fencing. They are placed as needed during operations, and installed as necessary. They are most frequently placed below disturbed slopes to prevent silt in overland flow from reaching channels or ditches. Sediment control fences will also be constructed and maintained in the drainage channels of the active areas of the site. Sediment shall be removed to keep channels open and the soil replaced at the source as required.

4.3.2 Sediment Basins

The Facility will be equipped with temporary and permanent perimeter non-contact stormwater run-off control collection, control, and conveyance systems. These stormwater conveyances will ultimately deliver collected stormwater to one of three sedimentation ponds that are designed to prevent releases of sediment from the site. Water will be retained in the ponds and evaporated. The Facility will also have a 2-foot high berm around the perimeter and if a storm event greater than the 25-year, 24-hour design storm occurs, stormwater will back up into the bermed areas of the site within the perimeter berm system. Offsite discharge from the Facility is not anticipated.

4.4 System Maintenance Procedures

It is very important that the stormwater management system at the Facility be maintained so that it may function properly during a storm event. The following maintenance is recommended especially after large storm events.

- Keep all ditches and swales unobstructed;
- Remove sediment from ditches, swales, sediment basins, and sediment barriers routinely. Sediment controls are most effective when sediment is removed regularly;
- Inspect and clean check dams and outlet control structures of sediment and other materials that may restrict flow;
- Periodically inspect the stormwater system for damage and repair immediately; and
- Inspect and clean the stormwater system following a major storm event.

Additional inspection and maintenance requirements and procedures are included in the Facility Inspection and Maintenance Plan (see **Appendix E** of the permit narrative)

4.5 Emergency Procedures and Contingency Action

If necessary, immediate action will be taken to control damage by constructing physical barriers or channeling flows away from critical structures. Onsite drainage structures will be immediately repaired and returned to service. Any contaminated surface water or soils will be removed if it is determined to be necessary. Pursuant to ***19.15.36.8.C(10)***, the applicant is required to develop and implement a contingency plan in the event of fire or other emergency situations. The North Ranch Landfill has developed an emergency response contingency plan that is included in **Appendix F** of the PA narrative.

Pursuant to ***19.15.36.13K***, the operator will also comply with the spill reporting and corrective action provisions of **19.15.29** and **19.15.30**. In accordance with **19.15.29**, the operator will report unauthorized releases of oil, gases, produced water, condensate or oil field wastes, including regulated NORM or other oil filed related chemicals, contaminants or mixtures of those chemicals or contaminants during receiving and disposal operations. Notifications will go to the NMOCD and will include the content required by **19.15.29.10** and that content required by other spill prevention environmental plans held by the Facility, such as the SPCC Plan. **Attachment C** contains regulations **19.15.29** and **19.15.30**.

19.15.30 requires that the responsible party abate pollution of subsurface water so that ground water of the state that has a background concentration of 10,000 mg/l or less TDS is either remediated or protected for use as domestic, industrial and agricultural water supply, and to remediate or protect those segments of surface waters that are gaining because of subsurface-water inflow for uses designated in the water quality standards for interstate and intrastate surface waters in New Mexico, 20.6.4 NMAC; and abate surface-water pollution so that surface waters of the state are remediated or protected for designated or attainable uses as defined in the water quality standards for interstate and intrastate surface waters in New Mexico, 20.6.4 NMAC. The responsible party will abate the contaminants in accordance with the regulation under an approved abatement plan.

5.0 LANDFILL GROUNDWATER, VADOSE ZONE, & GAS MONITORING

5.1 Groundwater Monitoring

19.15.36.14.B requires that if fresh groundwater exists at a site, the operator shall establish a groundwater monitoring program at the Facility that is approved by the Division's Environmental Bureau. Groundwater was not found to be present within approximately 165 feet below the ground surface at the Oil Field Waste landfill footprint when characterized by borings in accordance with the boring plan submittal for landfill siting for the Facility, formerly known as McCloy Ranch Landfill. **Appendix I** shows the locations of the wells in relation to the landfill operations. Groundwater monitoring is not proposed for the Facility.

5.2 Vadose Zone Monitoring

Installment of vadose zone monitoring is proposed for the facility. When vadose zone monitoring wells are placed, they may secondarily be used for confirmatory explosive gas monitoring should such monitoring be required in the future. See the Vadose Zone Monitoring Plan provided as **Attachment B of Appendix E** of the Facility Permit Application Document.

5.3 Explosive Gas Control Monitoring

Significant landfill gas generation may be expected for wastes high in organics, such as municipal solid waste. Oil field wastes are not expected to contain significant amounts of organics. Considering the type of waste and the low availability of moisture in the arid desert climate at the Facility, no landfill gas monitoring is proposed. It is not expected that the limited landfill gas generation setting for the Oil Field Waste landfill will cause generation rates or pressure gradients at the point of generation that will interfere with landfill operations or cause an impact on fresh water, public health, and the environment. Facility buildings, such as the administration building, will be constructed with precautionary passive vapor mitigation systems consisting of a spray applied asphaltic membrane/geomembrane composite underlain by a low-profile gas vent system vented at the roof. Continuous monitoring for H2S gas is proposed for the administration building and any future occupied structures at the Facility.

6.0 LANDFILL LEACHATE COLLECTION AND TRANSMISSION

The Landfill has been designed to include a leachate collection and removal system, in accordance with **19.15.36.14.C(5)**. The design of the leachate collection system associated with the Oil Field Waste disposal area includes a lateral drainage layer and a series of pipes, sumps, and pumps designed to remove leachate from the waste mass to prevent buildup of leachate head on the liner system. Once the leachate is collected, it is pumped to the on-site evaporation pond as illustrated on the Permit Drawings in **Appendix K**. Diluted leachate may be reused as dust control over lined or future lined areas as provided in **Section 2.1.4.**

In general, wet wastes placed in the landfill will be dried out prior to placement and free liquids and/or liquids mobilization is not expected to occur once places. Further, due to the nature of the oil field wastes accepted at this facility (i.e. inorganic, non-putrescible, minimal natural leachate generation is expected. Therefore, the leachate collected will primarily be from precipitation, which is minimal in the local arid climate. Stormwater that comes in contact with waste material (i.e., working face) will be managed and treated as leachate. In addition, water that percolates through existing waste areas will be collected and managed as leachate. Stormwater not incidental to the active area and exposed slopes, will be separated from leachate by utilizing temporary diversion ditches and berms to divert drainage away from and/or around the active disposal operations.

All cells of the Oil Field Waste Landfill have sump pumps and side slope risers that serve as the regulator for the level of leachate in the waste disposal cells. The sump pumps are designed to turn on when the leachate in the sump reaches a level that would cause at least 12 inches of leachate to be present on the bottom liner. A Leachate Management Plan is presented as **Appendix G** of the permit narrative.

7.0 LANDFILL INSPECTION AND MAINTENANCE

The Inspection and Maintenance Plan is presented in **Appendix E** of the permit narrative.

8.0 HEALTH AND SAFETY

8.1 Introduction

8.1.1 General

The primary purpose of this section is to provide guidance to help prevent personal injuries or illnesses that could be caused by conditions typically found at Oil Field Waste landfill facilities. It is not the intent of this section to establish a comprehensive safety program for the North Ranch employees or contractors; but rather to augment the existing program with awareness of special hazards related to the Oil Field Waste landfill. Unless otherwise authorized by North Ranch and the NMOCD, all on-site contractors and Facility personnel shall refer and adhere to the North Ranch Landfill Contingency Plan requirements (see **Appendix F** of the permit narrative).

8.1.2 Reporting and Investigation of Accidents and Illnesses

Accidents must be reported PROMPTLY to the employee's immediate supervisor and the Solid Waste Management Facility Manager for evaluation and/or investigation. Immediate reporting is mandatory not only to comply with applicable laws and regulations, but also to ensure that steps are taken to correct the conditions that contributed to the accident. Since every accident includes a sequence of contributing factors, it is possible to avoid a repeat of the first event by recognizing and eliminating these factors. The removal of just a single factor could prevent a recurrence. Reporting procedures should be in compliance with the Facility Contingency Plan emergency procedures.

8.2 Potential Hazards

The North Ranch Landfill personnel work in all types of weather, with different types of heavy equipment, and with a variety of materials presenting diverse hazards. For this reason, safety equipment must be used and maintained in a sanitary and reliable condition. Personal protective equipment (for eyes, face, head, hearing, and extremities), protective clothing, respiratory devices, and other protective equipment must be worn whenever hazards of processes or environment are capable of causing injury.

8.3 Hazard Abatement

The following procedures, guidelines, and recommendations represent standards in the solid waste disposal industry presently in use to mitigate or eliminate the various safety and health hazards that may exist at the Oil Field Waste Landfill Facility.

8.3.1 Traffic Control

To prevent unnecessary traffic in and around the working face, trucks will be directed to dump waste only in designated areas.

8.3.2 Personal Protective Equipment

Facility personnel shall refer to the Facility Contingency Plan for personal protective equipment requirements.

8.3.3 Operations Safety

Transporting and unloading solid waste is a serious area of safety concern. Uncontrolled dust, differing flows and direction of traffic and operational equipment, and equipment operation angles pose dangers to those in the vicinity of the working face. For these reasons, safeguards will be provided on Oil Field Waste Landfill equipment to protect the operator and the vehicle. Operating personnel who direct the placement of the delivery vehicles must take care to maintain sufficient clearance between the vehicle and the equipment. Normal safety precautions will be exercised while operating or working in the vicinity of heavy equipment. General public traffic will be prohibited from the landfill working face area.

8.3.4 Fire Prevention and Control

Soil material is available at the site and will be used, if necessary, for controlling landfill fires. In the event of a fire, fire control measures, such as soil and landfill equipment, are available at the landfill. Additional measures include fire extinguishers (administration building and landfill equipment), and a water truck. In the event the fire cannot be controlled by onsite means, the Facility will notify the local fire department in accordance with the Contingency Plan located in **Appendix F** of the permit narrative. In event of a fire, as per 19.15.29.10.A(1), the NMOCD environmental bureau chief and the appropriate division district office will be notified verbally or by e-mail within 24 hours of discovery of the release.

8.3.5 Contaminant Releases

Liquid byproducts and contaminated water caused by precipitation percolating through the waste, as well as contaminated soil cover materials that run off during periods of wet weather are a potential hazard. In the event of a leachate seep or other type of contaminant release, the Landfill personnel will:

- Take immediate action to stop, contain, and clean up any unauthorized discharge;
- Take all reasonable steps to minimize adverse impacts to waters of the state and correct the problem; and
- Notify the NMOCD with the necessary information described in **Section 4.5 or 9.0** of this Plan, as applicable.

8.4 Emergency Procedures

The emergency conditions discussed in this section are general. It is not intended to cover every possible emergency situation. The Oil Field Waste Landfill personnel must be constantly aware that problems may arise. In addition, the list of important phone numbers should be kept at the Oil Field Waste Landfill administration building and should be updated regularly. Facility personnel, when necessary, will provide emergency telephone numbers.

8.5 Handling of Unacceptable Wastes

Only wastes described in the permit and current Operating Plan are allowed for disposal at the Oil Field Waste Landfill. Any wastes other than the approved wastes shall be approved by the NMOCD before placement in the landfill.

9.0 RECORDKEEPING AND REPORTING

9.1 Landfill Permanent Operating Record (POR)

The North Ranch SWMF has in place a POR in place to satisfy permit requirements. All information contained in the Facility POR is available for inspection and is provided to the NMOCD upon request. The Facility will maintain these records until the NMOCD authorizes the destruction of the records following the completion of the post-closure care monitoring period. The POR includes the following information if applicable:

- Permit information, regulations, and operator requirements;
- Siting restriction demonstrations;
- Groundwater/Vadose Zone monitoring and gas monitoring data and reports;
- Leachate analytical data and disposal documentation;
- Operational plans and programs;
- Inspection records, training procedures and records, and notification procedures;
- Design demonstrations;
- Geotechnical and hydrogeological information;
- Any reports and testing data related to final closure of areas;
- Financial assurance documentation; and
- Quality assurance/quality control documentation, certification, and test results relating to the construction of the Landfill and Evaporation Pond liner systems, leachate collection system and final cover system, waste drying pads, and truck wash pads

9.2 Inspection Log

Inspections of the overall site, facilities, and operations are carried out on a routine basis. Inspections are performed often enough to identify problems in time to correct them before they harm human health or the environment. Inspections also prevent malfunction, deterioration, and operator error from affecting the performance of the facilities and operations.

The frequencies of inspections are noted on the inspection checklist (Operations Inspection Forms are located in **Appendix E** – Inspection and Maintenance Plan of the permit narrative). Inspections are also carried out after any major storm event or natural disaster. The inspection checklist will be kept in the POR and will be made available to the NMOCD on request.

9.3 Reports

9.3.1 Waste Acceptance Records

The records include the weight and description of solid waste that has been disposed at the Landfill. Copies of waste acceptance records will be maintained in the Facility POR for 5 years post-closure. (See also section 2.11)

9.3.2 Monitoring Results

Records of monitoring activities and results are submitted to the NMOCD, as required, and will be maintained in the Facility POR until destruction of the records is authorized by the NMOCD following completion of the post-closure care monitoring period.

9.4 Incident Reports

9.4.1 Emergency Reports

The Facility will submit a written report to the NMOCD district office for the area within 48 hours after an emergency has occurred at the landfill Facility. The report will describe the emergency and the actions taken to minimize hazards to human health and the environment. The report will also outline any follow up procedures that will be implemented. Emergencies include fires, explosions, storm damage, and any other events requiring the prompt intervention of Facility personnel, police, fire department, or other public health and safety officials.

9.4.2 Notifying Government Agencies

In the event that the Facility does not, or is unable to, comply with any of the conditions specified in the Facility's operating permit and **19.15.36**, the North Ranch SWMF will do the following:

- Provide the NMOCD with a description of the nature and cause of noncompliance;
- Inform the NMOCD of the period of noncompliance, including exact dates and times and/or the anticipated time when the Facility will return to compliance;
- Notify the NMOCD of steps taken or to be taken to reduce, eliminate, and prevent recurrences of the noncompliance; and
- Take the first three actions listed above within 24 hours in the case of any noncompliance that could constitute a threat to human health, welfare or the environment, and, if the requisite information is provided orally, provide it in writing within five (5) days, unless this requirement is waived or extended by the NMOCD on a case-by-case basis.

8'

4'

R360 Antelope Draw LLC

SURFACE WASTE MANAGEMENT FACILITY
OIL CONSERVATION DIVISION PERMIT NO. NM 1-66
Sections 9 and 10, T25S, R34E

HOURS OF OPERATION: 24 HOURS PER DAY - 7 DAYS PER WEEK

SITE RESTRICTIONS:
NO Hazardous waste
NO Scavenging
NO Smoking
NO Fires
NO Disposal after hours
NO Trespassing - authorized personnel only

FOLLOW SITE RULES
Check - in at Administration building
OBEY Posted Speed Limits
OBEY Signs and Traffic Barriers
OBEY Instructions by Site Staff
Loads Subject to Inspection
Unload Only as Directed
Untarped Loads May Be Penalized

EMERGENCY CONTACT (24 HOURS): 575-263-6959 OR 911

OCD: 575-626-0830 LEA COUNTY EMERGENCY: 575-605-6561

3" MIN. LETTERING HEIGHT

N:\GECARCHIVE\CAD\572\002\MCCLOY\PERMIT TEXT FIGURES\OPERATING PLAN\FIG1 SITE ENTRANCE SIGN.DWG

Project Mngr:	MPB	Project No.	35187378
Drawn By:	DEW	Scale:	AS SHOWN
Checked By:	MPB	File No.	572/002
Approved By:	FOC	Date:	3/30/2019

Terracon
Consulting Engineers and Scientists
25809 INTERSTATE 30 S BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (501) 847-2910

SITE ENTRANCE SIGN
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. No.
1

Received by OCD: 8/14/2024 8:48:23 PM

R360 ANTELOPE DRAW LLC
E & P WASTE LANDFILL &
EVAPORATION POND

LEA COUNTY, NEW MEXICO

OIL CONSERVATION DIVISION PERMIT NO. NM-1-66

REV.	DATE	BY	DESCRIPTION

Terracon
Consu t ng Eng neers and Sc ent sts
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

TYPICAL SITE SIGNS
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. 2

DESIGNED BY:	DEW
DRAWN BY:	DEW
APPVD. BY:	FOC
SCALE:	AS SHOWN
DATE:	03/30/2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	X OF X

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ATTACHMENT A

Management Plan
Approved Oil Field Wastes

Management Plan
Approved Oil Field Wastes

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 2019 (Modified April 2023)
Project No. 35187378

Modified by:
NGL Waste Services, LLC
1008 Southview Circle
Center, TX 75935
(936)598-8587

Table of Contents

List of Exhibits

1.0 INTRODUCTION

1.1 Purpose, Scope, and Applicability

This document details how oil field solid wastes will be managed at the NGL North Ranch Surface Waste Management Facility (SWMF or Facility) located near Jal, Lea County, New Mexico.

1.1.1 Relationship to Other Facility Documents

This document is included as **Attachment A** to the Facility Operating Plan and may be used in conjunction with the Operating Plan and its ancillary components to properly handle and manage solid wastes at the Facility.

2.0 WASTE MANAGEMENT PLAN

2.1 Gate Receipt of Oil Field Solid Waste

Waste generators shall request approval for the Facility to accept their solid waste by submitting generator and waste profile information using the Shipping Manifest, incorporating the information required as per NMOCD Form C-138. A blank copy of the Shipping Manifest is presented in **Exhibit A** at the end of this document. Wastes will only be received at the Facility when the entrance gate is open and there is an operator/attendant present at the administration building to receive wastes.

2.2 Measurement of Gate Receipts

Oil field waste trucks will be directed to park adjacent to the administrative building. Tickets are issued to customers, including commercial in-state and out-of-state oil field waste haulers. Volumes as stated by the waste generator are used to determine the amount of material received. Solid waste volumes are compiled and entered into the permanent operating record (POR) quarterly. Landfill airspace utilization will periodically be entered into the POR.

The NGL North Ranch commercial facility shall maintain records of all Shipping Manifests reflecting the generator, the location of origin, the location of disposal within the commercial facility, the volume and type of oil field waste, the date of disposal and the hauling company for each load or category of oil field waste accepted at the commercial facility. The operator shall maintain such records in the POR, subject to NMOCD inspection. A blank Shipping Manifest form is provided in **Exhibit A**.

2.3 Waste Screening

Upon entry into the NGL North Ranch SWMF, and at the time of weighing of wastes, facility personnel will screen the wastes in accordance with procedures set forth in the Operating Plan and Hazardous and Unauthorized Waste Exclusion Plan (See **Attachment B** for the HUWEP). Screening is implemented to detect and prevent the disposal of regulated hazardous wastes, NORM, liquid wastes and additional unauthorized wastes.

Those wastes included in Operating Plan Section 2.15.4 – Eligible Wastes will be accepted for disposal in the E&PW landfill. At the Owner's discretion, oil field waste containing free liquids may be placed on drying pads for evaporation of liquids and/or for mixing with bulking soils or absorbents at the locations indicated in the Permit Drawings in **Appendix K**. Evaporation and/or absorption of free liquids will be confirmed using visual inspection and random paint filter tests prior to landfill disposal of the materials from the drying pads

2.4 Waste Haul Route Directions

Facility personnel will direct waste haulers with eligible wastes to the temporary and/or permanent haul route being used for deposition of oil field wastes that day. Waste haulers must follow routes and directions as directed by the Facility operator.

2.5 Unloading of Oil Field Solid Waste

Waste haulers must off-load wastes at the location indicated by Facility operations personnel at the current working face or drying pads. The operator will supervise the unloading and dumping at the site. Once waste is deposited as directed, haulers will return by the designated route to the outbound scale for tare weight if required.

2.6 Working Face Size

The Facility will limit waste disposal to the smallest practical area and compact the oil field waste to the smallest practical volume.

2.7 Access Requirements

The NGL North Ranch SWMF has only one public access for vehicular traffic located at the northeastern corner of the site. The administration building is located in-route upon entry into the site. As required by NMAC **19.15.13.I** a fence has been installed around the perimeter of the SWMF to control unauthorized access to the premises. The fence is constructed of 4 strands of barbed wire. Public traffic is prohibited from entering the property.

2.8 Periodic and Intermediate Cover

Waste will be covered on an as needed basis with at least six inches of soil, or an NMOCD approved alternative cover material, to control dust, debris, odors, vectors, and other potential nuisances. Cover soil material will be obtained from on-site borrow areas located throughout the landfill property. Any active area that does not receive waste or final cover for more than 30 days will be covered with an intermediate cover system that consists of at least 12 inches of onsite soils (including periodic cover). More information on daily/intermediate cover can be found in Section 2.1.6 of the Operating Plan.

2.9 Waste Filling Operations

Typically, waste disposal and fill progression in the E&PW Landfill will proceed from the lowest point in each cell or prepared area to the highest. A prepared area will be filled in lifts until the maximum design grades and/or slopes are reached (minus the final cover thickness). Waste will be spread and compacted per the Operating Plan. Normally, waste will be deposited in layers or lifts that generally will not exceed 10-15 feet in compacted thickness. Interior waste slopes will generally not exceed 3:1 (horizontal: vertical) with final slopes not exceeding 4:1. The top of each lift shall be graded to drain to the perimeter run-off control system at a minimum grade of 4%.

Waste loads will generally be deposited at or near the top or toe of the active working face, except as indicated below for the case of waste placement in a new cell. A waste compactor or large bulldozer will push the waste up or down the working face slope while evenly spreading the material. The waste compactor or dozer will then traverse the waste slope (both parallel and perpendicular to the slope if feasible) several times until the waste is compacted to the extent possible and practical. The number and orientation of compactor or dozer passes will vary depending on the type of compactor or dozer used, slope of the active working face, waste characteristics, and other factors.

The operator shall not use equipment that may damage the integrity of the liner system in direct contact with a geosynthetic liner. The design of the E&PW Landfill includes a leachate collection and removal system aggregate and a protective layer designed to provide separation and protection for the critical underlying liner/leachate collection system components.

The placement of the initial waste or first lift in a prepared area requires additional care and caution to avoid damage to the underlying liner and/or leachate collection systems. Generally, the only vehicles that should travel on the working surface/protective cover surface are pickup trucks, waste collection vehicles, trucks/trailers, and low ground pressure equipment. At no time shall waste compactors be allowed directly on the protective cover/working surface. Waste loads placed during initial development of a new cell will always be from the toe upward to the crest over the top of the leachate collection system protective cover. Once the initial 10-15 feet thick lift is placed and compacted over the protective cover, waste may be placed from the top or toe as indicated above.

EXHIBIT A

Shipping Manifest

NEW MEXICO NON-HAZARDOUS OILFIELD WASTE MANIFEST
(PLEASE PRINT)

Company Man Contact Information
Name ___________
Phone No. ___________

GENERATOR

NO.

Oper. Manifest #:		Location of Origin	
Operators Name		Lease/Well Name & No.	
Address		County	
		API No.	
City, State, Zip		Rig Name & No.	
Phone No.		AFE/PO No.	

EXEMPT E&P Waste/Service Identification and Amount (place volume next to waste type in barrels or cubic yards)

Oil Based Muds	______	NON-INJECTABLE WATERS		OTHER EXEMPT E&P WASTE STREAMS	
Oil Based Cuttings	______	Washout Water (Non-Injectable)	______		
Water Based Muds	______	Completion Fluid/Flow back (Non-Injectable)	______		
Water Based Cuttings	______	Produced Water (Non-Injectable)	______		
Produced Formation Solids	______	Gathering Line Water/Waste (Non-Injectable)	______		
Tank Bottoms	______	INTERNAL USE ONLY		TOP SOIL & CALICHE SALES	
E&P Contaminated Soil	______	Truck Washout (exempt waste) YES NO		QUANTITY	TOP SOIL CALICHE
Gas Plant Waste					

WASTE GENERATION PROCESS: ☐ DRILLING ☐ COMPLETION ☐ PRODUCTION ☐ GATHERING LINES

NON-EXEMPT E&P Waste/Service Identification and Amount
All non-exempt E&P waste must be analysed and be below the threshold limits for toxicity (TCLP), Ignitability, Corrosivity and Reactivity.

Non-Exempt Other ________________________________ **please select from **Non-Exempt Waste List** on back*

DISPOSAL QUANTITY B - BARRELS L - LIQUID Y - YARDS E - EACH

I hereby certify that according to the Resource Conservation and Recovery Act (RCRA) and the US Environmental Protection Agency's July 1988 regulatory determination, the above described waste load is (Check the appropriate classification)

☐ RCRA EXEMPT: Oil field wastes generated from oil and gas exploration and production operations and are not mixed with non-exempt waste (R360 Accepts certifications on a per load basis only)

☐ RCRA NON-EXEMPT: Oil field waste which is non-hazardous that does not exceed the minimum standards for waste hazardous by characteristics established in RCRA regulations, 40 CFR 261.21-261.24, or listed hazardous waste as defined by 40 CFR, part 261, subpart D, as amended. The following documentation demonstrating the waste as non-hazardous is attached. (Check the appropriate items as provided)

☐ MSDS Information ☐ RCRA Hazardous Waste Analysis ☐ Other (Provide Description Below)

____

☐ EMERGENCY NON-OILFIELD: Emergency non-hazradous, non-oilfeild waste that has been ordered by the Department of Public Safety (the order, documentation of non-hazardous waste determination and a desciption of the waste must accompany this form)

(PRINT) AUTHORIZED AGENTS NAME DATE SIGNATURE

TRANSPORTER

Transporter's Name		Driver's Name	
Address		Print Name	
Phone No.		Phone No.	
Trans. Ticket #		Truck No.	

I hereby certify that the above named material(s) was/were picked up at the Generator's site listed above and delivered without incident to the disposal facility listed below.

SHIPMENT DATE DRIVER'S SIGNATURE DELIVERY DATE DRIVER'S SIGNATURE

TRUCK TIME STAMP
IN: ____________ OUT: ____________

DISPOSAL FACILITY

RECEIVING AREA
Name/No.

Site Name/ Permit No.	**Antelope Draw Facility - Permit #**	Phone No.	575-236-1734
Address	476 Battle Axe Rd. , Jal, NM 88252		

NORM READINGS TAKEN? (Circle One) YES NO If YES, was reading > 99 micro roentgens? (circle one) YES NO

PASS THE PAINT FILTER TEST? (Circle One) YES NO

TANK BOTTOMS

	Feet	Inches
1st Gauge		
2nd Gauge		
Received		

BS&W/BBLS Received		BS&W (%)	
Free Water			
Total Received			

I hereby certify that the above load material has been (circle one): ACCEPTED DENIED If denied, must be maintained as permanent record. Why denied?____________

NAME (PRINT) DATE TITLE SIGNATURE

Generator – to be completed by the generator of the waste in transit

Company man contact information – Provide the rig manager's name and number
Operator's Name – Provide the name of the company from which the waste originates
Address, City, State, Zip – Business address for the generator company
Phone No. – Provide a phone number where the generator company can be reached
Permit/RRC No. – Provide the Railroad Commission permit number
Lease/ Well Name & No. – Provide the name of the lease/well name and number. If offshore, provide the OCS number
County – Provide the county at which the waste was generated in. If offshore, provide the Field name and Block number.
API No. – Provide the American Petroleum Institute number; may contain up to 14 digits
Rig Name & No. – Provide the name of the drilling contractor and the well number and well name
AFE/PO No. – Provide either the Authorization for Expenditure (AFE) number or the Purchase Order (PO) number

Origination of waste – Check the option that best describes where the waste originates from

Drilling – Waste generated while drilling the well
Initial Completion – Waste generated on the original completion (for re-completions see **Production**)
Production – Waste generated during the production life of the well (i.e., work overs, re-completions, hydraulic fracturing, gas plant treatment, etc.)
Commercial Facilities – Waste that is *generated* at commercial facilities (i.e., Refineries, SWD Wells, Compressor stations, Transfer stations, etc.)
In Transit – Waste which is spilled while in transit; NOT to include well gathering lines or field gathering lines; to include contaminated material resulting from the spill (typically trucking, post-production pipelines, or barges)

Transporter – To be completed by the waste hauler/transporter in the presence of the generator

Transporter name – Provide the company name that is transporting the waste
Address – Business address for the transport company
Driver's Name – Provide the first and last name of the driver hauling the waste
Phone No. – List the phone number at which the transport company can be reached
WHP No. – List the Waste Hauler's Permit Number associated with the truck that is hauling the material

Waste Categories

Exempt E&P Waste

Oil Based Mud
- Oil Based Drilling fluids
- Off Shore Oil Based Drilling fluids

Oil Based Cuttings
- Oil Based Drill cuttings
- Offshore Oil Based cuttings

Water Based Mud
- Water Based Drilling fluids
- Offshore Water Based Drilling fluids

Water Based Cuttings
- Water Based Drill cuttings
- Offshore Water Based cuttings

Produced Formation Sand and Solids
- Hydrogen sulfide abatement wastes from geothermal energy production
- Workover wastes
- Produced sand
- Constituents removed from produced water before it is injected

Tank Bottoms
- Basic sediment, water, and other tank bottoms from storage facilities that hold product and exempt waste
- Pit sludges and contaminated bottoms from storage or disposal of exempt wastes
- Accumulated materials such as hydrocarbons, solids, sands, and emulsion from production separators, fluid treating vessels, and production impoundments
- Constituents removed from produced water before it is injected or otherwise disposed of
- Liquid hydrocarbons removed from the production stream but not from oil refining
- Waste crude oil from primary field operations

E&P Contaminated Soil
- On-Lease oil spill

Wash Out Water
- Rigwash
- Cooling tower blowdown

Completion Fluids/Flowback
- Well completion, treatment, and stimulation fluids, and frac proppant
- Packing fluids

Produced Water
- Produced water
- Geothermal Production Fluids
- Materials ejected from a producing well during blowdown

Gathering Line Water/Waste
- Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation
- Pigging wastes from gathering lines

Gas Plant Waste
- Gas plant dehydration wastes, including glycol-based compounds, glycol filters, and filter media, backwash, and molecular sieves
- Gas plant sweetering wastes for sulfur removal, including amines, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge
- Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream)
- Wastes from subsurface gas storage and retrieval, except for the non-exempt wastes

Non-Exempt E&P Waste

All non-exempt oil & gas waste must be analyzed for and be below the threshold limits for Toxicity (TCLP Metals), Ignitability, Corrosivity and Reactivity.

www.epa.gov/osw/hazard/wastetypes/characteristic.htm

- Unused fracturing fluids or acids
- Gas plant cooling tower cleaning wastes
- Oil and gas service company wastes such as drum rinsate, sandblast media, painging wastes, spent solvents, spilled chemicals, and waste acids
- Vacuum truck and drum rinsate from trucks and drums transporting or containing non-exempt waste
- Non-Exempt E&P liquid and solid wastes generated by crude oil and tank bottom reclaimers
- Waste compressor filters and blowdown
- Non-Exempt E&P waste in transportation pipeline related pits
- Caustic or acid cleaners
- Boiler cleaning wastes
- Boiler scrubber fluids, sludges, and ash
- E&P Contaminated Soil
  - Transportation spill of post-production oil and gas

ATTACHMENT B

Hazardous and Unauthorized Waste Exclusion Plan

Hazardous and Unauthorized Waste Exclusion Plan

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 2019 (Modified May 2023)
Project No. 35187378

Modified by:

NGL Waste Services, LLC
1008 Southview Circle
Center, TX 75935
(936) 598-8587

Table of Contents

LIST OF EXHIBITS

1.0 PURPOSE

The purpose of this Hazardous and Unauthorized Waste Exclusion Plan (HWEP) is to provide procedures for solid waste acceptance at the North Ranch E&P Waste Landfill Facility (Facility), in accordance with the current New Mexico Administrative Code Rules [Energy, Minerals and Natural Resources Department, Oil Conservation Division (NMOCD, OCD or Division), effective date June 30, 2016 2007]. This HWEP provides pre-acceptance procedures for E&P wastes to determine the acceptability of a waste pursuant to Facility permit conditions, operational capabilities and state and federal regulations. This program is designed to monitor incoming waste loads and verify that it agrees with the pre-acceptance waste conditions and the provisions of the Facility permit issued by the OCD. It should be noted that throughout this HWEP the references to *New Mexico Administrative Code (NMAC)* are noted as **19.15.36.XX**.

This plan includes at a minimum:

- Purpose of monitoring and roles of landfill personnel;
- Types of wastes to be excluded;
- A written protocol that describes the methods to identify and screen potentially hazardous waste and other unauthorized wastes before it enters the landfill including the review of industrial customer's procedures for separating hazardous waste and other unauthorized wastes from other wastes. The written protocol shall describe the procedures, evaluation criteria, testing requirements and decision making process that will be followed to determine whether to accept or reject industrial or process waste for disposal before it enters the landfill;
- Sampling and analysis procedures to be followed for new customers and for periodic re-testing of existing customer wastes. Testing laboratories shall be certified by the Department;
- Random inspection procedures and documentation;
- Personnel training to be provided;
- Recordkeeping requirements; and
- A contingency procedure, that includes notification procedures, and remedial actions to be taken when hazardous waste and other unauthorized wastes are identified.

Hazardous Wastes are defined by the Federal government under the Resource Conservation and Recovery Act (RCRA) and subsequent amendments. This plan shall define a procedure for the rejection and removal of any waste determined unacceptable, whether pre or post disposal, by the Facility, to comply with Federal or State of New Mexico Rules and Regulations for disposal in the E&PW Landfill.

2.0 TYPES OF WASTE TO BE EXCLUDED

19.15.36 allows for the disposal of all eligible wastes that are Exempt oil field wastes or Non-exempt, non-hazardous oil field wastes containing no free liquids and no regulated NORM**.** Non-hazardous oil field waste materials must be characterized by the generator of the waste prior to acceptance for disposal in the landfill in accordance with the Facility written hazardous waste exclusion program. Generators of exempt oil field wastes, or their authorized agent, shall provide signed documentation that the oil field wastes are generated from oil and gas exploration and production operations, are exempt waste and are not mixed with non-exempt waste as certified on the Shipping Manifest, incorporating information required as per NMOCD form C-138 (see form in **Exhibit A**). Generators of Non-exempt, non-hazardous oil field wastes shall provide documentation that the waste has been characterized, sampled and laboratory tested for ignitability, corrosivity, reactivity and toxicity characteristics in addition to the Shipping Manifest. If the materials show characteristics of a hazardous waste, it shall not be accepted. All wastes require specified written authorization in a Shipping Manifest prior to acceptance at the Facility. Any waste, not encompassed by the definitions of Exempt oil field waste or Non-exempt, non-hazardous oil field waste, should be excluded from disposal at the Facility, with the following exception - the operator may accept non-hazardous, non-oil field wastes in an emergency if ordered by the Department of Public Safety. The operator shall complete a Shipping Manifest, oil field waste document, describing the waste, and maintain the same, accompanied by the Department of Public Safety order, subject to Division inspection.

A non-exempt oil field solid waste should be considered hazardous if it is listed in Subpart D – Lists of Hazardous Wastes of **40 CFR §261**. Exempt oil field wastes have been excluded from that subpart under **40 CFR Section 261.4 (b)(5)** Exclusions. **Section 2.15.4** of the Operating Plan lists exempt E&P wastes. A copy of Subpart D – Lists of Hazardous Wastes has been included as **Exhibit B** to this HWEP. Hazardous wastes shall not be accepted for disposal at the Facility.

Liquid Waste is currently defined in **19.15.36.13.E** as any waste material that is determined to contain "free liquids" as defined by Method 9095 (Paint Filter Liquids Test), described in "Test Methods of Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Pub. No. SW-846). All future updates or revisions to the Paint Filter Liquids Test shall be incorporated into this plan by reference. Wastes which fail the paint filter test (i.e. contain free liquids) shall not be immediately disposed of in the landfill. Liquid wastes may be placed on one of the proposed concrete waste drying pads to allow the waste to dry. Wastes placed on a drying pad will be managed until such a time that it can pass a paint filter test, at which point it will be taken to the active disposal area. The results of Paint Filter Tests shall be recorded on a form such as the Paint Filter Test Form located in **Exhibit C**.

Regulated NORM as defined in **19.15.35.9** and **20.3.14.1403** will be excluded by surveying loads for a twice background maximum threshold exceedance. From **20.3.14.1403 (A)**, Samples should be taken if gamma radiation readings (mR/hr) are equal to or exceed twice background readings when surveyed at a distance of 1 cm from the surface of the soil. The facility background reading has been determined to be 49.5 mR/hr, from an average of 4 readings at a distance of 100', in the north, south, east and west directions from facility office and . The regulated NORM exclusion maximum threshold is therefore 99 mR/hr.

3.0 IDENTIFICATION AND SCREENING PROTOCOLS

Pre-acceptance procedures are put it place to determine whether to accept or reject a particular waste before it is disposed of in the landfill. If the waste is classified as either (1) a non-exempt hazardous waste, (2) a waste containing free liquids, (3) regulated NORM or (4) as an un-permitted waste, it shall not be accepted for disposal at the Facility. The procedures are based on the Facility permit and the current state and federal regulations on waste classification. The pre-acceptance protocols also state what information a waste generator must provide to the Facility in order to determine the acceptability of a particular waste for disposal. Oil field wastes may be accepted under the pre-acceptance procedures if the waste generator can provide the documentation mentioned in Section 2.0 Types of Wastes to be Excluded. The documentation and approval procedures used during the pre-acceptance of an applicable waste are outlined below.

The program for detecting and preventing the disposal of regulated hazardous wastes as defined in Section 2.0 Types of Waste to be Excluded includes the following:

- Inspections of incoming waste loads
  - Visual observation of incoming waste shipments by a trained individual(s);
  - Monitoring for hydrogen sulfide using a H_2S monitor at the administration building;
  - Minimum random inspection frequency as described in Section 5.0 Random Inspection Procedures; and
  - Special attention given to shipments from new oil field waste generators.
  - Verification that exempt oil field waste is not mixed with non-exempt oil field waste as required by **19.15.36.13.F(1)**
- Record-keeping Procedures
  - Documentation of questionable wastes identified, and
  - Record maintenance required during the life of the Facility and the 30-year post closure care period.
- Training
  - Employee training to address identification, handling, and safety associated with hazardous materials or regulated NORM, and
  - Documentation of training certification maintained in the Facility permanent operating record.
- Notification
  - Notification to the OCD if a regulated hazardous waste or regulated NORM is discovered at the Facility.

The generator of Exempt oil field wastes; Non-exempt, non-hazardous, oil field wastes; and Emergency non-oil field wastes must provide a completed Shipping Manifest to the operator for review and signature before the waste will be considered for landfilling. The signed documentation form (Shipping Manifest, **Exhibit A**) must contain the following information:

- Generator name and address;
- Facility address of site generating waste;
- Contact name of the party responsible;
- Name of the disposal Facility;
- Quantity of waste to be disposed of at the Facility; and
- Characterization of the type of waste including:
  - Name of the type of waste;
  - Process generating the waste;
  - Special handling instructions; if required;
  - Pertinent physical, chemical and shipping information;
  - Analytical testing information, if appropriate; and
  - Certification that the waste is RCRA exempt or Non-exempt, non-hazardous oil field waste and does not contain regulated NORM or radioactive materials.

Non-exempt oil field wastes shall require testing for the hazardous characteristics of ignitability, corrosivity, reactivity, and toxicity (40 CFR 261.21-24) prior to acceptance of the waste, or documented process knowledge which confirms that the waste is not a characteristic or listed hazardous waste as defined by federal regulations. Regulated NORM as defined in **20.3.14** will not be accepted, as noted in section 2.0 above. New customers requesting disposal of Non-exempt oil field wastes shall provide analytical testing in accordance with this paragraph prior to delivery of initial wastes for disposal. Periodic re-testing of existing customers' wastes shall be requested in accordance with Facility policies.

The documentation of the waste as described above shall be sent to the landfill manager or his/her designee for documentation noting any conditions or limitations. Once received, documentation and analytical data will be reviewed by the landfill's representative or consultant. If the information confirms that the waste is (1) non-hazardous, (2) not regulated NORM, and (3) within the scope of waste acceptable for disposal, the landfill manager will then send the appropriate approval or denial correspondence. If the waste stream is deemed unacceptable for disposal, the waste generator will be notified.

Once approved for disposal, the waste generator may be required to notify the Facility and to schedule the delivery of the material so that the landfill's operation and efficiency will not be impaired. All waste information records will be maintained in the Facility's on-site or electronic operating record for a minimum period of 5-years after closure. Facility personnel receive training in regulatory compliance which provides a review of applicable state regulations with emphasis on the Surface Waste Management Facility permit. The controlled and documented entry of incoming waste loads by trained personnel will reasonably ensure exclusion of prohibited waste. Shipping Manifest (alternative form C-138) denials will be maintained in the Facility's on-site or electronic operating record for a minimum period of 5-years after closure.

prohibited waste.

Upon arrival at the Facility, if the waste is materially different from the pre-acceptance documentation (e.g. significant inconsistencies with pre-acceptance documentation), the truck will not be allowed to unload. If any significant inconsistencies in the waste are identified during unloading at the landfill, the material may be rejected and the truck reloaded. The applicant/waste generator will be notified of the material difference in the waste stream characteristics. No unapproved waste, or waste with unapproved documentation, will be accepted for landfilling. The landfill manager reserves the right to reject any load at any time. The landfill manager may consult other appropriate technical personnel prior to a final determination. Loads will be visually inspected at the working face by operation personnel. In the event the waste is determined to be a hazardous, regulated NORM, or other regulated waste excluded by the Facility permit, the landfill manager will be notified. Waste rejection and removal procedures may be initiated under a contingency procedure if necessary.

If the waste delivery process indicates the waste is approved and all required information is documented the truck will be directed to proceed to the appropriate disposal area. The waste will be unloaded and disposed of with other solid wastes. The operator shall also document the approximate location of where wastes are being filled within the landfill as necessary for location purposes in the event that a waste needs to be exhumed and removed after the fact.

4.0 SAMPLING AND ANALYSIS PROCEDURES

The Facility's landfill policy is that it is the responsibility of the waste generator and waste shipper to demonstrate that the waste is acceptable, according to all applicable rules and regulations of the Facility. The Facility reserves the right to refuse a shipment if any landfill personnel suspects that any amount of waste, no matter how small, may be found to be unacceptable by Facility, Federal or State of New Mexico Rules and Regulations.

If a shipment is refused, the waste generator shall have the suspect waste tested at a laboratory and certified that the waste is acceptable for disposal at the Facility. All fees associated with the testing will be the responsibility of the shipper/applicant. If the laboratory proves that the waste is acceptable for disposal at the Facility, the waste generator or waste shipper/applicant shall provide documentation to the Facility before the shipper/applicant will be allowed to landfill the waste. Any shipment of waste that enters the property of the landfill may be subject to a random inspection per Section 5.0 Random Inspection Procedures in order to determine if non-exempt hazardous, radioactive, or other un-authorized wastes are present. If testing is deemed necessary by landfill personnel, all fees associated with the testing will be the responsibility of the shipper/applicant. If the shipper/applicant does not agree to these terms, the shipment shall be refused.

5.0 RANDOM INSPECTION PROCEDURES

Random inspections of incoming loads will be used as a tool for detecting and preventing the disposal of regulated non-exempt hazardous, radioactive, or other unauthorized wastes. Landfill personnel shall conduct random load inspections in accordance with Facility random inspection procedures outlined below. Documentation of the inspections shall be maintained in the landfill records. A reasonable number of inspections will be conducted each month. The procedures for conducting a random load inspection are:

- A designated person (equipment operator, landfill manager, etc.) will be responsible for random load inspections;
- The load to be inspected will be chosen at random;
- After the load has been designated for inspection, the driver of that vehicle will be notified and the vehicle directed to a designated location on the landfill. The designated location will be away from the active face and other customer traffic but over a lined area
- The load will be discharged for inspection and the driver of the load will be invited to monitor the inspection process;
- A radiation survey will be performed. If any part of the load exceeds twice background (XX mR/hr) the load will be deemed unacceptable.
- A pH test will be performed using a pH strip. Any load that shows less than or equal to pH 2.0m or greater than or equal to pH 12.5 will be deemed unacceptable.
- An LEL survey will be performed using an electronic meter to check for combustible gases. If the load exceeds 10% LEL the load will be deemed unacceptable.
- An H_2S survey will be performed using an electronic meter. If the load exceeds 1 ppm H_2S the load will be deemed unacceptable.
- If the designated person suspects any unauthorized waste in the load, the load will be rejected whether the above test limits are exceeded or not, and quantity two, 1 liter samples of the waste will be obtained, placed into sealed glass jars and submitted to an accredited laboratory for analysis
- Any waste found to be unacceptable for disposal will be returned to the vehicle for containment until further notifications and shipping arrangements have been made
- The denial will be documented on the Shipping Manifest; and
- A random load inspection form (**Exhibit D**) will be completed by the inspector and may be signed by the driver of the vehicle at the driver's discretion.
- The random load inspection form, any sample analyses, and the Shipping Manifest form will be maintained in the facility permanent record.

If a waste load is refused for disposal, the waste generator's name and phone number shall be documented on the random inspection form. The waste generator shall be notified and the random inspection form will be maintained in the landfill office or electronic permanent operating record. If during a random inspection, a regulated hazardous, radioactive, or other un-authorized waste is discovered, the OCD shall be notified within 72 hours.

6.0 PERSONNEL TRAINING

Landfill personnel responsible for waste acceptance and random load inspections shall be able to properly identify and screen hazardous and unauthorized wastes. To train the landfill personnel to be able to perform the duties previously listed, the following procedures should, at a minimum, be followed:

- New employees shall be given this HWEP and the Solid Waste and Emergency Response Training Module – Introduction to Hazardous Waste Identification (40 CFR Parts 261) (**Exhibit E**), and the employee should become familiar with applicable sections of the documents;
- New employees shall be trained on:
  - This Hazardous Waste and Unauthorized Waste Exclusion Plan;
  - Applicable sections of the Solid Waste and Emergency Response Training Module located in **Exhibit E**;
  - Shipping Manifest;
  - Facility operations and screening procedures;
  - Proper identification of unacceptable wastes; and
  - How to conduct a random inspection and fill out the required inspection forms.
- Annual training shall be provided for all landfill personnel – to include:
  - Review of this Hazardous Waste and Unauthorized Waste Exclusion Plan;
  - Review of applicable sections of the Solid Waste and Emergency Response Training Module located in **Exhibit E**;
  - Review of Shipping Manifest;
  - Review and updates of Facility operations and screening procedures;
  - Review of how to properly identify unacceptable wastes; and
  - Review of how to conduct a random inspection and fill out the required inspection forms.
- Records shall be maintained for each employee at the landfill office. This includes new employee training and annual refreshers.

The safety of landfill employees is also a primary concern. All new employees will be given and trained in the correct use of personal protective equipment (PPE). In addition to the distribution and training on PPE, new employees will also be trained in safe waste handling procedures.

7.0 RECORD KEEPING

Landfill personnel must record and retain at the Facility, in an operating record, electronic operating record, or in an alternative location, the following:

- This Hazardous Waste Exclusion Plan;
- The Solid Waste and Emergency Response Training Module located in **Appendix E**;
- Paint Filter Test Forms;
- Shipping Manifests including documents provided by the waste generator(s);
- Random Load Inspection Forms; and
- Training records for landfill employees involved with waste acceptance and random load inspections.

These records will be made available to the OCD when requested. Records will be maintained by the operator for a minimum period of 5-year after closure.

8.0 CONTINGENCY PROCEDURES

This Contingency procedure is intended to protect the safety and welfare of the employees, Facility, and community in the event that a hazardous or unauthorized waste has been accepted for disposal in the landfill. This Contingency procedure is also intended to satisfy the requirements of **19.15.36** and describes the procedures for excluding the receipt of non-exempt hazardous waste and unauthorized waste. This Plan is developed to include, at a minimum, notification procedures and remedial actions to be taken when non-exempt hazardous waste and other unauthorized wastes are identified at the Facility. The Contingency procedure should be used by employees at the landfill as a guide for emergency and remedial procedures in the event a non-exempt hazardous or unauthorized waste has been accepted by the Facility. This plan is initiated by identification of hazardous or unauthorized waste, and includes the following:

- Internal notification process and notification to appropriate state and federal agencies;
- Assessment of the nature and extent of the incident;
- Control of the hazardous or unauthorized waste; and
- Reporting.

8.1 Internal Notification Process and Notification to Appropriate State and Federal Agencies

In the event of an incident involving hazardous or unauthorized wastes at the Facility, the employee first identifying the incident will contact the landfill manager regarding the incident. The landfill manager shall determine if it is necessary to halt operations at the Facility. The landfill manager shall then notify all landfill personnel of the incident and continue to follow the steps outline in this Contingency procedure.

The first priority of the landfill manager should be the safety of the employees at the Facility, and he/she therefore should begin mitigating the incident immediately. However, within 72 hours the manager shall contact the OCD of the acceptance of the hazardous or unauthorized waste. The landfill manager shall provide the OCD with all available information concerning the generator, type of waste, amount of waste, dates of disposal and reason for concern or reclassification of the waste. If the hazardous waste is determined to regulated NORM the manager shall also notify the NMED Radiation Control Bureau

8.2 Assessment of the Nature and Extent of the Incident

Once the applicable notifications have been made, the landfill manager will locate and determine the identity, exact source and amount of non-exempt hazardous or other unauthorized waste that was accepted into the landfill. The manager will then be able to determine if the acceptance of the hazardous or other unauthorized waste constitutes an emergency based on the gathered information. After the waste has been identified, the specific information on the associated hazards, appropriate PPE, decontamination, etc. will be obtained from the associated material safety data sheet (MSDS), the waste generator, or from appropriate reference materials. The assessment of the incident should include, at a minimum, the following:

- Exposure – The magnitude of actual or potential exposure to employees, the general public, and the environment. The duration and pathways of exposure should also be evaluated.
- Toxicity – The types of adverse health or environmental effects associated with exposure to the material.
- Reactivity – The degree to which the material is reactive with other materials.
- Uncertainties -Considerations for undeterminable or future exposures. Uncertain or unknown health effects, including future health effects.

8.3 Control of the Hazardous or Unauthorized Waste

After the applicable notifications have been made, and the landfill manager has assessed the nature and extent of the incident, the landfill manager should verify if the waste has been disposed of in the landfill. Different procedures should be followed depending on if the waste has been disposed of in the landfill, or if the waste has been accepted through the gate but not disposed. It should be noted that, if necessary, the Facility shall immediately suspend receipt of further shipment(s) of the non-authorized waste from the generator until the procedures of this section have been fulfilled.

If that waste has not been disposed of in the landfill, the waste should be stockpiled in a place that will reduce the potential for harm to employees, the general public, or the environment, preferably contained on the original hauler vehicle. As soon as practical, the waste shall be returned to the waste hauler or waste generator according to the materials safe handling procedures. Note that the hazardous waste must be hauled away by hauling company with an EPA transporter ID number and must comply with with EPA's Hazardous Waste Manifest System. The generator or hauler shall then take responsibility for the waste.

If the waste has been disposed of in the landfill, the landfill manager shall determine if the waste poses a risk to the health and safety of the employees or the general public. If the waste does not pose a potential risk, and with the approval of the OCD, NMED Hazardous Waste Bureau and EPA if hazardous waste and/or the NMED Radiation Control Bureau if regulated NORM, the waste shall remain in the landfill and records of the event will be maintained in the Facility operating record. Monitoring of constituents of concern, evaluation of potential receptors and pathways, and/or reclassification of the waste stream may result from this interactive process with the OCD. If the waste does pose a potential risk, the waste shall be removed from the landfill according to the following waste rejection and removal procedures.

The waste material will be removed by personnel specifically trained in projects of this nature. A Remedial Services Contractor (RSC) will perform the removal activities with assistance from properly trained Facility personnel. The Operator and RSC will work/consult with OCD, NMED Hazardous Waste Bureau, EPA, and in the event of regulated NORM, the NMED Radiaton Control Bureau to ensure that the approved hazardous waste hauling company has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System. Every effort and control necessary to minimize or eliminate the escape of leachate or waste to the ground, surface waters or the atmosphere shall be utilized. The RSC will document the waste removal activities and prepare a project summary report for documentation of all stages of removal. The following outlines the RSC operational and technical approach which may be necessary to perform remedial activities associated with the removal of waste stream.

- Mobilization;
- Site Preparation;
- Excavation of Overburden;
- Excavation and Staging of Waste;
- Excavation and Loading of Unauthorized Waste Material;
- Transportation and Disposal of Unauthorized Waste Material;
- Stormwater Control;
- Site Restoration;
- Decontamination of Equipment; and
- Demobilization.

A project health and safety plan shall be prepared by the RSC which will establish health and safety protocols for the project in strict accordance with OSHA, USEPA, NMOCD and/or NMED regulatory requirements. The health and safety plan will, at a minimum, address the following items:

- Preliminary investigation of the site to identify proper health and safety issues;
- Explosive or hazardous gases and other landfill specific hazards assessment;
- Training program for RSC personnel presented prior to allowing these individuals to enter the project site;
- Establish work zones for the project site. Individual areas within the zones will be delineated based on project activities which may require different levels of personal protection;
- Levels of personal protection required based upon a determination regarding the applicability of OSHA Levels A, B, C, or D protection with specified personal protective equipment being provided; and
- Emergency response procedures will be established prior to initiation of any RSC on-site operations.

A review of Facility records will indicate the dates and amounts of the waste material to be removed and rejected. Prior to initiation of excavation activities, the RSC will erect marked temporary barriers around the designated work zones to exclude vehicular and pedestrian traffic from those zones to areas during and after work hours. The overburden, if necessary, will be removed from those areas targeted for removal utilizing an excavator. If required, additional equipment will be used which provide the excavation capabilities required by the project.

The overburden will be used as required to construct temporary staging areas adjacent to the proposed removal locations. The overburden material will be separated from waste material designated for removal during the excavation process. Once the disposal locations have been uncovered, and the material identified, the material will be excavated and loaded directly into transport vehicles for off-site disposal at an approved facility. Note that an approved hazardous waste hauling company that has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System must be used and that the waste must be delivered to an approved hazardous waste disposal facility. Loading of the material will be conducted such that decontamination of the transport vehicle will not be required prior to departure from the Facility. Polyethylene sheeting will be place adjacent to the trucks to contain potential spillage during the loading process. Waste material spilled during the loading process will be collected and placed into the trucks. All trucks will be loaded to ensure the Department of Transportation (DOT) weight requirements have been met and maximum payloads have been achieved for each vehicle and for manifesting purposes.

It is anticipated the excavation equipment to be utilized will allow for the removal of the waste material from locations outside the excavation area. As a result, only the backhoe bucket and portion of the boom will come into contact with the material to be removed. All excavation activities shall be completed in accordance with OSHA trenching requirements, 29 CFR Part 1926.

If cleaning is required during excavation operations, the cleaning will take place directly over a designated decontamination area with fluid handling accommodations such that all contaminated fluids will be captured. The fluid will then be mixed with dry material until it passes the paint filter test. The mixed dry unauthorized waste would then be loaded into trucks for transport to an approved facility. Note that an approved hazardous waste hauling company that has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System must be used and that the waste must be delivered to an approved hazardous waste disposal facility. Prior to trucks leaving the Facility, they will be visually inspected for potential contact with the excavated material outside the truck's box. Decontamination of any affected portions of the truck will be performed by dry methods (i.e. scrapping, brushing) and/or steam cleaning as necessary. Documentation shall be made of the visual inspections and decontamination process if applicable. These inspections will be included in the project summary report.

A weatherproof tarp shall be provided and secured over each shipment leaving the site. All shipments will comply with applicable regulatory and DOT requirements of the waste material removed. Vehicles used for the transportation of waste material removed from the Facility will be licensed, as required, and will be plainly marked and placarded as specified by the USEPA, NMED and DOT regulatory requirements. Note that an approved hazardous waste hauling company that has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System must be used and that the waste must be delivered to an approved hazardous waste disposal facility.

The Generator of the rejected waste, or its designee, will be responsible for completing manifests for all shipments transported off-site. If the original generator cannot be located, the Operator will assume the responsibility of generator.

Once all waste removal activities have been completed and all required inspections performed, the excavation area will then be backfilled with refuse removed in the process as overburden. If necessary, additional waste accepted during normal Facility operations will be placed in the excavated area to achieve working grades up to permitted final grades. Intermediate cover material will be replaced, if previously present, and regraded according to the Facility permit requirements. Because unauthorized waste material in question will have been removed, there is no need for any maintenance procedures in addition to the Facility's existing landfill site maintenance.

8.4 Reporting

Every stage of the process, after identifying that a non-exempt hazardous or unauthorized waste was accepted at the landfill shall be documented and kept on-site in the Facility's operating record or electronic operating record.

If, after the non-exempt hazardous or unauthorized waste was disposed of in the landfill, each of the various stages of the rejection and removal process will be recorded for documentation purposes and placed into a project summary report. Documentation may include photographs, certified survey drawings/records, field reports of excavation procedures, Health and Safety Plan, manifests and waste disposal tickets. Once completed the project summary report will be placed in the Facility files for a permanent record of the waste rejection and removal activity. A copy will be provided to the waste material generator for their records and files.

At completion of the rejection and removal activities, as outlined above, the Facility will submit to the NMOCD a certification that the waste material has been removed in accordance with this Contingency procedure. If the waste material was disposed of in the landfill, the certification will be signed by the Facility Operator.

9.0 SUMMARY

This Hazardous Waste Exclusion Plan outlines the steps and procedures for acceptance of waste at the North Ranch Oil Field Waste Landfill Facility and enables a safe and efficient use of the Facility as the disposal site for oil field solid wastes. By following these guidelines, the Facility can minimize the potential for disposing of a non-exempt hazardous or unauthorized waste.

Exhibit A
Shipping Manifest C-138

NEW MEXICO NON-HAZARDOUS OILFIELD WASTE MANIFEST
(PLEASE PRINT)

Company Man Contact Information
Name ____________
Phone No. ____________

GENERATOR

NO.

Oper. Manifest #:		Location of Origin	
Operators Name		Lease/Well Name & No.	
Address		County	
		API No.	
City, State, Zip		Rig Name & No.	
Phone No.		AFE/PO No.	

EXEMPT E&P Waste/Service Identification and Amount (place volume next to waste type in barrels or cubic yards)

Oil Based Muds ________	NON-INJECTABLE WATERS		OTHER EXEMPT E&P WASTE STREAMS	
Oil Based Cuttings ________	Washout Water (Non-Injectable) ________			
Water Based Muds ________	Completion Fluid/Flow back (Non-Injectable) ________			
Water Based Cuttings ________	Produced Water (Non-Injectable) ________			
Produced Formation Solids ________	Gathering Line Water/Waste (Non-Injectable) ________			
Tank Bottoms ________	INTERNAL USE ONLY		TOP SOIL & CALICHE SALES	
E&P Contaminated Soil ________	Truck Washout (exempt waste)	YES NO	QUANTITY	TOP SOIL CALICHE
Gas Plant Waste				

WASTE GENERATION PROCESS: ☐ DRILLING ☐ COMPLETION ☐ PRODUCTION ☐ GATHERING LINES

NON-EXEMPT E&P Waste/Service Identification and Amount
All non-exempt E&P waste must be analysed and be below the threshold limits for toxicity (TCLP), Ignitability, Corrosivity and Reactivity.

Non-Exempt Other ______________________ *please select from **Non-Exempt Waste List** on back*

DISPOSAL QUANTITY B - BARRELS L - LIQUID Y - YARDS E - EACH

I hereby certify that according to the Resource Conservation and Recovery Act (RCRA) and the US Environmental Protection Agency's July 1988 regulatory determination, the above described waste load is (Check the appropriate classification)

☐ RCRA EXEMPT: Oil field wastes generated from oil and gas exploration and production operations and are not mixed with non-exempt waste (R360 Accepts certifications on a per load basis only)

☐ RCRA NON-EXEMPT: Oil field waste which is non-hazardous that does not exceed the minimum standards for waste hazardous by characteristics established in RCRA regulations, 40 CFR 261.21-261.24, or listed hazardous waste as defined by 40 CFR, part 261, subpart D, as amended. The following documentation demonstrating the waste as non-hazardous is attached. (Check the appropriate items as provided)

☐ MSDS Information ☐ RCRA Hazardous Waste Analysis ☐ Other (Provide Description Below)

____

☐ EMERGENCY NON-OILFIELD: Emergency non-hazradous, non-oilfeild waste that has been ordered by the Department of Public Safety (the order, documentation of non-hazardous waste determination and a desciption of the waste must accompany this form)

(PRINT) AUTHORIZED AGENTS NAME DATE SIGNATURE

TRANSPORTER

Transporter's Name		Driver's Name	
Address		Print Name	
Phone No.		Phone No.	
Trans. Ticket #		Truck No.	

I hereby certify that the above named material(s) was/were picked up at the Generator's site listed above and delivered without incident to the disposal facility listed below.

SHIPMENT DATE DRIVER'S SIGNATURE DELIVERY DATE DRIVER'S SIGNATURE

TRUCK TIME STAMP
IN: ____________ OUT: ____________

DISPOSAL FACILITY

RECEIVING AREA
Name/No.

Site Name/ Permit No.	**Antelope Draw Facility - Permit #**	Phone No.	575-236-1734
Address	476 Battle Axe Rd. , Jal, NM 88252		

NORM READINGS TAKEN? (Circle One) YES NO If YES, was reading > 99 micro roentgens? (circle one) YES NO

PASS THE PAINT FILTER TEST? (Circle One) YES NO

TANK BOTTOMS

	Feet	Inches
1st Gauge		
2nd Gauge		
Received		

BS&W/BBLS Received		BS&W (%)	
Free Water			
Total Received			

I hereby certify that the above load material has been (circle one): ACCEPTED DENIED If denied, must be maintained as permanent record. Why denied?____________

NAME (PRINT) DATE TITLE SIGNATURE

Generator – to be completed by the generator of the waste in transit

Company man contact information – Provide the rig manager's name and number
Operator's Name – Provide the name of the company from which the waste originates
Address, City, State, Zip – Business address for the generator company
Phone No. – Provide a phone number where the generator company can be reached
Permit/RRC No. – Provide the Railroad Commission permit number
Lease/ Well Name & No. – Provide the name of the lease/well name and number. If offshore, provide the OCS number
County – Provide the county at which the waste was generated in. If offshore, provide the Field name and Block number.
API No. – Provide the American Petroleum Institute number; may contain up to 14 digits
Rig Name & No. – Provide the name of the drilling contractor and the well number and well name
AFE/PO No. – Provide either the Authorization for Expenditure (AFE) number or the Purchase Order (PO) number

Origination of waste – Check the option that best describes where the waste originates from

Drilling – Waste generated while drilling the well
Initial Completion – Waste generated on the original completion (for re-completions see **Production**)
Production – Waste generated during the production life of the well (i.e., work overs, re-completions, hydraulic fracturing, gas plant treatment, etc.)
Commercial Facilities – Waste that is *generated* at commercial facilities (i.e., Refineries, SWD Wells, Compressor stations, Transfer stations, etc.)
In Transit – Waste which is spilled while in transit; NOT to include well gathering lines or field gathering lines; to include contaminated material resulting from the spill (typically trucking, post-production pipelines, or barges)

Transporter – To be completed by the waste hauler/transporter in the presence of the generator

Transporter name – Provide the company name that is transporting the waste
Address – Business address for the transport company
Driver's Name – Provide the first and last name of the driver hauling the waste
Phone No. – List the phone number at which the transport company can be reached
WHP No. – List the Waste Hauler's Permit Number associated with the truck that is hauling the material

Waste Categories

Exempt E&P Waste

Oil Based Mud
- Oil Based Drilling fluids
- Off Shore Oil Based Drilling fluids

Oil Based Cuttings
- Oil Based Drill cuttings
- Offshore Oil Based cuttings

Water Based Mud
- Water Based Drilling fluids
- Offshore Water Based Drilling fluids

Water Based Cuttings
- Water Based Drill cuttings
- Offshore Water Based cuttings

Produced Formation Sand and Solids
- Hydrogen sulfide abatement wastes from geothermal energy production
- Workover wastes
- Produced sand
- Constituents removed from produced water before it is injected

Tank Bottoms
- Basic sediment, water, and other tank bottoms from storage facilities that hold product and exempt waste
- Pit sludges and contaminated bottoms from storage or disposal of exempt wastes
- Accumulated materials such as hydrocarbons, solids, sands, and emulsion from production separators, fluid treating vessels, and production impoundments
- Constituents removed from produced water before it is injected or otherwise disposed of
- Liquid hydrocarbons removed from the production stream but not from oil refining
- Waste crude oil from primary field operations

E&P Contaminated Soil
- On-Lease oil spill

Wash Out Water
- Rigwash
- Cooling tower blowdown

Completion Fluids/Flowback
- Well completion, treatment, and stimulation fluids, and frac proppant
- Packing fluids

Produced Water
- Produced water
- Geothermal Production Fluids
- Materials ejected from a producing well during blowdown

Gathering Line Water/Waste
- Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation
- Pigging wastes from gathering lines

Gas Plant Waste
- Gas plant dehydration wastes, including glycol-based compounds, glycol filters, and filter media, backwash, and molecular sieves
- Gas plant sweetering wastes for sulfur removal, including amines, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge
- Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream)
- Wastes from subsurface gas storage and retrieval, except for the non-exempt wastes

Non-Exempt E&P Waste

All non-exempt oil & gas waste must be analyzed for and be below the threshold limits for Toxicity (TCLP Metals), Ignitability, Corrosivity and Reactivity.

www.epa.gov/osw/hazard/wastetypes/characteristic.htm

- Unused fracturing fluids or acids
- Gas plant cooling tower cleaning wastes
- Oil and gas service company wastes such as drum rinsate, sandblast media, painging wastes, spent solvents, spilled chemicals, and waste acids
- Vacuum truck and drum rinsate from trucks and drums transporting or containing non-exempt waste
- Non-Exempt E&P liquid and solid wastes generated by crude oil and tank bottom reclaimers
- Waste compressor filters and blowdown
- Non-Exempt E&P waste in transportation pipeline related pits
- Caustic or acid cleaners
- Boiler cleaning wastes
- Boiler scrubber fluids, sludges, and ash
- E&P Contaminated Soil
  - Transportation spill of post-production oil and gas

Exhibit B

40 CFR Part 261 Subsection D – Lists of Hazardous Waste

Title 40: Protection of Environment
PART 261—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

Subpart D—Lists of Hazardous Wastes

Contents

§261.30 General.

(a) A solid waste is a hazardous waste if it is listed in this subpart, unless it has been excluded from this list under §§260.20 and 260.22.

(b) The Administrator will indicate his basis for listing the classes or types of wastes listed in this subpart by employing one or more of the following Hazard Codes:

Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Toxicity Characteristic Waste	(E)
Acute Hazardous Waste	(H)
Toxic Waste	(T)

Appendix VII identifies the constituent which caused the Administrator to list the waste as a Toxicity Characteristic Waste (E) or Toxic Waste (T) in §§261.31 and 261.32.

(c) Each hazardous waste listed in this subpart is assigned an EPA Hazardous Waste Number which precedes the name of the waste. This number must be used in complying with the notification requirements of Section 3010 of the Act and certain recordkeeping and reporting requirements under parts 262 through 265, 267, 268, and 270 of this chapter.

(d) The following hazardous wastes listed in §261.31 are subject to the exclusion limits for acutely hazardous wastes established in §261.5: EPA Hazardous Wastes Nos. F020, F021, F022, F023, F026 and F027.

[45 FR 33119, May 19, 1980, as amended at 48 FR 14294, Apr. 1, 1983; 50 FR 2000, Jan. 14, 1985; 51 FR 40636, Nov. 7, 1986; 55 FR 11863, Mar. 29, 1990; 75 FR 13002, Mar. 18, 2010]

§261.31 Hazardous wastes from non-specific sources.

(a) The following solid wastes are listed hazardous wastes from non-specific sources unless they are excluded under §§260.20 and 260.22 and listed in appendix IX.

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Generic:		
F001	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(T)
F002	The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(T)
F003	The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(I)*
F004	The following spent non-halogenated solvents: Cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(T)
F005	The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-	(I,T)

	ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) Sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum	(T)
F007	Spent cyanide plating bath solutions from electroplating operations	(R, T)
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process	(R, T)
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process	(R, T)
F010	Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process	(R, T)
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations	(R, T)
F012	Quenching waste water treatment sludges from metal heat treating operations where cyanides are used in the process	(T)
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum except from zirconium phosphating in aluminum can washing when such phosphating is an exclusive conversion coating process. Wastewater treatment sludges from the manufacturing of motor vehicles using a zinc phosphating process will not be subject to this listing at the point of generation if the wastes are not placed outside on the land prior to shipment to a landfill for disposal and are either: disposed in a Subtitle D municipal or industrial landfill unit that is equipped with a single clay liner and is permitted, licensed or otherwise authorized by the state; or disposed in a landfill unit subject to, or otherwise meeting, the landfill requirements in §258.40, §264.301 or §265.301. For the purposes of this listing, motor vehicle manufacturing is defined in paragraph (b)(4)(i) of this section and (b)(4)(ii) of this section describes the recordkeeping requirements for motor vehicle manufacturing facilities	(T)
F020	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide	(H)

	derivatives. (This listing does not include wastes from the production of Hexachlorophene from highly purified 2,4,5-trichlorophenol.)	
F021	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives	(H)
F022	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions	(H)
F023	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols. (This listing does not include wastes from equipment used only for the production or use of Hexachlorophene from highly purified 2,4,5-trichlorophenol.)	(H)
F024	Process wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes, from the production of certain chlorinated aliphatic hydrocarbons by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution. (This listing does not include wastewaters, wastewater treatment sludges, spent catalysts, and wastes listed in §261.31 or §261.32.)	(T)
F025	Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution	(T)
F026	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions	(H)
F027	Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing Hexachlorophene sythesized from prepurified 2,4,5-trichlorophenol as the sole component.)	(H)

F028	Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027	(T)
F032	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations (except potentially cross-contaminated wastes that have had the F032 waste code deleted in accordance with §261.35 of this chapter or potentially cross-contaminated wastes that are otherwise currently regulated as hazardous wastes (i.e., F034 or F035), and where the generator does not resume or initiate use of chlorophenolic formulations). This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol	(T)
F034	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol	(T)
F035	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol	(T)
F037	Petroleum refinery primary oil/water/solids separation sludge—Any sludge generated from the gravitational separation of oil/water/solids during the storage or treatment of process wastewaters and oily cooling wastewaters from petroleum refineries. Such sludges include, but are not limited to, those generated in oil/water/solids separators; tanks and impoundments; ditches and other conveyances; sumps; and stormwater units receiving dry weather flow. Sludge generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges generated in aggressive biological treatment units as defined in §261.31(b)(2) (including sludges generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and K051 wastes are not included in this listing. This listing does include residuals generated from processing or recycling oil-bearing hazardous	(T)

	secondary materials excluded under §261.4(a)(12)(i), if those residuals are to be disposed of	
F038	Petroleum refinery secondary (emulsified) oil/water/solids separation sludge—Any sludge and/or float generated from the physical and/or chemical separation of oil/water/solids in process wastewaters and oily cooling wastewaters from petroleum refineries. Such wastes include, but are not limited to, all sludges and floats generated in: induced air flotation (IAF) units, tanks and impoundments, and all sludges generated in DAF units. Sludges generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges and floats generated in aggressive biological treatment units as defined in §261.31(b)(2) (including sludges and floats generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and F037, K048, and K051 wastes are not included in this listing	(T)
F039	Leachate (liquids that have percolated through land disposed wastes) resulting from the disposal of more than one restricted waste classified as hazardous under subpart D of this part. (Leachate resulting from the disposal of one or more of the following EPA Hazardous Wastes and no other Hazardous Wastes retains its EPA Hazardous Waste Number(s): F020, F021, F022, F026, F027, and/or F028.)	(T)

*(I,T) should be used to specify mixtures that are ignitable and contain toxic constituents.

(b) Listing Specific Definitions:

(1) For the purposes of the F037 and F038 listings, oil/water/solids is defined as oil and/or water and/or solids.

(2)(i) For the purposes of the F037 and F038 listings, aggressive biological treatment units are defined as units which employ one of the following four treatment methods: activated sludge; trickling filter; rotating biological contactor for the continuous accelerated biological oxidation of wastewaters; or high-rate aeration. High-rate aeration is a system of surface impoundments or tanks, in which intense mechanical aeration is used to completely mix the wastes, enhance biological activity, and (A) the units employ a minimum of 6 hp per million gallons of treatment volume; and either (B) the hydraulic retention time of the unit is no longer than 5 days; or (C) the hydraulic retention time is no longer than 30 days and the unit does not generate a sludge that is a hazardous waste by the Toxicity Characteristic.

(ii) Generators and treatment, storage and disposal facilities have the burden of proving that their sludges are exempt from listing as F037 and F038 wastes under this definition. Generators and treatment, storage and disposal facilities must maintain, in their operating or other onsite records, documents and data sufficient to prove that: (A) the unit is an aggressive biological treatment unit as defined in this subsection; and (B) the sludges sought to be exempted from the definitions of F037 and/or F038 were actually generated in the aggressive biological treatment unit.

(3) (i) For the purposes of the F037 listing, sludges are considered to be generated at the moment of deposition in the unit, where deposition is defined as at least a temporary cessation of lateral particle movement.

(ii) For the purposes of the F038 listing, (A) sludges are considered to be generated at the moment of deposition in the unit, where deposition is defined as at least a temporary cessation of lateral particle movement and (B) floats are considered to be generated at the moment they are formed in the top of the unit.

(4) For the purposes of the F019 listing, the following apply to wastewater treatment sludges from the manufacturing of motor vehicles using a zinc phosphating process.

(i) Motor vehicle manufacturing is defined to include the manufacture of automobiles and light trucks/utility vehicles (including light duty vans, pick-up trucks, minivans, and sport utility vehicles). Facilities must be engaged in manufacturing complete vehicles (body and chassis or unibody) or chassis only.

(ii) Generators must maintain in their on-site records documentation and information sufficient to prove that the wastewater treatment sludges to be exempted from the F019 listing meet the conditions of the listing. These records must include: the volume of waste generated and disposed of off site; documentation showing when the waste volumes were generated and sent off site; the name and address of the receiving facility; and documentation confirming receipt of the waste by the receiving facility. Generators must maintain these documents on site for no less than three years. The retention period for the documentation is automatically extended during the course of any enforcement action or as requested by the Regional Administrator or the state regulatory authority.

[46 FR 4617, Jan. 16, 1981]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §261.31, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at www.govinfo.gov.

§261.32 Hazardous wastes from specific sources.

(a) The following solid wastes are listed hazardous wastes from specific sources unless they are excluded under §§260.20 and 260.22 and listed in appendix IX.

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Wood preservation: K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol	(T)
Inorganic pigments:		
K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments	(T)

K003	Wastewater treatment sludge from the production of molybdate orange pigments	(T)
K004	Wastewater treatment sludge from the production of zinc yellow pigments	(T)
K005	Wastewater treatment sludge from the production of chrome green pigments	(T)
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated)	(T)
K007	Wastewater treatment sludge from the production of iron blue pigments	(T)
K008	Oven residue from the production of chrome oxide green pigments	(T)
Organic chemicals:		
K009	Distillation bottoms from the production of acetaldehyde from ethylene	(T)
K010	Distillation side cuts from the production of acetaldehyde from ethylene	(T)
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile	(R, T)
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile	(R, T)
K014	Bottoms from the acetonitrile purification column in the production of acrylonitrile	(T)
K015	Still bottoms from the distillation of benzyl chloride	(T)
K016	Heavy ends or distillation residues from the production of carbon tetrachloride	(T)
K017	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin	(T)
K018	Heavy ends from the fractionation column in ethyl chloride production	(T)
K019	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production	(T)
K020	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production	(T)
K021	Aqueous spent antimony catalyst waste from fluoromethanes production	(T)

K022	Distillation bottom tars from the production of phenol/acetone from cumene	(T)
K023	Distillation light ends from the production of phthalic anhydride from naphthalene	(T)
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene	(T)
K025	Distillation bottoms from the production of nitrobenzene by the nitration of benzene	(T)
K026	Stripping still tails from the production of methy ethyl pyridines	(T)
K027	Centrifuge and distillation residues from toluene diisocyanate production	(R, T)
K028	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane	(T)
K029	Waste from the product steam stripper in the production of 1,1,1-trichloroethane	(T)
K030	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene	(T)
K083	Distillation bottoms from aniline production	(T)
K085	Distillation or fractionation column bottoms from the production of chlorobenzenes	(T)
K093	Distillation light ends from the production of phthalic anhydride from ortho-xylene	(T)
K094	Distillation bottoms from the production of phthalic anhydride from ortho-xylene	(T)
K095	Distillation bottoms from the production of 1,1,1-trichloroethane	(T)
K096	Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane	(T)
K103	Process residues from aniline extraction from the production of aniline	(T)
K104	Combined wastewater streams generated from nitrobenzene/aniline production	(T)
K105	Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes	(T)
K107	Column bottoms from product separation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	(C,T)

K108	Condensed column overheads from product separation and condensed reactor vent gases from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	(I,T)
K109	Spent filter cartridges from product purification from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	(T)
K110	Condensed column overheads from intermediate separation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	(T)
K111	Product washwaters from the production of dinitrotoluene via nitration of toluene	(C,T)
K112	Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)
K113	Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)
K114	Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)
K115	Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)
K116	Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine	(T)
K117	Wastewater from the reactor vent gas scrubber in the production of ethylene dibromide via bromination of ethene	(T)
K118	Spent adsorbent solids from purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene	(T)
K136	Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene	(T)
K149	Distillation bottoms from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups, (This waste does not include still bottoms from the distillation of benzyl chloride.)	(T)
K150	Organic residuals, excluding spent carbon adsorbent, from the spent chlorine gas and hydrochloric acid recovery processes associated with the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups	(T)

K151	Wastewater treatment sludges, excluding neutralization and biological sludges, generated during the treatment of wastewaters from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups	(T)
K156	Organic waste (including heavy ends, still bottoms, light ends, spent solvents, filtrates, and decantates) from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)	(T)
K157	Wastewaters (including scrubber waters, condenser waters, washwaters, and separation waters) from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)	(T)
K158	Bag house dusts and filter/separation solids from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)	(T)
K159	Organics from the treatment of thiocarbamate wastes	(T)
K161	Purification solids (including filtration, evaporation, and centrifugation solids), bag house dust and floor sweepings from the production of dithiocarbamate acids and their salts. (This listing does not include K125 or K126.)	(R,T)
K174	Wastewater treatment sludges from the production of ethylene dichloride or vinyl chloride monomer (including sludges that result from commingled ethylene dichloride or vinyl chloride monomer wastewater and other wastewater), unless the sludges meet the following conditions: (i) they are disposed of in a subtitle C or non-hazardous landfill licensed or permitted by the state or federal government; (ii) they are not otherwise placed on the land prior to final disposal; and (iii) the generator maintains documentation demonstrating that the waste was either disposed of in an on-site landfill or consigned to a transporter or disposal facility that provided a written commitment to dispose of the waste in an off-site landfill. Respondents in any action brought to enforce the requirements of subtitle C must, upon a showing by the government that the respondent managed wastewater treatment sludges from the production of vinyl chloride monomer or ethylene dichloride, demonstrate that they meet the terms of the exclusion set forth above. In doing so, they must provide appropriate documentation (e.g., contracts between the generator and the	(T)

	landfill owner/operator, invoices documenting delivery of waste to landfill, etc.) that the terms of the exclusion were met	
K175	Wastewater treatment sludges from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process	(T)
K181	Nonwastewaters from the production of dyes and/or pigments (including nonwastewaters commingled at the point of generation with nonwastewaters from other processes) that, at the point of generation, contain mass loadings of any of the constituents identified in paragraph (c) of this section that are equal to or greater than the corresponding paragraph (c) levels, as determined on a calendar year basis. These wastes will not be hazardous if the nonwastewaters are: (i) disposed in a Subtitle D landfill unit subject to the design criteria in §258.40, (ii) disposed in a Subtitle C landfill unit subject to either §264.301 or §265.301, (iii) disposed in other Subtitle D landfill units that meet the design criteria in §258.40, §264.301, or §265.301, or (iv) treated in a combustion unit that is permitted under Subtitle C, or an onsite combustion unit that is permitted under the Clean Air Act. For the purposes of this listing, dyes and/or pigments production is defined in paragraph (b)(1) of this section. Paragraph (d) of this section describes the process for demonstrating that a facility's nonwastewaters are not K181. This listing does not apply to wastes that are otherwise identified as hazardous under §§261.21-261.24 and 261.31-261.33 at the point of generation. Also, the listing does not apply to wastes generated before any annual mass loading limit is met	(T)
Inorganic chemicals:		
K071	Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used	(T)
K073	Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production	(T)
K106	Wastewater treatment sludge from the mercury cell process in chlorine production	(T)
K176	Baghouse filters from the production of antimony oxide, including filters from the production of intermediates (e.g., antimony metal or crude antimony oxide)	(E)
K177	Slag from the production of antimony oxide that is speculatively accumulated or disposed, including slag from the production of intermediates (e.g., antimony metal or crude antimony oxide)	(T)

K178	Residues from manufacturing and manufacturing-site storage of ferric chloride from acids formed during the production of titanium dioxide using the chloride-ilmenite process	(T)
Pesticides:		
K031	By-product salts generated in the production of MSMA and cacodylic acid	(T)
K032	Wastewater treatment sludge from the production of chlordane	(T)
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane	(T)
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane	(T)
K035	Wastewater treatment sludges generated in the production of creosote	(T)
K036	Still bottoms from toluene reclamation distillation in the production of disulfoton	(T)
K037	Wastewater treatment sludges from the production of disulfoton	(T)
K038	Wastewater from the washing and stripping of phorate production	(T)
K039	Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate	(T)
K040	Wastewater treatment sludge from the production of phorate	(T)
K041	Wastewater treatment sludge from the production of toxaphene	(T)
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T	(T)
K043	2,6-Dichlorophenol waste from the production of 2,4-D	(T)
K097	Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane	(T)
K098	Untreated process wastewater from the production of toxaphene	(T)
K099	Untreated wastewater from the production of 2,4-D	(T)
K123	Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salt	(T)
K124	Reactor vent scrubber water from the production of ethylenebisdithiocarbamic acid and its salts	(C, T)
K125	Filtration, evaporation, and centrifugation solids from the production of ethylenebisdithiocarbamic acid and its salts	(T)

K126	Baghouse dust and floor sweepings in milling and packaging operations from the production or formulation of ethylenebisdithiocarbamic acid and its salts	(T)
K131	Wastewater from the reactor and spent sulfuric acid from the acid dryer from the production of methyl bromide	(C, T)
K132	Spent absorbent and wastewater separator solids from the production of methyl bromide	(T)
Explosives:		
K044	Wastewater treatment sludges from the manufacturing and processing of explosives	(R)
K045	Spent carbon from the treatment of wastewater containing explosives	(R)
K046	Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds	(T)
K047	Pink/red water from TNT operations	(R)
Petroleum refining:		
K048	Dissolved air flotation (DAF) float from the petroleum refining industry	(T)
K049	Slop oil emulsion solids from the petroleum refining industry	(T)
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry	(T)
K051	API separator sludge from the petroleum refining industry	(T)
K052	Tank bottoms (leaded) from the petroleum refining industry	(T)
K169	Crude oil storage tank sediment from petroleum refining operations	(T)
K170	Clarified slurry oil tank sediment and/or in-line filter/separation solids from petroleum refining operations	(T)
K171	Spent Hydrotreating catalyst from petroleum refining operations, including guard beds used to desulfurize feeds to other catalytic reactors (this listing does not include inert support media)	(I,T)
K172	Spent Hydrorefining catalyst from petroleum refining operations, including guard beds used to desulfurize feeds to other catalytic reactors (this listing does not include inert support media)	(I,T)
Iron and steel:		
K061	Emission control dust/sludge from the primary production of steel in electric furnaces	(T)

K062	Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry (SIC Codes 331 and 332)	(C,T)
Primary aluminum:		
K088	Spent potliners from primary aluminum reduction	(T)
Secondary lead:		
K069	Emission control dust/sludge from secondary lead smelting. (NOTE: This listing is stayed administratively for sludge generated from secondary acid scrubber systems. The stay will remain in effect until further administrative action is taken. If EPA takes further action effecting this stay, EPA will publish a notice of the action in the FEDERAL REGISTER)	(T)
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting	(T)
Veterinary pharmaceuticals:		
K084	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K101	Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K102	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
Ink formulation:		
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead	(T)
Coking:		
K060	Ammonia still lime sludge from coking operations	(T)
K087	Decanter tank tar sludge from coking operations	(T)
K141	Process residues from the recovery of coal tar, including, but not limited to, collecting sump residues from the production of coke from coal or the recovery of coke by-products produced from coal. This listing does not include K087 (decanter tank tar sludges from coking operations)	(T)

K142	Tar storage tank residues from the production of coke from coal or from the recovery of coke by-products produced from coal	(T)
K143	Process residues from the recovery of light oil, including, but not limited to, those generated in stills, decanters, and wash oil recovery units from the recovery of coke by-products produced from coal	(T)
K144	Wastewater sump residues from light oil refining, including, but not limited to, intercepting or contamination sump sludges from the recovery of coke by-products produced from coal	(T)
K145	Residues from naphthalene collection and recovery operations from the recovery of coke by-products produced from coal	(T)
K147	Tar storage tank residues from coal tar refining	(T)
K148	Residues from coal tar distillation, including but not limited to, still bottoms	(T)

(b) *Listing Specific Definitions:* (1) For the purposes of the K181 listing, dyes and/or pigments production is defined to include manufacture of the following product classes: dyes, pigments, or FDA certified colors that are classified as azo, triarylmethane, perylene or anthraquinone classes. Azo products include azo, monoazo, diazo, triazo, polyazo, azoic, benzidine, and pyrazolone products. Triarylmethane products include both triarylmethane and triphenylmethane products. Wastes that are not generated at a dyes and/or pigments manufacturing site, such as wastes from the offsite use, formulation, and packaging of dyes and/or pigments, are not included in the K181 listing.

(c) *K181 Listing Levels.* Nonwastewaters containing constituents in amounts equal to or exceeding the following levels during any calendar year are subject to the K181 listing, unless the conditions in the K181 listing are met.

Constituent	Chemical abstracts No.	Mass levels (kg/yr)
Aniline	62-53-3	9,300
o-Anisidine	90-04-0	110
4-Chloroaniline	106-47-8	4,800
p-Cresidine	120-71-8	660
2,4-Dimethylaniline	95-68-1	100
1,2-Phenylenediamine	95-54-5	710
1,3-Phenylenediamine	108-45-2	1,200

(d) *Procedures for demonstrating that dyes and/or pigment nonwastewaters are not K181.* The procedures described in paragraphs (d)(1)-(d)(3) and (d)(5) of this section establish when nonwastewaters from the production of dyes/pigments would not be hazardous (these procedures apply to wastes that are not disposed in landfill units or treated in combustion units as specified in paragraph (a) of this section). If the nonwastewaters are disposed in landfill units or treated in combustion units as described in paragraph (a) of this section, then the nonwastewaters are not hazardous. In order to demonstrate that it is meeting the landfill disposal or combustion conditions contained in the K181 listing description, the generator must maintain documentation as described in paragraph (d)(4) of this section.

(1) *Determination based on no K181 constituents.* Generators that have knowledge (e.g., knowledge of constituents in wastes based on prior sampling and analysis data and/or information about raw materials used, production processes used, and reaction and degradation products formed) that their wastes contain none of the K181 constituents (*see* paragraph (c) of this section) can use their knowledge to determine that their waste is not K181. The generator must document the basis for all such determinations on an annual basis and keep each annual documentation for three years.

(2) *Determination for generated quantities of 1,000 MT/yr or less for wastes that contain K181 constituents.*If the total annual quantity of dyes and/or pigment nonwastewaters generated is 1,000 metric tons or less, the generator can use knowledge of the wastes (e.g., knowledge of constituents in wastes based on prior analytical data and/or information about raw materials used, production processes used, and reaction and degradation products formed) to conclude that annual mass loadings for the K181 constituents are below the listing levels of paragraph (c) of this section. To make this determination, the generator must:

(i) Each year document the basis for determining that the annual quantity of nonwastewaters expected to be generated will be less than 1,000 metric tons.

(ii) Track the actual quantity of nonwastewaters generated from January 1 through December 31 of each year. If, at any time within the year, the actual waste quantity exceeds 1,000 metric tons, the generator must comply with the requirements of paragraph (d)(3) of this section for the remainder of the year.

(iii) Keep a running total of the K181 constituent mass loadings over the course of the calendar year.

(iv) Keep the following records on site for the three most recent calendar years in which the hazardous waste determinations are made:

(A) The quantity of dyes and/or pigment nonwastewaters generated.

(B) The relevant process information used.

(C) The calculations performed to determine annual total mass loadings for each K181 constituent in the nonwastewaters during the year.

(3) *Determination for generated quantities greater than 1,000 MT/yr for wastes that contain K181 constituents.* If the total annual quantity of dyes and/or pigment nonwastewaters generated is greater than 1,000 metric tons, the generator must perform all of the steps described in paragraphs ((d)(3)(i)-(d)(3)(xi) of this section) in order to make a determination that its waste is not K181.

(i) Determine which K181 constituents (see paragraph (c) of this section) are reasonably expected to be present in the wastes based on knowledge of the wastes (e.g., based on prior sampling and analysis data and/or information about raw materials used, production processes used, and reaction and degradation products formed).

(ii) If 1,2-phenylenediamine is present in the wastes, the generator can use either knowledge or sampling and analysis procedures to determine the level of this constituent in the wastes. For determinations based on use of knowledge, the generator must comply with the procedures for using knowledge described in paragraph (d)(2) of this section and keep the records described in paragraph (d)(2)(iv) of this section. For determinations based on sampling and analysis, the generator must comply with the sampling and analysis and recordkeeping requirements described below in this section.

(iii) Develop a waste sampling and analysis plan (or modify an existing plan) to collect and analyze representative waste samples for the K181 constituents reasonably expected to be present in the wastes. At a minimum, the plan must include:

(A) A discussion of the number of samples needed to characterize the wastes fully;

(B) The planned sample collection method to obtain representative waste samples;

(C) A discussion of how the sampling plan accounts for potential temporal and spatial variability of the wastes.

(D) A detailed description of the test methods to be used, including sample preparation, clean up (if necessary), and determinative methods.

(iv) Collect and analyze samples in accordance with the waste sampling and analysis plan.

(A) The sampling and analysis must be unbiased, precise, and representative of the wastes.

(B) The analytical measurements must be sufficiently sensitive, accurate and precise to support any claim that the constituent mass loadings are below the listing levels of paragraph (c) of this section.

(v) Record the analytical results.

(vi) Record the waste quantity represented by the sampling and analysis results.

(vii) Calculate constituent-specific mass loadings (product of concentrations and waste quantity).

(viii) Keep a running total of the K181 constituent mass loadings over the course of the calendar year.

(ix) Determine whether the mass of any of the K181 constituents listed in paragraph (c) of this section generated between January 1 and December 31 of any year is below the K181 listing levels.

(x) Keep the following records on site for the three most recent calendar years in which the hazardous waste determinations are made:

(A) The sampling and analysis plan.

(B) The sampling and analysis results (including QA/QC data)

(C) The quantity of dyes and/or pigment nonwastewaters generated.

(D) The calculations performed to determine annual mass loadings.

(xi) Nonhazardous waste determinations must be conducted annually to verify that the wastes remain nonhazardous.

(A) The annual testing requirements are suspended after three consecutive successful annual demonstrations that the wastes are nonhazardous. The generator can then use knowledge of the wastes to support subsequent annual determinations.

(B) The annual testing requirements are reinstated if the manufacturing or waste treatment processes generating the wastes are significantly altered, resulting in an increase of the potential for the wastes to exceed the listing levels.

(C) If the annual testing requirements are suspended, the generator must keep records of the process knowledge information used to support a nonhazardous determination. If testing is reinstated, a description of the process change must be retained.

(4) *Recordkeeping for the landfill disposal and combustion exemptions.* For the purposes of meeting the landfill disposal and combustion condition set out in the K181 listing description, the generator must maintain on site for three years documentation demonstrating that each shipment of waste was received by a landfill unit that is subject to or meets the landfill design standards set out in the listing description, or was treated in combustion units as specified in the listing description.

(5) *Waste holding and handling.* During the interim period, from the point of generation to completion of the hazardous waste determination, the generator is responsible for storing the wastes appropriately. If the wastes are determined to be hazardous and the generator has not complied with the subtitle C requirements during the interim period, the generator could be subject to an enforcement action for improper management.

[46 FR 4618, Jan. 16, 1981]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §261.32, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at www.govinfo.gov.

§261.33 Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof.

The following materials or items are hazardous wastes if and when they are discarded or intended to be discarded as described in §261.2(a)(2)(i), when they are mixed with waste oil or used oil or other material and applied to the land for dust suppression or road treatment, when they are otherwise applied to the land in lieu of their original intended use or when they are contained in products that are applied to the land in lieu of their original intended use, or when, in lieu of their original intended use, they are produced for use as (or as a component of) a fuel, distributed for use as a fuel, or burned as a fuel.

(a) Any commercial chemical product, or manufacturing chemical intermediate having the generic name listed in paragraph (e) or (f) of this section.

(b) Any off-specification commercial chemical product or manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in paragraph (e) or (f) of this section.

(c) Any residue remaining in a container or in an inner liner removed from a container that has held any commercial chemical product or manufacturing chemical intermediate having the generic name listed in paragraphs (e) or (f) of this section, unless the container is empty as defined in §261.7(b) of this chapter.

[*Comment:* Unless the residue is being beneficially used or reused, or legitimately recycled or reclaimed; or being accumulated, stored, transported or treated prior to such use, re-use, recycling or reclamation, EPA considers the residue to be intended for discard, and thus, a hazardous waste. An example of a legitimate re-use of the residue would be where the residue remains in the container and the container is used to hold the same commercial chemical product or manufacturing chemical intermediate it previously held. An example of the discard of the residue would be where the drum is sent to a drum reconditioner who reconditions the drum but discards the residue.]

(d) Any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having the generic name listed in paragraph (e) or (f) of this section, or any residue or contaminated soil, water or other debris resulting from the cleanup of a spill, into or on any land or water, of any off-specification chemical product and manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in paragraph (e) or (f) of this section.

[*Comment:* The phrase "commercial chemical product or manufacturing chemical intermediate having the generic name listed in . . ." refers to a chemical substance which is manufactured or formulated for commercial or manufacturing use which consists of the commercially pure grade of the chemical, any technical grades of the chemical that are produced or marketed, and all formulations in which the chemical is the sole active ingredient. It does not refer to a material, such as a manufacturing process waste, that contains any of the substances listed in paragraph (e) or (f). Where a manufacturing process waste is deemed to be a hazardous waste because it contains a substance listed in paragraph (e) or (f), such waste will be listed in either §261.31 or §261.32 or will be identified as a hazardous waste by the characteristics set forth in subpart C of this part.]

(e) The commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products or manufacturing chemical intermediates referred to in paragraphs (a) through (d) of this section, are identified as acute hazardous wastes (H).

[*Comment:* For the convenience of the regulated community the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), and R (Reactivity). Absence of a letter indicates that the compound only is listed for acute toxicity. Wastes are first listed in alphabetical order by substance and then listed again in numerical order by Hazardous Waste Number.]

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste No.	Chemical abstracts No.	Substance
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-

P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone.
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid $H_3 AsO_4$
P012	1327-53-3	Arsenic oxide $As_2 O_3$
P011	1303-28-2	Arsenic oxide $As_2 O_5$
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol

P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1).
P001	[1]81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide $Ca(CN)_2$
P189	55285-14-8	Carbamic acid, [(dibutylamino)- thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)-1H- pyrazol-5-yl ester.
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester.
P127	1563-66-2	Carbofuran.
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P189	55285-14-8	Carbosulfan.
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P202	64-00-6	m-Cumenyl methylcarbamate.
P030		Cyanides (soluble cyanide salts), not otherwise specified

P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro- 1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro- 1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro- 1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta, 7aalpha)-
P051	[1]72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro- 1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta, 7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan.
P047	[1]534-52-1	4,6-Dinitro-o-cresol, & salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret

P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)-carbonyl]oxime.
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P194	23135-22-0	Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53-9	Formetanate hydrochloride.
P197	17702-57-7	Formparanate.
P065	628-86-4	Fulminic acid, mercury(2 +) salt (R,T)
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P192	119-38-0	Isolan.
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate.

P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S′)-,
P196	15339-36-3	Manganese dimethyldithiocarbamate.
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane, tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P198	23422-53-9	Methanimidamide, N,N-dimethyl-N′-[3-[[(methylamino)-carbonyl]oxy]phenyl]-, monohydrochloride.
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N′-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
P199	2032-65-7	Methiocarb.
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P190	1129-41-5	Metolcarb.
P128	315-8-4	Mexacarbate.
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl $Ni(CO)_4$, (T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cyanide $Ni(CN)_2$

P075	[1]54-11-5	Nicotine, & salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO_2
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO_4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P194	23135-22-0	Oxamyl.
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51-28-5	Phenol, 2,4-dinitro-
P047	[1]534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate.
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester

P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate.
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime.
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine

P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P075	[1]54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-.
P114	12039-52-0	Selenious acid, dithallium(1 +) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	[1]57-24-9	Strychnidin-10-one, & salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	[1]57-24-9	Strychnine, & salts
P115	7446-18-6	Sulfuric acid, dithallium(1 +) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide Tl_2O_3
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide $[(H_2N)C(S)]_2NH$
P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide

P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P185	26419-73-8	Tirpate.
P123	8001-35-2	Toxaphene
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V_2O_5
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	[1]81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S′)-,
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide $Zn(CN)_2$
P122	1314-84-7	Zinc phosphide Zn_3P_2, when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram.
P001	[1]81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P001	[1]81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P002	591-08-2	Acetamide, -(aminothioxomethyl)-
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P003	107-02-8	2-Propenal
P004	309-00-2	Aldrin
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-
P005	107-18-6	Allyl alcohol
P005	107-18-6	2-Propen-1-ol
P006	20859-73-8	Aluminum phosphide (R,T)

P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P008	504-24-5	4-Aminopyridine
P008	504-24-5	4-Pyridinamine
P009	131-74-8	Ammonium picrate (R)
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P010	7778-39-4	Arsenic acid $H_3 AsO_4$
P011	1303-28-2	Arsenic oxide $As_2 O_5$
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic oxide $As_2 O_3$
P012	1327-53-3	Arsenic trioxide
P013	542-62-1	Barium cyanide
P014	108-98-5	Benzenethiol
P014	108-98-5	Thiophenol
P015	7440-41-7	Beryllium powder
P016	542-88-1	Dichloromethyl ether
P016	542-88-1	Methane, oxybis[chloro-
P017	598-31-2	Bromoacetone
P017	598-31-2	2-Propanone, 1-bromo-
P018	357-57-3	Brucine
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P020	88-85-7	Dinoseb
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide $Ca(CN)_2$
P022	75-15-0	Carbon disulfide
P023	107-20-0	Acetaldehyde, chloro-
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	Benzenamine, 4-chloro-
P024	106-47-8	p-Chloroaniline

P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P027	542-76-7	3-Chloropropionitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P028	100-44-7	Benzene, (chloromethyl)-
P028	100-44-7	Benzyl chloride
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P030		Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P031	460-19-5	Ethanedinitrile
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P036	696-28-6	Arsonous dichloride, phenyl-
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta, 7aalpha)-
P038	692-42-2	Arsine, diethyl-
P038	692-42-2	Diethylarsine
P039	298-04-4	Disulfoton
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P042	51-43-4	Epinephrine

P043	55-91-4	Diisopropylfluorophosphate (DFP)
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P044	60-51-5	Dimethoate
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methyl amino)-2-oxoethyl] ester
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime
P045	39196-18-4	Thiofanox
P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P047	[1]534-52-1	4,6-Dinitro-o-cresol, & salts
P047	[1]534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P048	51-28-5	2,4-Dinitrophenol
P048	51-28-5	Phenol, 2,4-dinitro-
P049	541-53-7	Dithiobiuret
P049	541-53-7	Thioimidodicarbonic diamide $[(H_2N)C(S)]_2NH$
P050	115-29-7	Endosulfan
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P051	[1]72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta, 7aalpha)-, & metabolites
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P054	151-56-4	Aziridine
P054	151-56-4	Ethyleneimine
P056	7782-41-4	Fluorine
P057	640-19-7	Acetamide, 2-fluoro-
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P058	62-74-8	Fluoroacetic acid, sodium salt

P059	76-44-8	Heptachlor
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-
P060	465-73-6	Isodrin
P062	757-58-4	Hexaethyl tetraphosphate
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P064	624-83-9	Methane, isocyanato-
P064	624-83-9	Methyl isocyanate
P065	628-86-4	Fulminic acid, mercury(2 +) salt (R,T)
P065	628-86-4	Mercury fulminate (R,T)
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P066	16752-77-5	Methomyl
P067	75-55-8	Aziridine, 2-methyl-
P067	75-55-8	1,2-Propylenimine
P068	60-34-4	Hydrazine, methyl-
P068	60-34-4	Methyl hydrazine
P069	75-86-5	2-Methyllactonitrile
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P070	116-06-3	Aldicarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P071	298-00-0	Methyl parathion
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P072	86-88-4	alpha-Naphthylthiourea
P072	86-88-4	Thiourea, 1-naphthalenyl-
P073	13463-39-3	Nickel carbonyl

P073	13463-39-3	Nickel carbonyl $Ni(CO)_4$, (T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cyanide $Ni(CN)_2$
P075	[1]54-11-5	Nicotine, & salts
P075	[1]54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P076	10102-43-9	Nitric oxide
P076	10102-43-9	Nitrogen oxide NO
P077	100-01-6	Benzenamine, 4-nitro-
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P078	10102-44-0	Nitrogen oxide NO_2
P081	55-63-0	Nitroglycerine (R)
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P082	62-75-9	Methanamine, -methyl-N-nitroso-
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P084	4549-40-0	Vinylamine, -methyl-N-nitroso-
P085	152-16-9	Diphosphoramide, octamethyl-
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO_4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	Endothall
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P089	56-38-2	Parathion
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P092	62-38-4	Mercury, (acetato-O)phenyl-
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P093	103-85-5	Thiourea, phenyl-
P094	298-02-2	Phorate

P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P095	75-44-5	Carbonic dichloride
P095	75-44-5	Phosgene
P096	7803-51-2	Hydrogen phosphide
P096	7803-51-2	Phosphine
P097	52-85-7	Famphur
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P099	506-61-6	Potassium silver cyanide
P101	107-12-0	Ethyl cyanide
P101	107-12-0	Propanenitrile
P102	107-19-7	Propargyl alcohol
P102	107-19-7	2-Propyn-1-ol
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	[1]157-24-9	Strychnidin-10-one, & salts
P108	[1]157-24-9	Strychnine, & salts
P109	3689-24-5	Tetraethyldithiopyrophosphate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P110	78-00-2	Plumbane, tetraethyl-
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P111	107-49-3	Tetraethyl pyrophosphate

P112	509-14-8	Methane, tetranitro-(R)
P112	509-14-8	Tetranitromethane (R)
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide $Tl_2 O_3$
P114	12039-52-0	Selenious acid, dithallium(1 +) salt
P114	12039-52-0	Tetraethyldithiopyrophosphate
P115	7446-18-6	Thiodiphosphoric acid, tetraethyl ester
P115	7446-18-6	Plumbane, tetraethyl-
P116	79-19-6	Tetraethyl lead
P116	79-19-6	Thiosemicarbazide
P118	75-70-7	Methanethiol, trichloro-
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Ammonium vanadate
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V_2O_5
P120	1314-62-1	Vanadium pentoxide
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide $Zn(CN)_2$
P122	1314-84-7	Zinc phosphide $Zn_3 P_2$, when present at concentrations greater than 10% (R,T)
P123	8001-35-2	Toxaphene
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P127	1563-66-2	Carbofuran
P128	315-8-4	Mexacarbate
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)-carbonyl]oxime.
P185	26419-73-8	Tirpate
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1)

P188	57-64-7	Physostigmine salicylate
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester
P189	55285-14-8	Carbosulfan
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester
P190	1129-41-5	Metolcarb
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]-5-methyl-1H-pyrazol-3-yl ester
P191	644-64-4	Dimetilan
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H-pyrazol-5-yl ester
P192	119-38-0	Isolan
P194	23135-22-0	Ethanimidthioic acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester
P194	23135-22-0	Oxamyl
P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S′)-,
P196	15339-36-3	Manganese dimethyldithiocarbamate
P197	17702-57-7	Formparanate
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N′-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-
P198	23422-53-9	Formetanate hydrochloride
P198	23422-53-9	Methanimidamide, N,N-dimethyl-N′-[3-[[(methylamino)-carbonyl]oxy]phenyl]-monohydrochloride
P199	2032-65-7	Methiocarb
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate
P201	2631-37-0	Promecarb
P202	64-00-6	m-Cumenyl methylcarbamate
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate
P203	1646-88-4	Aldicarb sulfone
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime

P204	57-47-6	Physostigmine
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S′)-,
P205	137-30-4	Ziram

[1]CAS Number given for parent compound only.

(f) The commercial chemical products, manufacturing chemical intermediates, or off-specification commercial chemical products referred to in paragraphs (a) through (d) of this section, are identified as toxic wastes (T) unless otherwise designated.

[*Comment:* For the convenience of the regulated community, the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), R (Reactivity), I (Ignitability) and C (Corrosivity). Absence of a letter indicates that the compound is only listed for toxicity. Wastes are first listed in alphabetical order by substance and then listed again in numerical order by Hazardous Waste Number.]

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste No.	Chemical abstracts No.	Substance
U394	30558-43-1	A2213.
U001	75-07-0	Acetaldehyde (I)
U034	75-87-6	Acetaldehyde, trichloro-
U187	62-44-2	Acetamide, N-(4-ethoxyphenyl)-
U005	53-96-3	Acetamide, N-9H-fluoren-2-yl-
U240	[1]94-75-7	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters
U112	141-78-6	Acetic acid ethyl ester (I)
U144	301-04-2	Acetic acid, lead(2 +) salt
U214	563-68-8	Acetic acid, thallium(1 +) salt
see F027	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-
U002	67-64-1	Acetone (I)
U003	75-05-8	Acetonitrile (I,T)
U004	98-86-2	Acetophenone
U005	53-96-3	2-Acetylaminofluorene

U006	75-36-5	Acetyl chloride (C,R,T)
U007	79-06-1	Acrylamide
U008	79-10-7	Acrylic acid (I)
U009	107-13-1	Acrylonitrile
U011	61-82-5	Amitrole
U012	62-53-3	Aniline (I,T)
U136	75-60-5	Arsinic acid, dimethyl-
U014	492-80-8	Auramine
U015	115-02-6	Azaserine
U010	50-07-7	Azirino[2′,3′:3,4]pyrrolo[1,2-a]indole-4,7-dione, 6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha, 8beta,8aalpha,8balpha)]-
U280	101-27-9	Barban.
U278	22781-23-3	Bendiocarb.
U364	22961-82-6	Bendiocarb phenol.
U271	17804-35-2	Benomyl.
U157	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U016	225-51-4	Benz[c]acridine
U017	98-87-3	Benzal chloride
U192	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U018	56-55-3	Benz[a]anthracene
U094	57-97-6	Benz[a]anthracene, 7,12-dimethyl-
U012	62-53-3	Benzenamine (I,T)
U014	492-80-8	Benzenamine, 4,4′-carbonimidoylbis[N,N-dimethyl-
U049	3165-93-3	Benzenamine, 4-chloro-2-methyl-, hydrochloride

U093	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-
U328	95-53-4	Benzenamine, 2-methyl-
U353	106-49-0	Benzenamine, 4-methyl-
U158	101-14-4	Benzenamine, 4,4′-methylenebis[2-chloro-
U222	636-21-5	Benzenamine, 2-methyl-, hydrochloride
U181	99-55-8	Benzenamine, 2-methyl-5-nitro-
U019	71-43-2	Benzene (I,T)
U038	510-15-6	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U035	305-03-3	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-
U037	108-90-7	Benzene, chloro-
U221	25376-45-8	Benzenediamine, ar-methyl-
U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U069	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester
U088	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
U102	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
U107	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester
U070	95-50-1	Benzene, 1,2-dichloro-
U071	541-73-1	Benzene, 1,3-dichloro-
U072	106-46-7	Benzene, 1,4-dichloro-
U060	72-54-8	Benzene, 1,1′-(2,2-dichloroethylidene)bis[4-chloro-
U017	98-87-3	Benzene, (dichloromethyl)-
U223	26471-62-5	Benzene, 1,3-diisocyanatomethyl- (R,T)
U239	1330-20-7	Benzene, dimethyl- (I)
U201	108-46-3	1,3-Benzenediol
U127	118-74-1	Benzene, hexachloro-

U056	110-82-7	Benzene, hexahydro- (I)
U220	108-88-3	Benzene, methyl-
U105	121-14-2	Benzene, 1-methyl-2,4-dinitro-
U106	606-20-2	Benzene, 2-methyl-1,3-dinitro-
U055	98-82-8	Benzene, (1-methylethyl)- (I)
U169	98-95-3	Benzene, nitro-
U183	608-93-5	Benzene, pentachloro-
U185	82-68-8	Benzene, pentachloronitro-
U020	98-09-9	Benzenesulfonic acid chloride (C,R)
U020	98-09-9	Benzenesulfonyl chloride (C,R)
U207	95-94-3	Benzene, 1,2,4,5-tetrachloro-
U061	50-29-3	Benzene, 1,1′-(2,2,2-trichloroethylidene)bis[4-chloro-
U247	72-43-5	Benzene, 1,1′-(2,2,2-trichloroethylidene)bis[4- methoxy-
U023	98-07-7	Benzene, (trichloromethyl)-
U234	99-35-4	Benzene, 1,3,5-trinitro-
U021	92-87-5	Benzidine
U278	22781-23-3	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate.
U364	22961-82-6	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,
U203	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-
U141	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-
U367	1563-38-8	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-
U090	94-58-6	1,3-Benzodioxole, 5-propyl-
U064	189-55-9	Benzo[rst]pentaphene
U248	[1]81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts, when present at concentrations of 0.3% or less
U022	50-32-8	Benzo[a]pyrene
U197	106-51-4	p-Benzoquinone

U023	98-07-7	Benzotrichloride (C,R,T)
U085	1464-53-5	2,2′-Bioxirane
U021	92-87-5	[1,1′-Biphenyl]-4,4′-diamine
U073	91-94-1	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dichloro-
U091	119-90-4	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dimethoxy-
U095	119-93-7	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dimethyl-
U225	75-25-2	Bromoform
U030	101-55-3	4-Bromophenyl phenyl ether
U128	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	924-16-3	1-Butanamine, N-butyl-N-nitroso-
U031	71-36-3	1-Butanol (I)
U159	78-93-3	2-Butanone (I,T)
U160	1338-23-4	2-Butanone, peroxide (R,T)
U053	4170-30-3	2-Butenal
U074	764-41-0	2-Butene, 1,4-dichloro- (I,T)
U143	303-34-4	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy- 2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]- 2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*),7aalpha]]-
U031	71-36-3	n-Butyl alcohol (I)
U136	75-60-5	Cacodylic acid
U032	13765-19-0	Calcium chromate
U372	10605-21-7	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester.
U271	17804-35-2	Carbamic acid, [1-[(butylamino)carbonyl]-1H-benzimidazol-2-yl]-, methyl ester.

U280	101-27-9	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester.
U238	51-79-6	Carbamic acid, ethyl ester
U178	615-53-2	Carbamic acid, methylnitroso-, ethyl ester
U373	122-42-9	Carbamic acid, phenyl-, 1-methylethyl ester.
U409	23564-05-8	Carbamic acid, [1,2-phenylenebis (iminocarbonothioyl)]bis-, dimethyl ester.
U097	79-44-7	Carbamic chloride, dimethyl-
U389	2303-17-5	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester.
U387	52888-80-9	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester.
U114	[1]111-54-6	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters
U062	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester
U279	63-25-2	Carbaryl.
U372	10605-21-7	Carbendazim.
U367	1563-38-8	Carbofuran phenol.
U215	6533-73-9	Carbonic acid, dithallium(1 +) salt
U033	353-50-4	Carbonic difluoride
U156	79-22-1	Carbonochloridic acid, methyl ester (I,T)
U033	353-50-4	Carbon oxyfluoride (R,T)
U211	56-23-5	Carbon tetrachloride
U034	75-87-6	Chloral
U035	305-03-3	Chlorambucil
U036	57-74-9	Chlordane, alpha & gamma isomers
U026	494-03-1	Chlornaphazin
U037	108-90-7	Chlorobenzene
U038	510-15-6	Chlorobenzilate

U039	59-50-7	p-Chloro-m-cresol
U042	110-75-8	2-Chloroethyl vinyl ether
U044	67-66-3	Chloroform
U046	107-30-2	Chloromethyl methyl ether
U047	91-58-7	beta-Chloronaphthalene
U048	95-57-8	o-Chlorophenol
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U032	13765-19-0	Chromic acid H_2CrO_4, calcium salt
U050	218-01-9	Chrysene
U051		Creosote
U052	1319-77-3	Cresol (Cresylic acid)
U053	4170-30-3	Crotonaldehyde
U055	98-82-8	Cumene (I)
U246	506-68-3	Cyanogen bromide (CN)Br
U197	106-51-4	2,5-Cyclohexadiene-1,4-dione
U056	110-82-7	Cyclohexane (I)
U129	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-
U057	108-94-1	Cyclohexanone (I)
U130	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U058	50-18-0	Cyclophosphamide
U240	[1]94-75-7	2,4-D, salts & esters
U059	20830-81-3	Daunomycin
U060	72-54-8	DDD
U061	50-29-3	DDT
U062	2303-16-4	Diallate
U063	53-70-3	Dibenz[a,h]anthracene

U064	189-55-9	Dibenzo[a,i]pyrene
U066	96-12-8	1,2-Dibromo-3-chloropropane
U069	84-74-2	Dibutyl phthalate
U070	95-50-1	o-Dichlorobenzene
U071	541-73-1	m-Dichlorobenzene
U072	106-46-7	p-Dichlorobenzene
U073	91-94-1	3,3′-Dichlorobenzidine
U074	764-41-0	1,4-Dichloro-2-butene (I,T)
U075	75-71-8	Dichlorodifluoromethane
U078	75-35-4	1,1-Dichloroethylene
U079	156-60-5	1,2-Dichloroethylene
U025	111-44-4	Dichloroethyl ether
U027	108-60-1	Dichloroisopropyl ether
U024	111-91-1	Dichloromethoxy ethane
U081	120-83-2	2,4-Dichlorophenol
U082	87-65-0	2,6-Dichlorophenol
U084	542-75-6	1,3-Dichloropropene
U085	1464-53-5	1,2:3,4-Diepoxybutane (I,T)
U108	123-91-1	1,4-Diethyleneoxide
U028	117-81-7	Diethylhexyl phthalate
U395	5952-26-1	Diethylene glycol, dicarbamate.
U086	1615-80-1	N,N′-Diethylhydrazine
U087	3288-58-2	O,O-Diethyl S-methyl dithiophosphate
U088	84-66-2	Diethyl phthalate
U089	56-53-1	Diethylstilbesterol
U090	94-58-6	Dihydrosafrole
U091	119-90-4	3,3′-Dimethoxybenzidine

U092	124-40-3	Dimethylamine (I)
U093	60-11-7	p-Dimethylaminoazobenzene
U094	57-97-6	7,12-Dimethylbenz[a]anthracene
U095	119-93-7	3,3′-Dimethylbenzidine
U096	80-15-9	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U097	79-44-7	Dimethylcarbamoyl chloride
U098	57-14-7	1,1-Dimethylhydrazine
U099	540-73-8	1,2-Dimethylhydrazine
U101	105-67-9	2,4-Dimethylphenol
U102	131-11-3	Dimethyl phthalate
U103	77-78-1	Dimethyl sulfate
U105	121-14-2	2,4-Dinitrotoluene
U106	606-20-2	2,6-Dinitrotoluene
U107	117-84-0	Di-n-octyl phthalate
U108	123-91-1	1,4-Dioxane
U109	122-66-7	1,2-Diphenylhydrazine
U110	142-84-7	Dipropylamine (I)
U111	621-64-7	Di-n-propylnitrosamine
U041	106-89-8	Epichlorohydrin
U001	75-07-0	Ethanal (I)
U404	121-44-8	Ethanamine, N,N-diethyl-
U174	55-18-5	Ethanamine, N-ethyl-N-nitroso-
U155	91-80-5	1,2-Ethanediamine, N,N-dimethyl-N′-2-pyridinyl-N′-(2-thienylmethyl)-
U067	106-93-4	Ethane, 1,2-dibromo-
U076	75-34-3	Ethane, 1,1-dichloro-
U077	107-06-2	Ethane, 1,2-dichloro-
U131	67-72-1	Ethane, hexachloro-
U024	111-91-1	Ethane, 1,1′-[methylenebis(oxy)]bis[2-chloro-

U117	60-29-7	Ethane, 1,1′-oxybis-(I)
U025	111-44-4	Ethane, 1,1′-oxybis[2-chloro-
U184	76-01-7	Ethane, pentachloro-
U208	630-20-6	Ethane, 1,1,1,2-tetrachloro-
U209	79-34-5	Ethane, 1,1,2,2-tetrachloro-
U218	62-55-5	Ethanethioamide
U226	71-55-6	Ethane, 1,1,1-trichloro-
U227	79-00-5	Ethane, 1,1,2-trichloro-
U410	59669-26-0	Ethanimidothioic acid, N,N′-[thiobis[(methylimino)carbonyloxy]]bis-, dimethyl ester
U394	30558-43-1	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester.
U359	110-80-5	Ethanol, 2-ethoxy-
U173	1116-54-7	Ethanol, 2,2′-(nitrosoimino)bis-
U395	5952-26-1	Ethanol, 2,2′-oxybis-, dicarbamate.
U004	98-86-2	Ethanone, 1-phenyl-
U043	75-01-4	Ethene, chloro-
U042	110-75-8	Ethene, (2-chloroethoxy)-
U078	75-35-4	Ethene, 1,1-dichloro-
U079	156-60-5	Ethene, 1,2-dichloro-, (E)-
U210	127-18-4	Ethene, tetrachloro-
U228	79-01-6	Ethene, trichloro-
U112	141-78-6	Ethyl acetate (I)
U113	140-88-5	Ethyl acrylate (I)
U238	51-79-6	Ethyl carbamate (urethane)
U117	60-29-7	Ethyl ether (I)
U114	[1]111-54-6	Ethylenebisdithiocarbamic acid, salts & esters
U067	106-93-4	Ethylene dibromide

U077	107-06-2	Ethylene dichloride
U359	110-80-5	Ethylene glycol monoethyl ether
U115	75-21-8	Ethylene oxide (I,T)
U116	96-45-7	Ethylenethiourea
U076	75-34-3	Ethylidene dichloride
U118	97-63-2	Ethyl methacrylate
U119	62-50-0	Ethyl methanesulfonate
U120	206-44-0	Fluoranthene
U122	50-00-0	Formaldehyde
U123	64-18-6	Formic acid (C,T)
U124	110-00-9	Furan (I)
U125	98-01-1	2-Furancarboxaldehyde (I)
U147	108-31-6	2,5-Furandione
U213	109-99-9	Furan, tetrahydro-(I)
U125	98-01-1	Furfural (I)
U124	110-00-9	Furfuran (I)
U206	18883-66-4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-, D-
U206	18883-66-4	D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)-carbonyl]amino]-
U126	765-34-4	Glycidylaldehyde
U163	70-25-7	Guanidine, N-methyl-N′-nitro-N-nitroso-
U127	118-74-1	Hexachlorobenzene
U128	87-68-3	Hexachlorobutadiene
U130	77-47-4	Hexachlorocyclopentadiene
U131	67-72-1	Hexachloroethane
U132	70-30-4	Hexachlorophene
U243	1888-71-7	Hexachloropropene
U133	302-01-2	Hydrazine (R,T)

U086	1615-80-1	Hydrazine, 1,2-diethyl-
U098	57-14-7	Hydrazine, 1,1-dimethyl-
U099	540-73-8	Hydrazine, 1,2-dimethyl-
U109	122-66-7	Hydrazine, 1,2-diphenyl-
U134	7664-39-3	Hydrofluoric acid (C,T)
U134	7664-39-3	Hydrogen fluoride (C,T)
U135	7783-06-4	Hydrogen sulfide
U135	7783-06-4	Hydrogen sulfide H_2S
U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethyl- (R)
U116	96-45-7	2-Imidazolidinethione
U137	193-39-5	Indeno[1,2,3-cd]pyrene
U190	85-44-9	1,3-Isobenzofurandione
U140	78-83-1	Isobutyl alcohol (I,T)
U141	120-58-1	Isosafrole
U142	143-50-0	Kepone
U143	303-34-4	Lasiocarpine
U144	301-04-2	Lead acetate
U146	1335-32-6	Lead, bis(acetato-O)tetrahydroxytri-
U145	7446-27-7	Lead phosphate
U146	1335-32-6	Lead subacetate
U129	58-89-9	Lindane
U163	70-25-7	MNNG
U147	108-31-6	Maleic anhydride
U148	123-33-1	Maleic hydrazide
U149	109-77-3	Malononitrile

U150	148-82-3	Melphalan
U151	7439-97-6	Mercury
U152	126-98-7	Methacrylonitrile (I, T)
U092	124-40-3	Methanamine, N-methyl- (I)
U029	74-83-9	Methane, bromo-
U045	74-87-3	Methane, chloro- (I, T)
U046	107-30-2	Methane, chloromethoxy-
U068	74-95-3	Methane, dibromo-
U080	75-09-2	Methane, dichloro-
U075	75-71-8	Methane, dichlorodifluoro-
U138	74-88-4	Methane, iodo-
U119	62-50-0	Methanesulfonic acid, ethyl ester
U211	56-23-5	Methane, tetrachloro-
U153	74-93-1	Methanethiol (I, T)
U225	75-25-2	Methane, tribromo-
U044	67-66-3	Methane, trichloro-
U121	75-69-4	Methane, trichlorofluoro-
U036	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
U154	67-56-1	Methanol (I)
U155	91-80-5	Methapyrilene
U142	143-50-0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-
U247	72-43-5	Methoxychlor
U154	67-56-1	Methyl alcohol (I)
U029	74-83-9	Methyl bromide
U186	504-60-9	1-Methylbutadiene (I)
U045	74-87-3	Methyl chloride (I,T)
U156	79-22-1	Methyl chlorocarbonate (I,T)

U226	71-55-6	Methyl chloroform
U157	56-49-5	3-Methylcholanthrene
U158	101-14-4	4,4′-Methylenebis(2-chloroaniline)
U068	74-95-3	Methylene bromide
U080	75-09-2	Methylene chloride
U159	78-93-3	Methyl ethyl ketone (MEK) (I,T)
U160	1338-23-4	Methyl ethyl ketone peroxide (R,T)
U138	74-88-4	Methyl iodide
U161	108-10-1	Methyl isobutyl ketone (I)
U162	80-62-6	Methyl methacrylate (I,T)
U161	108-10-1	4-Methyl-2-pentanone (I)
U164	56-04-2	Methylthiouracil
U010	50-07-7	Mitomycin C
U059	20830-81-3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-
U167	134-32-7	1-Naphthalenamine
U168	91-59-8	2-Naphthalenamine
U026	494-03-1	Naphthalenamine, N,N′-bis(2-chloroethyl)-
U165	91-20-3	Naphthalene
U047	91-58-7	Naphthalene, 2-chloro-
U166	130-15-4	1,4-Naphthalenedione
U236	72-57-1	2,7-Naphthalenedisulfonic acid, 3,3′-[(3,3′-dimethyl[1,1′-biphenyl]-4,4′-diyl)bis(azo)bis[5-amino-4-hydroxy]-, tetrasodium salt
U279	63-25-2	1-Naphthalenol, methylcarbamate.
U166	130-15-4	1,4-Naphthoquinone
U167	134-32-7	alpha-Naphthylamine
U168	91-59-8	beta-Naphthylamine

U217	10102-45-1	Nitric acid, thallium(1 +) salt
U169	98-95-3	Nitrobenzene (I,T)
U170	100-02-7	p-Nitrophenol
U171	79-46-9	2-Nitropropane (I,T)
U172	924-16-3	N-Nitrosodi-n-butylamine
U173	1116-54-7	N-Nitrosodiethanolamine
U174	55-18-5	N-Nitrosodiethylamine
U176	759-73-9	N-Nitroso-N-ethylurea
U177	684-93-5	N-Nitroso-N-methylurea
U178	615-53-2	N-Nitroso-N-methylurethane
U179	100-75-4	N-Nitrosopiperidine
U180	930-55-2	N-Nitrosopyrrolidine
U181	99-55-8	5-Nitro-o-toluidine
U193	1120-71-4	1,2-Oxathiolane, 2,2-dioxide
U058	50-18-0	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U115	75-21-8	Oxirane (I,T)
U126	765-34-4	Oxiranecarboxyaldehyde
U041	106-89-8	Oxirane, (chloromethyl)-
U182	123-63-7	Paraldehyde
U183	608-93-5	Pentachlorobenzene
U184	76-01-7	Pentachloroethane
U185	82-68-8	Pentachloronitrobenzene (PCNB)
See F027	87-86-5	Pentachlorophenol
U161	108-10-1	Pentanol, 4-methyl-
U186	504-60-9	1,3-Pentadiene (I)
U187	62-44-2	Phenacetin
U188	108-95-2	Phenol

U048	95-57-8	Phenol, 2-chloro-
U039	59-50-7	Phenol, 4-chloro-3-methyl-
U081	120-83-2	Phenol, 2,4-dichloro-
U082	87-65-0	Phenol, 2,6-dichloro-
U089	56-53-1	Phenol, 4,4′-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U101	105-67-9	Phenol, 2,4-dimethyl-
U052	1319-77-3	Phenol, methyl-
U132	70-30-4	Phenol, 2,2′-methylenebis[3,4,6-trichloro-
U411	114-26-1	Phenol, 2-(1-methylethoxy)-, methylcarbamate.
U170	100-02-7	Phenol, 4-nitro-
See F027	87-86-5	Phenol, pentachloro-
See F027	58-90-2	Phenol, 2,3,4,6-tetrachloro-
See F027	95-95-4	Phenol, 2,4,5-trichloro-
See F027	88-06-2	Phenol, 2,4,6-trichloro-
U150	148-82-3	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-
U145	7446-27-7	Phosphoric acid, lead(2 +) salt (2:3)
U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U189	1314-80-3	Phosphorus sulfide (R)
U190	85-44-9	Phthalic anhydride
U191	109-06-8	2-Picoline
U179	100-75-4	Piperidine, 1-nitroso-
U192	23950-58-5	Pronamide
U194	107-10-8	1-Propanamine (I,T)
U111	621-64-7	1-Propanamine, N-nitroso-N-propyl-
U110	142-84-7	1-Propanamine, N-propyl- (I)

U066	96-12-8	Propane, 1,2-dibromo-3-chloro-
U083	78-87-5	Propane, 1,2-dichloro-
U149	109-77-3	Propanedinitrile
U171	79-46-9	Propane, 2-nitro- (I,T)
U027	108-60-1	Propane, 2,2′-oxybis[2-chloro-
U193	1120-71-4	1,3-Propane sultone
See F027	93-72-1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-
U235	126-72-7	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U140	78-83-1	1-Propanol, 2-methyl- (I,T)
U002	67-64-1	2-Propanone (I)
U007	79-06-1	2-Propenamide
U084	542-75-6	1-Propene, 1,3-dichloro-
U243	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	107-13-1	2-Propenenitrile
U152	126-98-7	2-Propenenitrile, 2-methyl- (I,T)
U008	79-10-7	2-Propenoic acid (I)
U113	140-88-5	2-Propenoic acid, ethyl ester (I)
U118	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester
U162	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U373	122-42-9	Propham.
U411	114-26-1	Propoxur.
U387	52888-80-9	Prosulfocarb.
U194	107-10-8	n-Propylamine (I,T)
U083	78-87-5	Propylene dichloride
U148	123-33-1	3,6-Pyridazinedione, 1,2-dihydro-
U196	110-86-1	Pyridine
U191	109-06-8	Pyridine, 2-methyl-

U237	66-75-1	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U164	56-04-2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U180	930-55-2	Pyrrolidine, 1-nitroso-
U200	50-55-5	Reserpine
U201	108-46-3	Resorcinol
U203	94-59-7	Safrole
U204	7783-00-8	Selenious acid
U204	7783-00-8	Selenium dioxide
U205	7488-56-4	Selenium sulfide
U205	7488-56-4	Selenium sulfide SeS_2 (R,T)
U015	115-02-6	L-Serine, diazoacetate (ester)
See F027	93-72-1	Silvex (2,4,5-TP)
U206	18883-66-4	Streptozotocin
U103	77-78-1	Sulfuric acid, dimethyl ester
U189	1314-80-3	Sulfur phosphide (R)
See F027	93-76-5	2,4,5-T
U207	95-94-3	1,2,4,5-Tetrachlorobenzene
U208	630-20-6	1,1,1,2-Tetrachloroethane
U209	79-34-5	1,1,2,2-Tetrachloroethane
U210	127-18-4	Tetrachloroethylene
See F027	58-90-2	2,3,4,6-Tetrachlorophenol
U213	109-99-9	Tetrahydrofuran (I)
U214	563-68-8	Thallium(I) acetate
U215	6533-73-9	Thallium(I) carbonate

U216	7791-12-0	Thallium(I) chloride
U216	7791-12-0	thallium chloride TlCl
U217	10102-45-1	Thallium(I) nitrate
U218	62-55-5	Thioacetamide
U410	59669-26-0	Thiodicarb.
U153	74-93-1	Thiomethanol (I,T)
U244	137-26-8	Thioperoxydicarbonic diamide $[(H_2N)C(S)]_2S_2$, tetramethyl-
U409	23564-05-8	Thiophanate-methyl.
U219	62-56-6	Thiourea
U244	137-26-8	Thiram
U220	108-88-3	Toluene
U221	25376-45-8	Toluenediamine
U223	26471-62-5	Toluene diisocyanate (R,T)
U328	95-53-4	o-Toluidine
U353	106-49-0	p-Toluidine
U222	636-21-5	o-Toluidine hydrochloride
U389	2303-17-5	Triallate.
U011	61-82-5	1H-1,2,4-Triazol-3-amine
U226	71-55-6	1,1,1-Trichloroethane
U227	79-00-5	1,1,2-Trichloroethane
U228	79-01-6	Trichloroethylene
U121	75-69-4	Trichloromonofluoromethane
See F027	95-95-4	2,4,5-Trichlorophenol
See F027	88-06-2	2,4,6-Trichlorophenol

U404	121-44-8	Triethylamine.
U234	99-35-4	1,3,5-Trinitrobenzene (R,T)
U182	123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-
U235	126-72-7	Tris(2,3-dibromopropyl) phosphate
U236	72-57-1	Trypan blue
U237	66-75-1	Uracil mustard
U176	759-73-9	Urea, N-ethyl-N-nitroso-
U177	684-93-5	Urea, N-methyl-N-nitroso-
U043	75-01-4	Vinyl chloride
U248	[1]81-81-2	Warfarin, & salts, when present at concentrations of 0.3% or less
U239	1330-20-7	Xylene (I)
U200	50-55-5	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methyl ester, (3beta,16beta,17alpha,18beta,20alpha)-
U249	1314-84-7	Zinc phosphide $Zn_3 P_2$, when present at concentrations of 10% or less
U001	75-07-0	Acetaldehyde (I)
U001	75-07-0	Ethanal (I)
U002	67-64-1	Acetone (I)
U002	67-64-1	2-Propanone (I)
U003	75-05-8	Acetonitrile (I,T)
U004	98-86-2	Acetophenone
U004	98-86-2	Ethanone, 1-phenyl-
U005	53-96-3	Acetamide, -9H-fluoren-2-yl-
U005	53-96-3	2-Acetylaminofluorene
U006	75-36-5	Acetyl chloride (C,R,T)
U007	79-06-1	Acrylamide
U007	79-06-1	2-Propenamide
U008	79-10-7	Acrylic acid (I)

U008	79-10-7	2-Propenoic acid (I)
U009	107-13-1	Acrylonitrile
U009	107-13-1	2-Propenenitrile
U010	50-07-7	Azirino[2′,3′:3,4]pyrrolo[1,2-a]indole-4,7-dione, 6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha, 8beta,8aalpha,8balpha)]-
U010	50-07-7	Mitomycin C
U011	61-82-5	Amitrole
U011	61-82-5	1H-1,2,4-Triazol-3-amine
U012	62-53-3	Aniline (I,T)
U012	62-53-3	Benzenamine (I,T)
U014	492-80-8	Auramine
U014	492-80-8	Benzenamine, 4,4′-carbonimidoylbis[N,N-dimethyl-
U015	115-02-6	Azaserine
U015	115-02-6	L-Serine, diazoacetate (ester)
U016	225-51-4	Benz[c]acridine
U017	98-87-3	Benzal chloride
U017	98-87-3	Benzene, (dichloromethyl)-
U018	56-55-3	Benz[a]anthracene
U019	71-43-2	Benzene (I,T)
U020	98-09-9	Benzenesulfonic acid chloride (C,R)
U020	98-09-9	Benzenesulfonyl chloride (C,R)
U021	92-87-5	Benzidine
U021	92-87-5	[1,1′-Biphenyl]-4,4′-diamine
U022	50-32-8	Benzo[a]pyrene
U023	98-07-7	Benzene, (trichloromethyl)-
U023	98-07-7	Benzotrichloride (C,R,T)
U024	111-91-1	Dichloromethoxy ethane

U024	111-91-1	Ethane, 1,1′-[methylenebis(oxy)]bis[2-chloro-
U025	111-44-4	Dichloroethyl ether
U025	111-44-4	Ethane, 1,1′-oxybis[2-chloro-
U026	494-03-1	Chlornaphazin
U026	494-03-1	Naphthalenamine, N,N′-bis(2-chloroethyl)-
U027	108-60-1	Dichloroisopropyl ether
U027	108-60-1	Propane, 2,2′-oxybis[2-chloro-
U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U028	117-81-7	Diethylhexyl phthalate
U029	74-83-9	Methane, bromo-
U029	74-83-9	Methyl bromide
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U030	101-55-3	4-Bromophenyl phenyl ether
U031	71-36-3	1-Butanol (I)
U031	71-36-3	n-Butyl alcohol (I)
U032	13765-19-0	Calcium chromate
U032	13765-19-0	Chromic acid $H_2 CrO_4$, calcium salt
U033	353-50-4	Carbonic difluoride
U033	353-50-4	Carbon oxyfluoride (R,T)
U034	75-87-6	Acetaldehyde, trichloro-
U034	75-87-6	Chloral
U035	305-03-3	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-
U035	305-03-3	Chlorambucil
U036	57-74-9	Chlordane, alpha & gamma isomers
U036	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
U037	108-90-7	Benzene, chloro-

U037	108-90-7	Chlorobenzene
U038	510-15-6	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester
U038	510-15-6	Chlorobenzilate
U039	59-50-7	p-Chloro-m-cresol
U039	59-50-7	Phenol, 4-chloro-3-methyl-
U041	106-89-8	Epichlorohydrin
U041	106-89-8	Oxirane, (chloromethyl)-
U042	110-75-8	2-Chloroethyl vinyl ether
U042	110-75-8	Ethene, (2-chloroethoxy)-
U043	75-01-4	Ethene, chloro-
U043	75-01-4	Vinyl chloride
U044	67-66-3	Chloroform
U044	67-66-3	Methane, trichloro-
U045	74-87-3	Methane, chloro- (I,T)
U045	74-87-3	Methyl chloride (I,T)
U046	107-30-2	Chloromethyl methyl ether
U046	107-30-2	Methane, chloromethoxy-
U047	91-58-7	beta-Chloronaphthalene
U047	91-58-7	Naphthalene, 2-chloro-
U048	95-57-8	o-Chlorophenol
U048	95-57-8	Phenol, 2-chloro-
U049	3165-93-3	Benzenamine, 4-chloro-2-methyl-, hydrochloride
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U050	218-01-9	Chrysene
U051		Creosote
U052	1319-77-3	Cresol (Cresylic acid)
U052	1319-77-3	Phenol, methyl-

U053	4170-30-3	2-Butenal
U053	4170-30-3	Crotonaldehyde
U055	98-82-8	Benzene, (1-methylethyl)-(I)
U055	98-82-8	Cumene (I)
U056	110-82-7	Benzene, hexahydro-(I)
U056	110-82-7	Cyclohexane (I)
U057	108-94-1	Cyclohexanone (I)
U058	50-18-0	Cyclophosphamide
U058	50-18-0	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U059	20830-81-3	Daunomycin
U059	20830-81-3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-
U060	72-54-8	Benzene, 1,1′-(2,2-dichloroethylidene)bis[4-chloro-
U060	72-54-8	DDD
U061	50-29-3	Benzene, 1,1′-(2,2,2-trichloroethylidene)bis[4-chloro-
U061	50-29-3	DDT
U062	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-di chloro-2-propenyl) ester
U062	2303-16-4	Diallate
U063	53-70-3	Dibenz[a,h]anthracene
U064	189-55-9	Benzo[rst]pentaphene
U064	189-55-9	Dibenzo[a,i]pyrene
U066	96-12-8	1,2-Dibromo-3-chloropropane
U066	96-12-8	Propane, 1,2-dibromo-3-chloro-
U067	106-93-4	Ethane, 1,2-dibromo-

U067	106-93-4	Ethylene dibromide
U068	74-95-3	Methane, dibromo-
U068	74-95-3	Methylene bromide
U069	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester
U069	84-74-2	Dibutyl phthalate
U070	95-50-1	Benzene, 1,2-dichloro-
U070	95-50-1	o-Dichlorobenzene
U071	541-73-1	Benzene, 1,3-dichloro-
U071	541-73-1	m-Dichlorobenzene
U072	106-46-7	Benzene, 1,4-dichloro-
U072	106-46-7	p-Dichlorobenzene
U073	91-94-1	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dichloro-
U073	91-94-1	3,3′-Dichlorobenzidine
U074	764-41-0	2-Butene, 1,4-dichloro-(I,T)
U074	764-41-0	1,4-Dichloro-2-butene (I,T)
U075	75-71-8	Dichlorodifluoromethane
U075	75-71-8	Methane, dichlorodifluoro-
U076	75-34-3	Ethane, 1,1-dichloro-
U076	75-34-3	Ethylidene dichloride
U077	107-06-2	Ethane, 1,2-dichloro-
U077	107-06-2	Ethylene dichloride
U078	75-35-4	1,1-Dichloroethylene
U078	75-35-4	Ethene, 1,1-dichloro-
U079	156-60-5	1,2-Dichloroethylene
U079	156-60-5	Ethene, 1,2-dichloro-, (E)-
U080	75-09-2	Methane, dichloro-
U080	75-09-2	Methylene chloride
U081	120-83-2	2,4-Dichlorophenol
U081	120-83-2	Phenol, 2,4-dichloro-
U082	87-65-0	2,6-Dichlorophenol

U082	87-65-0	Phenol, 2,6-dichloro-
U083	78-87-5	Propane, 1,2-dichloro-
U083	78-87-5	Propylene dichloride
U084	542-75-6	1,3-Dichloropropene
U084	542-75-6	1-Propene, 1,3-dichloro-
U085	1464-53-5	2,2′-Bioxirane
U085	1464-53-5	1,2:3,4-Diepoxybutane (I,T)
U086	1615-80-1	N,N′-Diethylhydrazine
U086	1615-80-1	Hydrazine, 1,2-diethyl-
U087	3288-58-2	O,O-Diethyl S-methyl dithiophosphate
U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U088	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
U088	84-66-2	Diethyl phthalate
U089	56-53-1	Diethylstilbesterol
U089	56-53-1	Phenol, 4,4′-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U090	94-58-6	1,3-Benzodioxole, 5-propyl-
U090	94-58-6	Dihydrosafrole
U091	119-90-4	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dimethoxy-
U091	119-90-4	3,3′-Dimethoxybenzidine
U092	124-40-3	Dimethylamine (I)
U092	124-40-3	Methanamine, -methyl-(I)
U093	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-
U093	60-11-7	p-Dimethylaminoazobenzene
U094	57-97-6	Benz[a]anthracene, 7,12-dimethyl-
U094	57-97-6	7,12-Dimethylbenz[a]anthracene

U095	119-93-7	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dimethyl-
U095	119-93-7	3,3′-Dimethylbenzidine
U096	80-15-9	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethyl-(R)
U097	79-44-7	Carbamic chloride, dimethyl-
U097	79-44-7	Dimethylcarbamoyl chloride
U098	57-14-7	1,1-Dimethylhydrazine
U098	57-14-7	Hydrazine, 1,1-dimethyl-
U099	540-73-8	1,2-Dimethylhydrazine
U099	540-73-8	Hydrazine, 1,2-dimethyl-
U101	105-67-9	2,4-Dimethylphenol
U101	105-67-9	Phenol, 2,4-dimethyl-
U102	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
U102	131-11-3	Dimethyl phthalate
U103	77-78-1	Dimethyl sulfate
U103	77-78-1	Sulfuric acid, dimethyl ester
U105	121-14-2	Benzene, 1-methyl-2,4-dinitro-
U105	121-14-2	2,4-Dinitrotoluene
U106	606-20-2	Benzene, 2-methyl-1,3-dinitro-
U106	606-20-2	2,6-Dinitrotoluene
U107	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester
U107	117-84-0	Di-n-octyl phthalate
U108	123-91-1	1,4-Diethyleneoxide
U108	123-91-1	1,4-Dioxane
U109	122-66-7	1,2-Diphenylhydrazine
U109	122-66-7	Hydrazine, 1,2-diphenyl-
U110	142-84-7	Dipropylamine (I)
U110	142-84-7	1-Propanamine, N-propyl-(I)
U111	621-64-7	Di-n-propylnitrosamine

U111	621-64-7	1-Propanamine, N-nitroso-N-propyl-
U112	141-78-6	Acetic acid ethyl ester (I)
U112	141-78-6	Ethyl acetate (I)
U113	140-88-5	Ethyl acrylate (I)
U113	140-88-5	2-Propenoic acid, ethyl ester (I)
U114	[1]111-54-6	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters
U114	[1]111-54-6	Ethylenebisdithiocarbamic acid, salts & esters
U115	75-21-8	Ethylene oxide (I,T)
U115	75-21-8	Oxirane (I,T)
U116	96-45-7	Ethylenethiourea
U116	96-45-7	2-Imidazolidinethione
U117	60-29-7	Ethane, 1,1′-oxybis-(I)
U117	60-29-7	Ethyl ether (I)
U118	97-63-2	Ethyl methacrylate
U118	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester
U119	62-50-0	Ethyl methanesulfonate
U119	62-50-0	Methanesulfonic acid, ethyl ester
U120	206-44-0	Fluoranthene
U121	75-69-4	Methane, trichlorofluoro-
U121	75-69-4	Trichloromonofluoromethane
U122	50-00-0	Formaldehyde
U123	64-18-6	Formic acid (C,T)
U124	110-00-9	Furan (I)
U124	110-00-9	Furfuran (I)
U125	98-01-1	2-Furancarboxaldehyde (I)
U125	98-01-1	Furfural (I)
U126	765-34-4	Glycidylaldehyde
U126	765-34-4	Oxiranecarboxyaldehyde
U127	118-74-1	Benzene, hexachloro-

U127	118-74-1	Hexachlorobenzene
U128	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U128	87-68-3	Hexachlorobutadiene
U129	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-
U129	58-89-9	Lindane
U130	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U130	77-47-4	Hexachlorocyclopentadiene
U131	67-72-1	Ethane, hexachloro-
U131	67-72-1	Hexachloroethane
U132	70-30-4	Hexachlorophene
U132	70-30-4	Phenol, 2,2′-methylenebis[3,4,6-trichloro-
U133	302-01-2	Hydrazine (R,T)
U134	7664-39-3	Hydrofluoric acid (C,T)
U134	7664-39-3	Hydrogen fluoride (C,T)
U135	7783-06-4	Hydrogen sulfide
U135	7783-06-4	Hydrogen sulfide H_2S
U136	75-60-5	Arsinic acid, dimethyl-
U136	75-60-5	Cacodylic acid
U137	193-39-5	Indeno[1,2,3-cd]pyrene
U138	74-88-4	Methane, iodo-
U138	74-88-4	Methyl iodide
U140	78-83-1	Isobutyl alcohol (I,T)
U140	78-83-1	1-Propanol, 2-methyl- (I,T)
U141	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-
U141	120-58-1	Isosafrole
U142	143-50-0	Kepone

U142	143-50-0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-
U143	303-34-4	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*),7aalpha]]-
U143	303-34-4	Lasiocarpine
U144	301-04-2	Acetic acid, lead(2 +) salt
U144	301-04-2	Lead acetate
U145	7446-27-7	Lead phosphate
U145	7446-27-7	Phosphoric acid, lead(2 +) salt (2:3)
U146	1335-32-6	Lead, bis(acetato-O)tetrahydroxytri-
U146	1335-32-6	Lead subacetate
U147	108-31-6	2,5-Furandione
U147	108-31-6	Maleic anhydride
U148	123-33-1	Maleic hydrazide
U148	123-33-1	3,6-Pyridazinedione, 1,2-dihydro-
U149	109-77-3	Malononitrile
U149	109-77-3	Propanedinitrile
U150	148-82-3	Melphalan
U150	148-82-3	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-
U151	7439-97-6	Mercury
U152	126-98-7	Methacrylonitrile (I,T)
U152	126-98-7	2-Propenenitrile, 2-methyl- (I,T)
U153	74-93-1	Methanethiol (I,T)
U153	74-93-1	Thiomethanol (I,T)

U154	67-56-1	Methanol (I)
U154	67-56-1	Methyl alcohol (I)
U155	91-80-5	1,2-Ethanediamine, N,N-dimethyl-N′-2-pyridinyl-N′-(2-thienylmethyl)-
U155	91-80-5	Methapyrilene
U156	79-22-1	Carbonochloridic acid, methyl ester (I,T)
U156	79-22-1	Methyl chlorocarbonate (I,T)
U157	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U157	56-49-5	3-Methylcholanthrene
U158	101-14-4	Benzenamine, 4,4′-methylenebis[2-chloro-
U158	101-14-4	4,4′-Methylenebis(2-chloroaniline)
U159	78-93-3	2-Butanone (I,T)
U159	78-93-3	Methyl ethyl ketone (MEK) (I,T)
U160	1338-23-4	2-Butanone, peroxide (R,T)
U160	1338-23-4	Methyl ethyl ketone peroxide (R,T)
U161	108-10-1	Methyl isobutyl ketone (I)
U161	108-10-1	4-Methyl-2-pentanone (I)
U161	108-10-1	Pentanol, 4-methyl-
U162	80-62-6	Methyl methacrylate (I,T)
U162	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U163	70-25-7	Guanidine, -methyl-N'-nitro-N-nitroso-
U163	70-25-7	MNNG
U164	56-04-2	Methylthiouracil
U164	56-04-2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U165	91-20-3	Naphthalene
U166	130-15-4	1,4-Naphthalenedione
U166	130-15-4	1,4-Naphthoquinone
U167	134-32-7	1-Naphthalenamine

U167	134-32-7	alpha-Naphthylamine
U168	91-59-8	2-Naphthalenamine
U168	91-59-8	beta-Naphthylamine
U169	98-95-3	Benzene, nitro-
U169	98-95-3	Nitrobenzene (I,T)
U170	100-02-7	p-Nitrophenol
U170	100-02-7	Phenol, 4-nitro-
U171	79-46-9	2-Nitropropane (I,T)
U171	79-46-9	Propane, 2-nitro- (I,T)
U172	924-16-3	1-Butanamine, N-butyl-N-nitroso-
U172	924-16-3	N-Nitrosodi-n-butylamine
U173	1116-54-7	Ethanol, 2,2′-(nitrosoimino)bis-
U173	1116-54-7	N-Nitrosodiethanolamine
U174	55-18-5	Ethanamine, -ethyl-N-nitroso-
U174	55-18-5	N-Nitrosodiethylamine
U176	759-73-9	N-Nitroso-N-ethylurea
U176	759-73-9	Urea, N-ethyl-N-nitroso-
U177	684-93-5	N-Nitroso-N-methylurea
U177	684-93-5	Urea, N-methyl-N-nitroso-
U178	615-53-2	Carbamic acid, methylnitroso-, ethyl ester
U178	615-53-2	N-Nitroso-N-methylurethane
U179	100-75-4	N-Nitrosopiperidine
U179	100-75-4	Piperidine, 1-nitroso-
U180	930-55-2	N-Nitrosopyrrolidine
U180	930-55-2	Pyrrolidine, 1-nitroso-
U181	99-55-8	Benzenamine, 2-methyl-5-nitro-
U181	99-55-8	5-Nitro-o-toluidine
U182	123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-
U182	123-63-7	Paraldehyde

U183	608-93-5	Benzene, pentachloro-
U183	608-93-5	Pentachlorobenzene
U184	76-01-7	Ethane, pentachloro-
U184	76-01-7	Pentachloroethane
U185	82-68-8	Benzene, pentachloronitro-
U185	82-68-8	Pentachloronitrobenzene (PCNB)
U186	504-60-9	1-Methylbutadiene (I)
U186	504-60-9	1,3-Pentadiene (I)
U187	62-44-2	Acetamide, -(4-ethoxyphenyl)-
U187	62-44-2	Phenacetin
U188	108-95-2	Phenol
U189	1314-80-3	Phosphorus sulfide (R)
U189	1314-80-3	Sulfur phosphide (R)
U190	85-44-9	1,3-Isobenzofurandione
U190	85-44-9	Phthalic anhydride
U191	109-06-8	2-Picoline
U191	109-06-8	Pyridine, 2-methyl-
U192	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U192	23950-58-5	Pronamide
U193	1120-71-4	1,2-Oxathiolane, 2,2-dioxide
U193	1120-71-4	1,3-Propane sultone
U194	107-10-8	1-Propanamine (I,T)
U194	107-10-8	n-Propylamine (I,T)
U196	110-86-1	Pyridine
U197	106-51-4	p-Benzoquinone
U197	106-51-4	2,5-Cyclohexadiene-1,4-dione

U200	50-55-5	Reserpine
U200	50-55-5	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methyl ester,(3beta,16beta,17alpha,18beta,20alpha)-
U201	108-46-3	1,3-Benzenediol
U201	108-46-3	Resorcinol
U203	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-
U203	94-59-7	Safrole
U204	7783-00-8	Selenious acid
U204	7783-00-8	Selenium dioxide
U205	7488-56-4	Selenium sulfide
U205	7488-56-4	Selenium sulfide SeS_2 (R,T)
U206	18883-66-4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-, D-
U206	18883-66-4	D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)-carbonyl]amino]-
U206	18883-66-4	Streptozotocin
U207	95-94-3	Benzene, 1,2,4,5-tetrachloro-
U207	95-94-3	1,2,4,5-Tetrachlorobenzene
U208	630-20-6	Ethane, 1,1,1,2-tetrachloro-
U208	630-20-6	1,1,1,2-Tetrachloroethane
U209	79-34-5	Ethane, 1,1,2,2-tetrachloro-
U209	79-34-5	1,1,2,2-Tetrachloroethane
U210	127-18-4	Ethene, tetrachloro-
U210	127-18-4	Tetrachloroethylene
U211	56-23-5	Carbon tetrachloride
U211	56-23-5	Methane, tetrachloro-
U213	109-99-9	Furan, tetrahydro-(I)

U213	109-99-9	Tetrahydrofuran (I)
U214	563-68-8	Acetic acid, thallium(1 +) salt
U214	563-68-8	Thallium(I) acetate
U215	6533-73-9	Carbonic acid, dithallium(1 +) salt
U215	6533-73-9	Thallium(I) carbonate
U216	7791-12-0	Thallium(I) chloride
U216	7791-12-0	Thallium chloride TlCl
U217	10102-45-1	Nitric acid, thallium(1 +) salt
U217	10102-45-1	Thallium(I) nitrate
U218	62-55-5	Ethanethioamide
U218	62-55-5	Thioacetamide
U219	62-56-6	Thiourea
U220	108-88-3	Benzene, methyl-
U220	108-88-3	Toluene
U221	25376-45-8	Benzenediamine, ar-methyl-
U221	25376-45-8	Toluenediamine
U222	636-21-5	Benzenamine, 2-methyl-, hydrochloride
U222	636-21-5	o-Toluidine hydrochloride
U223	26471-62-5	Benzene, 1,3-diisocyanatomethyl- (R,T)
U223	26471-62-5	Toluene diisocyanate (R,T)
U225	75-25-2	Bromoform
U225	75-25-2	Methane, tribromo-
U226	71-55-6	Ethane, 1,1,1-trichloro-
U226	71-55-6	Methyl chloroform

U226	71-55-6	1,1,1-Trichloroethane
U227	79-00-5	Ethane, 1,1,2-trichloro-
U227	79-00-5	1,1,2-Trichloroethane
U228	79-01-6	Ethene, trichloro-
U228	79-01-6	Trichloroethylene
U234	99-35-4	Benzene, 1,3,5-trinitro-
U234	99-35-4	1,3,5-Trinitrobenzene (R,T)
U235	126-72-7	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U235	126-72-7	Tris(2,3-dibromopropyl) phosphate
U236	72-57-1	2,7-Naphthalenedisulfonic acid, 3,3′-[(3,3′-dimethyl[1,1′-biphenyl]-4,4′-diyl)bis(azo)bis[5-amino-4-hydroxy]-, tetrasodium salt
U236	72-57-1	Trypan blue
U237	66-75-1	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U237	66-75-1	Uracil mustard
U238	51-79-6	Carbamic acid, ethyl ester
U238	51-79-6	Ethyl carbamate (urethane)
U239	1330-20-7	Benzene, dimethyl- (I,T)
U239	1330-20-7	Xylene (I)
U240	[1]94-75-7	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters
U240	[1]94-75-7	2,4-D, salts & esters
U243	1888-71-7	Hexachloropropene
U243	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
U244	137-26-8	Thioperoxydicarbonic diamide $[(H_2N)C(S)]_2 S_2$, tetramethyl-
U244	137-26-8	Thiram
U246	506-68-3	Cyanogen bromide (CN)Br

U247	72-43-5	Benzene, 1,1′-(2,2,2-trichloroethylidene)bis[4- methoxy-
U247	72-43-5	Methoxychlor
U248	[1]81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts, when present at concentrations of 0.3% or less
U248	[1]81-81-2	Warfarin, & salts, when present at concentrations of 0.3% or less
U249	1314-84-7	Zinc phosphide Zn_3 P_2, when present at concentrations of 10% or less
U271	17804-35-2	Benomyl
U271	17804-35-2	Carbamic acid, [1-[(butylamino)carbonyl]-1H-benzimidazol-2-yl]-, methyl ester
U278	22781-23-3	Bendiocarb
U278	22781-23-3	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate
U279	63-25-2	Carbaryl
U279	63-25-2	1-Naphthalenol, methylcarbamate
U280	101-27-9	Barban
U280	101-27-9	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester
U328	95-53-4	Benzenamine, 2-methyl-
U328	95-53-4	o-Toluidine
U353	106-49-0	Benzenamine, 4-methyl-
U353	106-49-0	p-Toluidine
U359	110-80-5	Ethanol, 2-ethoxy-
U359	110-80-5	Ethylene glycol monoethyl ether
U364	22961-82-6	Bendiocarb phenol
U364	22961-82-6	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,
U367	1563-38-8	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-

U367	1563-38-8	Carbofuran phenol
U372	10605-21-7	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester
U372	10605-21-7	Carbendazim
U373	122-42-9	Carbamic acid, phenyl-, 1-methylethyl ester
U373	122-42-9	Propham
U387	52888-80-9	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester
U387	52888-80-9	Prosulfocarb
U389	2303-17-5	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester
U389	2303-17-5	Triallate
U394	30558-43-1	A2213
U394	30558-43-1	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester
U395	5952-26-1	Diethylene glycol, dicarbamate
U395	5952-26-1	Ethanol, 2,2′-oxybis-, dicarbamate
U404	121-44-8	Ethanamine, N,N-diethyl-
U404	121-44-8	Triethylamine
U409	23564-05-8	Carbamic acid, [1,2-phenylenebis (iminocarbonothioyl)]bis-, dimethyl ester
U409	23564-05-8	Thiophanate-methyl
U410	59669-26-0	Ethanimidothioic acid, N,N′-[thiobis[(methylimino)carbonyloxy]]bis-, dimethyl ester
U410	59669-26-0	Thiodicarb

U411	114-26-1	Phenol, 2-(1-methylethoxy)-, methylcarbamate
U411	114-26-1	Propoxur
See F027	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-
See F027	87-86-5	Pentachlorophenol
See F027	87-86-5	Phenol, pentachloro-
See F027	58-90-2	Phenol, 2,3,4,6-tetrachloro-
See F027	95-95-4	Phenol, 2,4,5-trichloro-
See F027	88-06-2	Phenol, 2,4,6-trichloro-
See F027	93-72-1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-
See F027	93-72-1	Silvex (2,4,5-TP)
See F027	93-76-5	2,4,5-T
See F027	58-90-2	2,3,4,6-Tetrachlorophenol
See F027	95-95-4	2,4,5-Trichlorophenol
See F027	88-06-2	2,4,6-Trichlorophenol

[1]CAS Number given for parent compound only.

[45 FR 78529, 78541, Nov. 25, 1980]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §261.33, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov.*

§261.35 Deletion of certain hazardous waste codes following equipment cleaning and replacement.

(a) Wastes from wood preserving processes at plants that do not resume or initiate use of chlorophenolic preservatives will not meet the listing definition of F032 once the generator has met all of the requirements of paragraphs (b) and (c) of this section. These wastes may, however, continue to meet another hazardous waste listing description or may exhibit one or more of the hazardous waste characteristics.

(b) Generators must either clean or replace all process equipment that may have come into contact with chlorophenolic formulations or constituents thereof, including, but not limited to, treatment cylinders, sumps, tanks, piping systems, drip pads, fork lifts, and trams, in a manner that minimizes or eliminates the escape of hazardous waste or constituents, leachate, contaminated drippage, or hazardous waste decomposition products to the ground water, surface water, or atmosphere.

(1) Generators shall do one of the following:

(i) Prepare and follow an equipment cleaning plan and clean equipment in accordance with this section;

(ii) Prepare and follow an equipment replacement plan and replace equipment in accordance with this section; or

(iii) Document cleaning and replacement in accordance with this section, carried out after termination of use of chlorophenolic preservations.

(2) Cleaning Requirements.

(i) Prepare and sign a written equipment cleaning plan that describes:

(A) The equipment to be cleaned;

(B) How the equipment will be cleaned;

(C) The solvent to be used in cleaning;

(D) How solvent rinses will be tested; and

(E) How cleaning residues will be disposed.

(ii) Equipment must be cleaned as follows:

(A) Remove all visible residues from process equipment;

(B) Rinse process equipment with an appropriate solvent until dioxins and dibenzofurans are not detected in the final solvent rinse.

(iii) Analytical requirements.

(A) Rinses must be tested by using an appropriate method.

(B) “Not detected” means at or below the following lower method calibration limits (MCLs): The 2,3,7,8-TCDD-based MCL—0.01 parts per trillion (ppt), sample weight of 1000 g, IS spiking level of 1 ppt, final extraction volume of 10-50 μL. For other congeners—multiply the values by 1 for TCDF/PeCDD/PeCDF, by 2.5 for HxCDD/HxCDF/HpCDD/HpCDF, and by 5 for OCDD/OCDF.

(iv) The generator must manage all residues from the cleaning process as F032 waste.

(3) Replacement requirements.

(i) Prepare and sign a written equipment replacement plan that describes:

(A) The equipment to be replaced;

(B) How the equipment will be replaced; and

(C) How the equipment will be disposed.

(ii) The generator must manage the discarded equipment as F032 waste.

(4) Documentation requirements.

(i) Document that previous equipment cleaning and/or replacement was performed in accordance with this section and occurred after cessation of use of chlorophenolic preservatives.

(c) The generator must maintain the following records documenting the cleaning and replacement as part of the facility's operating record:

(1) The name and address of the facility;

(2) Formulations previously used and the date on which their use ceased in each process at the plant;

(3) Formulations currently used in each process at the plant;

(4) The equipment cleaning or replacement plan;

(5) The name and address of any persons who conducted the cleaning and replacement;

(6) The dates on which cleaning and replacement were accomplished;

(7) The dates of sampling and testing;

(8) A description of the sample handling and preparation techniques, including techniques used for extraction, containerization, preservation, and chain-of-custody of the samples;

(9) A description of the tests performed, the date the tests were performed, and the results of the tests;

(10) The name and model numbers of the instrument(s) used in performing the tests;

(11) QA/QC documentation; and

(12) The following statement signed by the generator or his authorized representative:

I certify under penalty of law that all process equipment required to be cleaned or replaced under 40 CFR 261.35 was cleaned or replaced as represented in the equipment cleaning and replacement plan and accompanying documentation. I am aware that there are significant penalties for providing false information, including the possibility of fine or imprisonment.

[55 FR 50482, Dec. 6, 1990, as amended at 56 FR 30195, July 1, 1991; 70 FR 34561, June 14, 2005]

Exhibit C
Paint Filter Test Form

PAINT FILTER TEST RESULTS

TEST DATE: ________________

SAMPLE INFORMATION: TYPE OF WASTE: ______________________

SOLIDIFICATION AGENT USED: ___ _

SAMPLE TAKEN BY: ______________________

TEST INFORMATION: TEST PERFORMED BY: ________________

TIME OF TEST: START: ___________

FINISHED: ___ _

RESULTS: ___ PASS (no liquid in test cylinder)

__ FAIL (liquid in test cylinder)

ACTION TAKEN: ____

____

____

____

____

METHOD 9095B

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

3.2 Temperature can affect the test results if the test is performed below the freezing point of any liquid in the sample. Tests must be performed above the freezing point and can, but are not required to, exceed room temperature of 25 ^{o}C.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter -- Mesh number 60 +/- 5% (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden.

4.2 Glass funnel -- If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel should be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker -- 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids. If the sample is measured volumetrically, then it should lack major air spaces or voids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter. If the sample is of such light bulk density that it overflows the filter, then the sides of the filter can be extended upward by taping filter paper to the <u>inside</u> of the filter and above the mesh. Settling the sample into the paint filter may be facilitated by lightly tapping the side of the filter as it is being filled.

7.3 In order to assure uniformity and standardization of the test, material such as sorbent pads or pillows which do not conform to the shape of the paint filter should be cut into small pieces and poured into the filter. Sample size reduction may be accomplished by cutting the sorbent material with scissors, shears, a knife, or other such device so as to preserve as much of the original integrity of the sorbent fabric as possible. Sorbents enclosed in a fabric should be mixed with the resultant fabric pieces. The particles to be tested should be reduced smaller than 1 cm (i.e., should be capable of passing through a 9.5 mm (0.375 inch) standard sieve). Grinding sorbent materials should be avoided as this may destroy the integrity of the sorbent and produce many "fine particles" which would normally not be present.

7.4 For brittle materials larger than 1 cm that do not conform to the filter, light crushing to reduce oversize particles is acceptable if it is not practical to cut the material. Materials such as clay, silica gel, and some polymers may fall into this category.

7.5 Allow sample to drain for 5 min into the graduated cylinder.

7.6 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

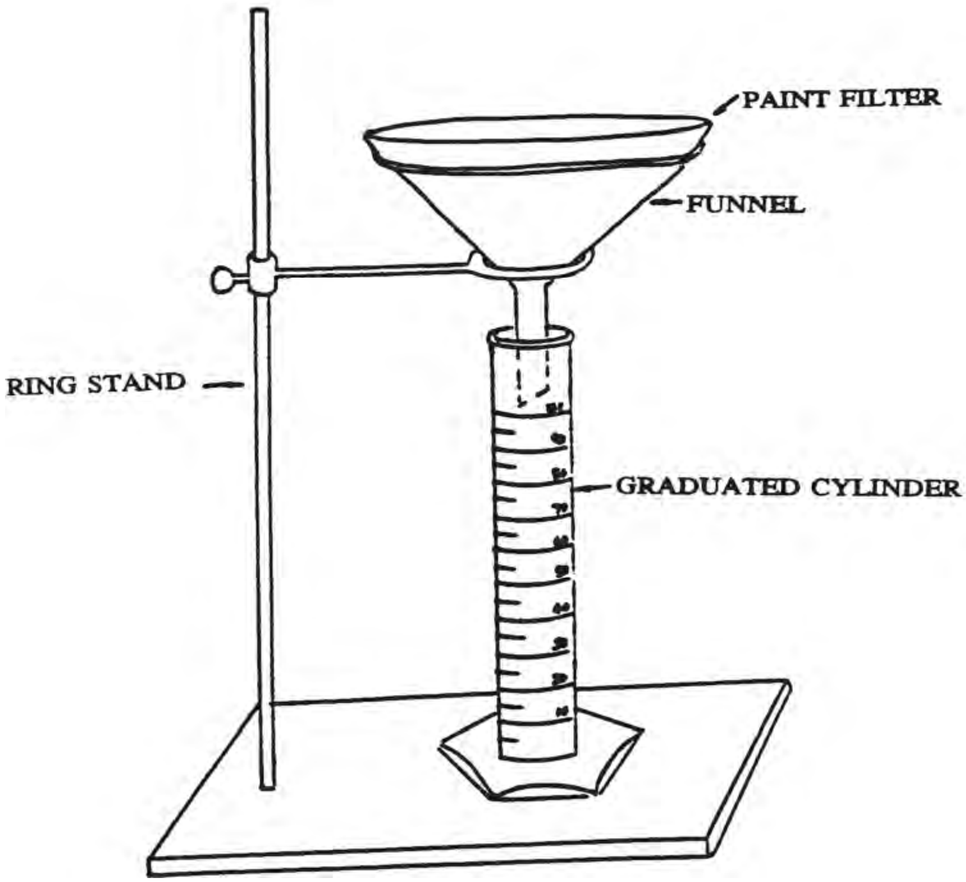
9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

10.1 None provided.

FIGURE 1
PAINT FILTER TEST APPARATUS



METHOD 9095B
PAINT FILTER LIQUIDS TEST

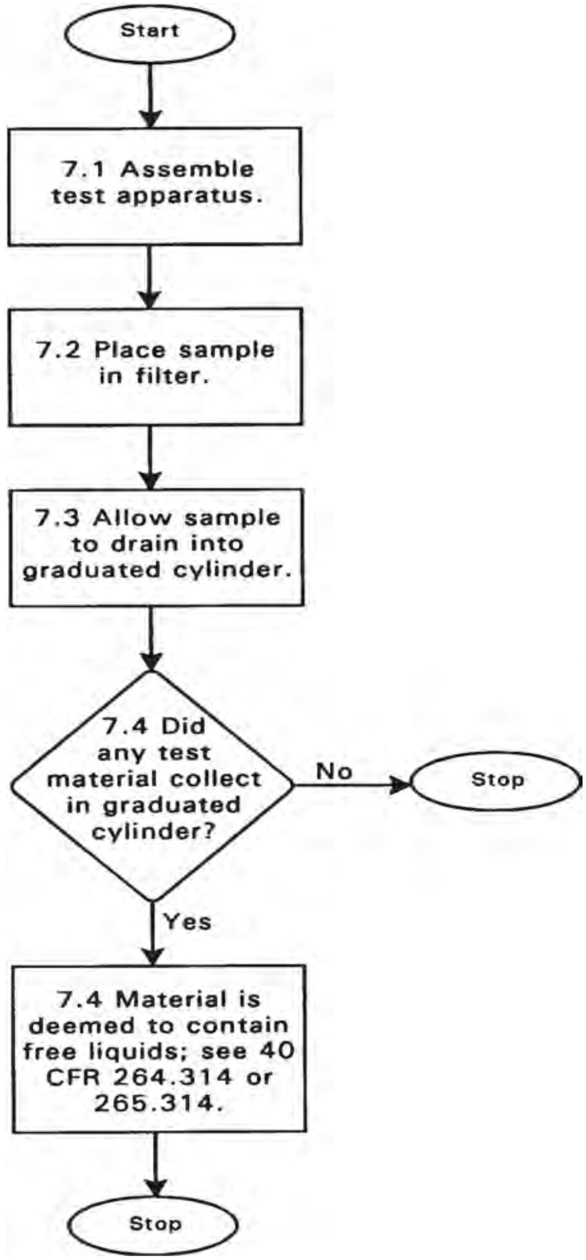


Exhibit D
Random Inspection Form

RANDOM INSPECTION DOCUMENTATION

NGL North Ranch Landfill

Lea County, NM

DATE: ______________________

TIME: ______________________

INSPECTED BY: ______________________

WASTE GENERATOR: ______________________

WASTE ORIGIN LOCATION: ______________________

WASTE HAULER: ______________________

WASTE HAULER TRUCK NUMBER: ______________________

	CIRCLE ONE		
RADIATION SURVEY RESULTS:	GOOD	BAD	< XX mR/HR OK
pH TEST RESULTS:	GOOD	BAD	BETWEEN pH 2.0 and pH 12.5 OK
LEL SURVEY RESULTS:	GOOD	BAD	<10% OK
H2S SURVEY RESULTS:	GOOD	BAD	<1 PPM OK
VISUAL INSPECTION:	GOOD	BAD	

DESCRIPTION OF QUESTIONABLE WASTE:

ACTION TAKEN:

CIRCLE ONE

LOAD ACCEPTABLE: YES NO

INSPECTOR SIGNATURE: ______________________

HAULER SIGNATURE: ______________________

Exhibit E

Solid Waste and Emergency Response Training Module – Introduction to Hazardous Waste Identification (40 CFR Part 261)

Solid Waste and Emergency Response
(5305W)
EPA530-K-05-012

RCRA Training Module

Introduction to

Hazardous Waste Identification
(40 CFR Parts 261)

United States
Environmental Protection
Agency

September 2005

HAZARDOUS WASTE IDENTIFICATION

CONTENTS

1. INTRODUCTION

"Is my waste a hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA)?" This is one of the most common and basic RCRA questions and is the key to the RCRA hazardous waste program. If something is not a hazardous waste, it is not regulated under RCRA. Proper identification of a hazardous waste can be a difficult and confusing task, as the RCRA regulations establish a complex definition of the term "hazardous waste." To help make sense of what is and is not a hazardous waste, this module presents the steps involved in the process of identifying, or "characterizing," a hazardous waste.

While introducing the entire hazardous waste identification process, this module will focus on the final steps, the definition of a hazardous waste. The other steps in the process, including the definition of solid waste and the solid and hazardous waste exclusions will be discussed in other modules.

After reading this module, you will be able to explain the hazardous waste identification process and the definition of hazardous waste, and be familiar with the following concepts:

- hazardous waste listings
- hazardous waste characteristics
- the "mixture" and "derived-from" rules
- the "contained-in" policy
- the Hazardous Waste Identification Rules (HWIR).

2. REGULATORY OVERVIEW

What is a hazardous waste? In its most basic form, the answer to that question can be quite simple. A hazardous waste is a waste with a chemical composition or other properties that make it capable of causing illness, death, or some other harm to humans and other life forms when mismanaged or released into the environment. Developing a regulatory program that ensures the safe handling of such dangerous wastes, however, demands a far more precise definition of the term. EPA therefore created hazardous waste identification regulations that outline a process to determine whether any particular material is a hazardous waste for the purposes of RCRA.

2.1 HAZARDOUS WASTE IDENTIFICATION PROCESS

Proper hazardous waste identification is essential to the success of the hazardous waste management program. The RCRA regulations at 40 CFR §262.11 require that any person who produces or generates a waste must determine if that waste is hazardous. In doing so, §262.11 presents the steps in the hazardous waste identification process:

- Is the waste a "solid waste"?
- Is the waste specifically excluded from the RCRA regulations?
- Is the waste a "listed" hazardous waste?
- Does the waste exhibit a characteristic of hazardous waste?

When faced with the question of whether or not a waste is regulated as hazardous under RCRA, turn to §262.11. This regulation will remind you of the four steps in the RCRA hazardous waste identification process.

IS THE WASTE A SOLID WASTE?

Hazardous waste identification begins with an obvious point: in order for any material to be a hazardous waste, it must first be a waste. But, deciding whether an item is or is not a waste is not always easy. For example, a material (like an aluminum can) that one person discards could seem valuable to another person who recycles that material. EPA developed a set of regulations to assist in determining whether a material is a waste. RCRA uses the term "solid waste" in place of the common term "waste." Under RCRA, the term "solid waste" means any waste, whether it is a solid, semisolid, or liquid. The first section of the RCRA hazardous waste identification regulations focuses on the definition of solid waste. For this module, you need only understand in general terms the role that the definition of solid waste plays in the RCRA hazardous waste identification process. Another module, <u>Definition of Solid Waste and Hazardous Waste Recycling</u>, explains the definition of solid waste in greater detail.

IS THE WASTE EXCLUDED?

Only a small fraction of all RCRA solid wastes actually qualify as hazardous wastes. At first glance, one would imagine that distinguishing between hazardous and nonhazardous wastes is a simple matter of chemical and toxicological analysis. Other factors must be considered, however, before evaluating the actual hazard that a waste's chemical composition poses. Regulation of certain wastes may be impractical, unfair, or otherwise undesirable, regardless of the hazards they pose. For instance, household waste can contain dangerous chemicals, like solvents and pesticides, but making households subject to the strict RCRA waste management regulations would create a number of practical problems. Congress and EPA exempted or excluded certain wastes, like household wastes, from the hazardous waste definition and regulations. Determining whether or not a waste is excluded or exempted from hazardous waste regulation is the second step in the RCRA hazardous waste identification process. Only after determining that a solid waste is not somehow excluded from hazardous waste regulation should the analysis proceed to evaluate the actual chemical hazard that a waste poses. The module entitled Solid and Hazardous Waste Exclusions explains which wastes are excluded from hazardous waste regulation.

IS THE WASTE A LISTED HAZARDOUS WASTE, OR DOES IT EXHIBIT A CHARACTERISTIC?

The final steps in the hazardous waste identification process determine whether a waste actually poses a sufficient chemical or physical hazard to merit regulation. These steps in the hazardous waste identification process involve evaluating the waste in light of the regulatory definition of hazardous waste. The remainder of this module explains the definition of hazardous waste in detail.

2.2 DEFINITION OF HAZARDOUS WASTE

A discussion of the definition of hazardous waste should begin with Congress' original statutory definition of the term. RCRA §1004(5) defines hazardous waste as:

> A solid waste, or combination of solid waste, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

This broad statutory definition provides a general indication of which wastes Congress intended to regulate as hazardous, but it obviously does not provide the clear distinctions necessary for industrial waste handlers to determine whether their wastes pose a sufficient threat to warrant regulation or not. Congress instructed EPA to develop more specific criteria for defining hazardous waste. There are therefore two definitions of hazardous waste under the RCRA program: a statutory definition and a regulatory definition. The statutory definition cited above is seldom used today. It served primarily as a general guideline for EPA to follow in developing the regulatory definition of hazardous waste. The regulatory definition is an essential element of the current RCRA program. It precisely identifies which wastes are subject to RCRA waste management regulations.

Congress asked EPA to fulfill the task of developing a regulatory definition of hazardous waste by using two different mechanisms: by listing certain specific wastes as hazardous and by identifying characteristics which, when present in a waste, make it hazardous. Following its statutory mandate, EPA developed a regulatory definition of hazardous waste that incorporates both listings and characteristics.

HAZARDOUS WASTE LISTINGS

A hazardous waste listing is a narrative description of a specific type of waste that EPA considers dangerous enough to warrant regulation. Hazardous waste listings describe wastes from various industrial processes, wastes from specific sectors of industry, or wastes in the form of specific chemical formulations. Before developing a hazardous waste listing, EPA thoroughly studies a particular wastestream and the threat it can pose to human health and the environment. If the waste poses enough of a threat, EPA includes a precise description of that waste on one of the hazardous waste lists in the regulations. Thereafter, any waste fitting that narrative listing description is considered hazardous, regardless of its chemical composition or any other potential variable. For example, one of the current hazardous waste listings reads as: "API separator sludge from the petroleum refining industry." An API separator is a device commonly used by the petroleum refining industry to separate contaminants from refinery wastewaters. After studying the petroleum refining industry and typical sludges from API separators, EPA decided these sludges were dangerous enough to warrant regulation as hazardous waste under all circumstances. The listing therefore designates all petroleum refinery API separator sludges as hazardous. Chemical composition or other factors about a specific sample of API separator sludge are not relevant to its status as hazardous waste under the RCRA program.

Using listings to define hazardous wastes presents certain advantages and disadvantages. One advantage is that listings make the hazardous waste identification process easy for industrial waste handlers. Only knowledge of a waste's origin is needed to determine if it is listed; laboratory analysis is unnecessary. By comparing any waste to narrative listing descriptions, one can easily determine whether or not the waste is hazardous. EPA's use of listings also presents certain disadvantages. For example, listing a waste as hazardous demands extensive study of that waste by EPA. EPA lacks the resources to investigate the countless types of chemical wastes produced in the United States – the hazardous waste listings simply cannot address all dangerous wastes. Another disadvantage of the hazardous waste listings is their lack of flexibility. Listings designate a waste as hazardous if it falls within a particular category or class. The actual composition of the waste is not a consideration as long as the waste matches the appropriate listing description. For instance, some API separator sludges from petroleum refining might contain relatively few hazardous constituents and pose a negligible risk to human health and the environment. Such sludges are still regulated as hazardous, however, because the listing for this wastestream does not consider the potential variations in waste composition. Thus, the hazardous waste listings can unnecessarily regulate some wastes that do not pose a significant health threat. It is also possible for industries to substantially change their processes so that wastes would no longer meet a listing description in spite of the presence of hazardous constituents. The hazardous waste characteristics provide an important complement to listings by addressing most of the shortcomings of the listing methodology of hazardous waste identification.

HAZARDOUS WASTE CHARACTERISTICS

A hazardous waste characteristic is a property which, when present in a waste, indicates that the waste poses a sufficient threat to merit regulation as hazardous. When defining hazardous waste characteristics, EPA does not study particular wastestreams from specific industries. Instead, EPA asks the question, "what properties or qualities can a waste have which cause that waste to be dangerous?" For example, EPA found that ignitability, or the tendency for a waste to easily catch fire and burn, is a dangerous property. Thus, ignitability is one of the hazardous waste characteristics and a waste displaying that property is regulated as hazardous, regardless of whether the waste is listed. When defining hazardous waste characteristics, EPA identifies, where practicable, analytical tests capable of detecting or demonstrating the presence of the characteristic. For instance, EPA regulations reference a laboratory flash point test to be used when deciding if a liquid waste is ignitable. Whether or not a waste displays a hazardous characteristic generally depends on how it fares in one of the characteristics tests. Therefore, the chemical makeup or other factors about the composition of a particular waste typically determine whether or not it tests as hazardous for a characteristic.

Using characteristics to define hazardous wastes presents certain advantages over designating hazardous wastes by listings. One advantage is that hazardous characteristics and the tests used to evaluate their presence have broad applicability. Once EPA has defined a characteristic and selected a test for use in identifying it, waste handlers can evaluate any wastestream to see if it is classified as a hazardous waste. Furthermore, use of characteristics can be a more equitable way of designating wastes as hazardous. Instead of categorizing an entire group of wastes as hazardous, characteristics allow a waste handler to evaluate each waste sample on its own merits and classify it according to the actual danger it poses. Aware of these advantages, EPA originally planned to use characteristics as the primary means of identifying hazardous waste. EPA hoped to define and select test methods for identifying all hazardous characteristics, including organic toxicity, mutagenicity (the tendency to cause mutations), teratogenicity (the tendency to cause defects in offspring), bioaccumulation potential, and phytotoxicity (toxicity to plants). EPA encountered problems, however, when trying to develop regulatory definitions of these properties. One primary problem was that no straightforward testing protocols were available for use in determining if a waste possessed any of these characteristics. For example, deciding if a particular wastestream poses an unacceptable cancer risk demands extensive laboratory experimentation. Requiring such analysis on a routine basis from industrial waste handlers would be impractical. Therefore, EPA developed a hazardous waste definition that relies on both listings and characteristics to define hazardous wastes.

2.3 LISTED HAZARDOUS WASTES

EPA has studied and listed as hazardous hundreds of specific industrial wastestreams. These wastes are described or listed on four different lists that are found in the regulations at Part 261, Subpart D. These four lists are:

- The F list — The F list designates particular solid wastes from certain common industrial or manufacturing processes as hazardous. Because the processes producing these wastes can occur in different sectors of industry, the F list wastes are known as wastes from nonspecific sources. The F list is codified in the regulations at §261.31.

- The K list — The K list designates particular solid wastes from certain specific industries as hazardous. K list wastes are known as wastes from specific sources. The K list is found at §261.32.

- The P list and the U list — These two lists are similar in that both list pure or commercial grade formulations of certain specific unused chemicals as hazardous. Both the P list and U list are codified in §261.33.

These four lists each designate anywhere from 30 to a few hundred wastestreams as hazardous. Each waste on the lists is assigned a waste code consisting of the letter associated with the list followed by three numbers. For example, the wastes on the F list are assigned the waste codes F001, F002, and so on. These waste codes are an important part of the RCRA regulatory system. Assigning the correct waste code to a waste has important implications for the management standards that apply to the waste.

LISTING CRITERIA

Before listing any waste as hazardous, the Agency developed a set of criteria to use as a guide when determining whether or not a waste should be listed. These listing criteria provide a consistent frame of reference when EPA considers listing a wastestream. Remember that EPA only uses these criteria when evaluating whether to list a waste; the listing criteria are not used by waste handlers, who refer to the actual hazardous waste lists for hazardous waste identification purposes. There are four different criteria upon which EPA may base its determination to list a waste as hazardous. These criteria are codified in Part 261, Subpart B. Note that these four criteria do not directly correspond to the four different lists of hazardous waste. The four criteria EPA may use to list a waste are:

- The waste typically contains harmful chemicals, and other factors indicate that it could pose a threat to human health and the environment in the absence of special regulation. Such wastes are known as toxic listed wastes.

- The waste contains such dangerous chemicals that it could pose a threat to human health and the environment even when properly managed. Such wastes are known as acutely hazardous wastes.

- The waste typically exhibits one of the four characteristics of hazardous waste described in the hazardous waste identification regulations (ignitability, corrosivity, reactivity, or toxicity).

- When EPA has to cause to believe for some other reason, the waste typically fits within the statutory definition of hazardous waste developed by Congress.

EPA may list a waste as hazardous for any and all of the above reasons. The majority of listed wastes fall into the toxic waste category. To decide if a waste should be a toxic listed waste, EPA first determines whether it typically contains harmful chemical constituents. Appendix VIII of Part 261 contains a list of chemical compounds or elements which scientific studies show to have toxic, carcinogenic, mutagenic, or teratogenic effects on humans or other life forms. If a waste contains chemical constituents found on the Appendix VIII list, EPA then evaluates 11 other factors to determine if the wastestream is likely to pose a threat in the absence of special restrictions on its handling. These additional considerations include a risk assessment and study of past cases of damage caused by the waste.

Acutely hazardous wastes are the second most common type of listed waste. EPA designates a waste as acutely hazardous if it contains Appendix VIII constituents that scientific studies show to be fatal to humans or animals in low doses. In a few cases, acutely hazardous wastes contain no Appendix VIII constituents, but are extremely dangerous for another reason. An example is the listed waste P081, which designates unused discarded formulations of nitroglycerine as acutely hazardous. Although nitroglycerine is not an Appendix VIII hazardous constituent, wastes containing unused nitroglycerine are so unstable that they pose an acute hazard. The criteria for designating a waste as acutely hazardous require only that EPA considers the typical chemical makeup of the wastestream. EPA is not required to study other factors, such as relative risk and evidence of harm, when listing a waste as acutely hazardous.

To indicate its reason for listing a waste, EPA assigns a hazard code to each waste listed on the F, K, P, and U lists. These hazard codes are listed below. The last four hazard codes apply to wastes that have been listed because they typically exhibit one of the four regulatory characteristics of hazardous waste. You will learn more about the four characteristics of hazardous waste. The hazard codes indicating the basis for listing a waste are:

Toxic Waste	(T)
Acute Hazardous Waste	(H)
Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Toxicity Characteristic Waste	(E)

The hazard codes assigned to listed wastes affect the regulations that apply to handling the waste. For instance, acute hazardous wastes accompanied by the hazard code (H) are subject to stricter management standards than most other wastes.

THE F LIST: WASTES FROM NONSPECIFIC SOURCES

The F list designates as hazardous particular wastestreams from certain common industrial or manufacturing processes. F list wastes usually consist of chemicals that have been used for their intended purpose in an industrial process. That is why F list wastes are known as "manufacturing process wastes." The F list wastes can be divided into seven groups, depending on the type of manufacturing or industrial operation that creates them. The seven categories of F-listed wastes are:

- spent solvent wastes (F001 - F005)
- wastes from electroplating and other metal finishing operations (F006 - F012, F019)
- dioxin-bearing wastes (F020 - F023 and F026 - F028)
- wastes from the production of certain chlorinated aliphatic hydrocarbons (F024, F025)
- wastes from wood preserving (F032, F034, and F035)
- petroleum refinery wastewater treatment sludges (F037 and F038)
- multisource leachate (F039).

Spent Solvent Wastes

Waste codes F001 - F005 apply to wastestreams from the use of certain common organic solvents. Solvents are chemicals with many uses, although they are most often used in degreasing or cleaning. The solvents covered by the F listings are commonly used in industries ranging from mechanical repair to dry cleaning to electronics manufacturing. EPA decided that only certain solvents used in certain ways produce wastestreams that warrant a hazardous waste listing. Therefore, a number of key factors must be evaluated in order to determine whether the F001 - F005 waste codes apply to a particular waste solvent. First, one or more of the 31 specific organic solvents designated in the F001 - F005 listing description must have been used in the operation that created the waste. Second, the listed solvent must have been used in a particular manner – it must have been used for its "solvent properties," as EPA defines that expression. Finally, EPA decided that only a wastestream created through use of concentrated solvents should be listed. Thus, the concentration of the solvent formulation or product before its use in the process that created the waste is also a factor in determining the applicability of the F001 - F005 listing.

The F001 - F005 spent solvent listings provide a good illustration of a principle common to all listed hazardous wastes. To determine whether a waste qualifies as listed, knowledge of the process that created the waste is essential, while information about the waste's chemical composition is often irrelevant. For example, the F005 listing description can allow two different wastes with identical chemical contents to be regulated differently because of subtle differences in the processes that created the wastes. A waste made up of toluene and paint is F005 if the toluene has been used to clean the paint from brushes or some other surface. A waste with the same chemical composition is not F005 if the toluene has been used as an ingredient (such as a thinner) in the paint. EPA considers use as a cleaner to be "use as a solvent;" use as an ingredient does not qualify as solvent use. As you can see, knowledge of the process that created a waste is the key in evaluating whether a waste can be a hazardous spent solvent or other listed hazardous waste.

Wastes from Electroplating and Other Metal-Finishing Operations

The listed hazardous wastes F006 - F012 and F019 are wastes commonly produced during electroplating and other metal finishing operations. Diverse industries use electroplating and other methods to change the surface of metal objects in order to enhance the appearance of the objects, make them more resistant to corrosion, or impart some other desirable property to them. Industries involved in plating and metal finishing range from jewelry manufacture to automobile production. A variety of techniques can be used to amend a metal's surface. For example, electroplating uses electricity to deposit a layer of a decorative or protective metal on the surface of another metal object. Chemical conversion coating also amends the surface of a metal, but does so by chemically converting (without use of electricity) a layer of the original base metal into a protective coating. Because each of these processes produces different types of wastes, EPA only designated wastes from certain metal-finishing operations as hazardous. The first step in determining whether one of the F006-F012 or F019 listings applies to a waste is identifying the type of metal finishing process involved in creating the waste:

- F006 - F009 listings only apply to wastes from electroplating operations
- F010 - F012 listings only apply to wastes from metal heat treating operations
- the F019 listing only applies to wastes from the chemical conversion coating of aluminum.

Dioxin-Bearing Wastes

The listed wastes F020 - F023 and F026 - F028 are commonly known as the "dioxin-bearing wastes." These listings describe a number of wastestreams that EPA believes are likely to contain dioxins, which are considered to be among the most dangerous known chemical compounds. The dioxin listings apply primarily to manufacturing process wastes from the production of specific pesticides or specific chemicals used in the production of pesticides. The F027 listing deserves special notice because it does not apply to used manufacturing wastes. It applies only to certain unused pesticide formulations. F027 is in fact the only listing on the F list or K list that describes an unused chemical rather than an industrial wastestream consisting of chemicals that have served their intended purpose. With the exception of F028, all of the dioxin-bearing wastes are considered acute hazardous wastes and are designated with the hazard code (H). These wastes are therefore subject to stricter management standards than other hazardous wastes.

Wastes from the Production of Certain Chlorinated Aliphatic Hydrocarbons

The F024 and F025 listings designate as hazardous certain wastestreams produced in the manufacture of chlorinated aliphatic hydrocarbons. These listings stand out on the F list (the list of wastes from nonspecific sources) because they focus on wastes from a very narrow industrial sector. Many other wastestreams from the manufacture of organic chemicals are listed on the K list, the list of wastes from specific sources, including two waste codes for chlorinated aliphatic wastes, K174 and K175.

Wood Preserving Wastes

The F032, F034, and F035 listings apply to certain wastes from wood preserving operations. Many types of wood used for construction or other non-fuel applications is chemically treated to slow the deterioration caused by decay and insects. Such chemical treatment is commonly used in telephone poles, railroad ties, and other wood products prepared to withstand the rigors of outdoor use. Wood preservation typically involves pressure treating the lumber with pentachlorophenol, creosote, or preservatives containing arsenic or chromium. (It should be noted that after December 31, 2003, many wood treaters will not be using arsenic or chromium based inorganic preservatives.) The wood preserving process creates a number of common wastestreams containing these chemicals. For example, once wood has been treated with a preservative excess preservative drips from the lumber. The F032, F034, and F035 listings designate this preservative drippage as listed hazardous waste. These listings also apply to a variety of other residues from wood preserving. Whether the F032, F034, or F035 listings apply to a particular wood preserving waste depends entirely on the type of preservative used at the facility. Waste generated from wood preserving processes using pentachlorophenol is F032, waste from the use of creosote is F034, and waste from treating wood with arsenic or chromium is F035. The K list also includes a waste code, K001, which applies to bottom sediment sludge from treating wastewaters associated with processes using pentachlorophenol and/or creosote.

Petroleum Refinery Wastewater Treatment Sludges

The F037 and F038 listings apply to specific wastestreams from petroleum refineries. The petroleum refining process typically creates large quantities of contaminated wastewater. Before this wastewater can be discharged to a river or sewer, it must be treated to remove oil, solid material, and chemical pollutants. Gravity provides a simple way of separating these pollutants from refinery wastewaters. Over time, solids and heavier pollutants precipitate from wastewaters to form a sludge. Other less dense pollutants accumulate on the surface of wastewaters, forming a material known as float. These gravitational separation processes can be encouraged through chemical or mechanical means. The F037 listing applies to the sludges and float created by gravitational treatment of petroleum refinery wastewaters. The F038 listing applies to sludges and float created during the chemical or physical treatment of refinery wastewaters. The K list also includes waste codes for certain petroleum wastestreams generated by the petroleum refining industry. These waste codes are K048 through K052 and K169 through K172.

Multisource Leachate

The F039 listing applies to multisource leachate, the liquid material that accumulates at the bottom of a hazardous waste landfill. Understanding the natural phenomenon known as leaching is essential to understanding a number of key RCRA regulations. Leaching occurs when liquids such as rainwater filter through soil or buried materials, such as wastes placed in a landfill. When this liquid comes in contact with buried wastes, it leaches or draws chemicals out of those wastes. This liquid (called leachate) can then carry the leached chemical contaminants further into the ground, eventually depositing them elsewhere in the subsurface or in groundwater. The leachate that percolates through landfills, particularly hazardous waste landfills, usually contains high concentrations of chemicals, and is often collected to minimize the potential that it may enter the subsurface environment and contaminate soil or groundwater. This leachate that percolates through hazardous waste landfills and other buried hazardous waste is designated as F039.

THE K LIST: WASTES FROM SPECIFIC SOURCES

The K list of hazardous wastes designates particular wastes from specific sectors of industry and manufacturing as hazardous. The K list wastes are therefore known as wastes from specific sources. Like F list wastes, K list wastes are manufacturing process wastes. They contain chemicals that have been used for their intended purpose. To determine whether a waste qualifies as K-listed, two primary questions must be answered. First, is the facility that created the waste within one of the industrial or manufacturing categories on the K list? Second, does the waste match one of the specific K list waste descriptions? The 13 industries that can generate K list wastes are:

- wood preservation
- inorganic pigment manufacturing
- organic chemicals manufacturing
- inorganic chemicals manufacturing
- pesticides manufacturing
- explosives manufacturing
- petroleum refining
- iron and steel production
- primary aluminum production
- secondary lead processing
- veterinary pharmaceuticals manufacturing
- ink formulation
- coking (processing of coal to produce coke, a material used in iron and steel production).

Remember that not all wastes from these 13 industries are hazardous, only those specifically described in the detailed K list descriptions.

Previously, the K list included waste codes for 17 different industries. However, EPA revoked the K waste codes applicable to the wastestreams in the primary copper, primary lead, primary zinc, and ferroalloys industries (K064, K065, K066, K090, and K091) (63 FR 28556, 28579; May 26, 1998). Currently, there are no K waste codes applicable to these four industries.

In general, the K listings target much more specific wastestreams than the F listings. For example, EPA added a number of listings to the petroleum refining category of the K list. EPA estimates that one hundred facilities nationwide produce wastestreams covered by these new K listings. In contrast, F-listed spent solvent wastes are commonly generated in thousands of different plants and facilities. You may also notice that industries generating K-listed wastes, such as the wood preserving and petroleum refining industries, can also generate F-listed wastes. Typically, K listings describe more specific wastestreams than F listings applicable to the same industry. For example, K051 and K048 designate as hazardous two very specific types of petroleum refinery wastewater treatment residues: wastewater treatment sludges created in API separators and wastewater treatment float created using dissolved air flotation (DAF) pollution control devices. The F037 and F038 listings complement these two K listings by designating as hazardous all other types of petroleum refinery wastewater treatment sludges and floats. These petroleum refinery listings illustrate that the K listings are typically more specific than the F listings. They also illustrate that the two lists are in many ways very similar.

THE P AND U LISTS: DISCARDED COMMERCIAL CHEMICAL PRODUCTS

The P and U lists designate as hazardous pure or commercial grade formulations of certain unused chemicals. As you will see, the P and U listings are quite different from the F and K listings. For a waste to qualify as P- or U-listed, a waste must meet the following three criteria:

- the waste must contain one of the chemicals listed on the P or U list
- the chemical in the waste must be unused
- the chemical in the waste must be in the form of a "commercial chemical product," as EPA defines that term.

The following paragraphs explore these three criteria in detail and examine EPA's rationale in creating the P and U lists.

You have already learned that hazardous waste listings are narrative descriptions of specific wastestreams and that a waste's actual chemical composition is generally irrelevant to whether a listing applies to it. At first glance, the P and U listings seem inconsistent with these principles. Each P and U listing consists only of the chemical name of a compound known to be toxic or otherwise dangerous; no description is included. EPA adopted this format because the same narrative description applies to all P and U list wastes. Instead of appearing next to each one of the hundreds of P and U list waste codes, this description is found in the regulatory text that introduces the two lists.

The generic P and U list waste description involves two key factors. First, a P or U listing applies only if one of the listed chemicals is discarded unused. In other words, the P and U lists do not apply to manufacturing process wastes, as do the F and K lists. The P and U listings apply to unused chemicals that become wastes. Unused chemicals become wastes for a number of reasons. For example, some unused chemicals are spilled by accident. Others are intentionally discarded because they are off-specification and cannot serve the purpose for which they were originally produced.

The second key factor governing the applicability of the P or U listings is that the listed chemical must be discarded in the form of a "commercial chemical product." EPA uses the phrase commercial chemical product to describe a chemical that is in pure form, that is in commercial grade form, or that is the sole active ingredient in a chemical formulation. The pure form of a chemical is a formulation consisting of 100 percent of that chemical. The commercial grade form of a chemical is a formulation in which the chemical is almost 100 percent pure, but contains minor impurities. A chemical is the sole active ingredient in a formulation if that chemical is the only ingredient serving the function of the formulation. For instance, a pesticide made for killing insects may contain a poison such as heptachlor as well as various solvent ingredients which act as carriers or lend other desirable properties to the poison. Although all of these chemicals may be capable of killing insects, only the heptachlor serves the primary purpose of the insecticide product. The other chemicals involved are present for other reasons, not because they are poisonous. Therefore, heptachlor is the sole active ingredient in such a formulation even though it may be present in low concentrations.

As you can see, the P and U listings apply only to a very narrow category of wastes. For example, an unused pesticide consisting of pure heptachlor is listed waste P059 when discarded. An unused pesticide consisting of pure toxaphene is listed waste P123 when discarded. An unused pesticide made up of 50 percent heptachlor and 50 percent toxaphene as active ingredients, while being just as deadly as the first two formulations, is not a listed waste when discarded. That is because neither compound is discarded in the form of a commercial chemical product. Why did EPA choose such specific criteria for designating P- or U-listed chemicals as hazardous? When first developing the definition of hazardous waste, EPA was not able to identify with confidence all the different factors that can cause a waste containing a known toxic chemical to be dangerous. It was obvious, however, those wastes consisting of pure, unadulterated forms of certain chemicals were worthy of regulation. EPA used the P and U lists to designate hazardous wastes consisting of pure or highly concentrated forms of known toxic chemicals. As you will see in the following sections of the module, wastes that remain unregulated by listings may still fall under protective hazardous waste regulation due to the four characteristics of hazardous waste.

2.4 CHARACTERISTIC HAZARDOUS WASTES

A hazardous waste characteristic is a property that indicates that a waste poses a sufficient threat to deserve regulation as hazardous. EPA tried to identify characteristics which, when present in a waste, can cause death or illness in humans or ecological damage. EPA also decided that the presence of any characteristic of hazardous waste should be detectable by using a standardized test method or by applying general knowledge of the waste's properties. EPA believed that unless generators were provided with widely available and uncomplicated test methods for determining whether their wastes exhibited hazardous characteristics, this system of identifying hazardous wastes would be unfair and impractical. Given these criteria, EPA only finalized four hazardous waste characteristics. These characteristics are a necessary supplement to the hazardous waste listings. They provide a screening mechanism that waste handlers must apply to all wastes from all industries. In this sense, the characteristics provide a more complete and inclusive means of identifying hazardous wastes than do the hazardous waste listings. The four characteristics of hazardous waste are:

- ignitability
- corrosivity
- reactivity
- toxicity.

The regulations explaining these characteristics and the test methods to be used in detecting their presence are found in Part 261, Subpart C. Note that although waste handlers can use the test methods referenced in Subpart C to determine whether a waste displays characteristics, they are not required to do so. In other words, any handler of industrial waste may apply knowledge of the waste's properties to determine if it exhibits a characteristic, instead of sending the waste for expensive laboratory testing. As with listed wastes, characteristic wastes are assigned waste codes. Ignitable, corrosive, and reactive wastes carry the waste codes D001, D002, and D003, respectively. Wastes displaying the characteristic of toxicity can carry any of the waste codes D004 through D043.

IGNITABILITY

Ignitable wastes are wastes that can readily catch fire and sustain combustion. Many paints, cleaners, and other industrial wastes pose such a fire hazard. Most ignitable wastes are liquid in physical form. EPA selected a flash point test as the method for determining whether a liquid waste is combustible enough to deserve regulation as hazardous. The flash point test determines the lowest temperature at which a chemical ignites when exposed to flame. Many wastes in solid or nonliquid physical form (e.g., wood, paper) can also readily catch fire and sustain combustion, but EPA did not intend to regulate most of these nonliquid materials as ignitable wastes. A nonliquid waste is only hazardous due to ignitability if it can spontaneously catch fire under normal handling conditions and can burn so vigorously that it creates a hazard. Certain compressed gases and chemicals called oxidizers can also be ignitable. Ignitable wastes carry the waste code D001 and are among the most common hazardous wastes. The regulations describing the characteristic of ignitability are codified at §261.21.

CORROSIVITY

Corrosive wastes are acidic or alkaline (basic) wastes which can readily corrode or dissolve flesh, metal, or other materials. They are also among the most common hazardous wastestreams. Waste sulfuric acid from automotive batteries is an example of a corrosive waste. EPA uses two criteria to identify corrosive hazardous wastes. The first is a pH test. Aqueous wastes with a pH greater than or equal to 12.5, or less than or equal to 2 are corrosive under EPA's rules. A waste may also be corrosive if it has the ability to corrode steel in a specific EPA-approved test protocol. Corrosive wastes carry the waste code D002. The regulations describing the corrosivity characteristic are found at §261.22.

REACTIVITY

A reactive waste is one that readily explodes or undergoes violent reactions. Common examples are discarded munitions or explosives. In many cases, there is no reliable test method to evaluate a waste's potential to explode or react violently under common handling conditions. Therefore, EPA uses narrative criteria to define most reactive wastes and allows waste handlers to use their best judgment in determining if a waste is sufficiently reactive to be regulated. This is possible because reactive hazardous wastes are relatively uncommon and the dangers they pose are well known to the few waste handlers who deal with them. A waste is reactive if it meets any of the following criteria:

- it can explode or violently react when exposed to water, when heated, or under normal handling conditions

- it can create toxic fumes or gases when exposed to water or under normal handling conditions

- it meets the criteria for classification as an explosive under Department of Transportation rules

- it generates toxic levels of sulfide or cyanide gas when exposed to a pH range of 2 through 12.5.

Wastes exhibiting the characteristic of reactivity are assigned the waste code D003. The reactivity characteristic is described in the regulations at §261.23.

TOXICITY CHARACTERISTIC

The leaching of toxic compounds or elements into groundwater drinking supplies from wastes disposed of in landfills is one of the most common ways the general population can be exposed to the chemicals found in industrial wastes. EPA developed a characteristic designed to identify wastes likely to leach dangerous concentrations of certain known toxic chemicals into groundwater. In order to predict whether any particular waste is likely to leach chemicals into groundwater in the absence of special restrictions on its handling, EPA first designed a lab procedure that replicates the leaching process and other effects that occur when wastes are buried in a typical municipal landfill. This lab procedure is known as the Toxicity Characteristic Leaching Procedure (TCLP). Using the TCLP on a waste sample creates a liquid leachate that is similar to the liquid EPA would expect to find in the ground near a landfill containing the same waste. Once the leachate is created in the lab, a waste handler must determine whether it contains any of 39 different toxic chemicals above specified regulatory levels. If the leachate sample contains a sufficient concentration of one of the specified chemicals, the waste exhibits the toxicity characteristic (TC). EPA used groundwater modeling studies and toxicity data for a number of common toxic compounds and elements to set these threshold concentration levels. Much of the toxicity data were originally developed under the Safe Drinking Water Act.

However, there is one exception to using the TCLP to identify a waste as hazardous. The D.C. Circuit Court, in *Association of Battery Recyclers vs. EPA*, vacated the use of the TCLP to determine whether manufactured gas plant (MGP) wastes exhibit the characteristic of toxicity. As previously stated, the TCLP replicates the leaching process in municipal landfills. The court found that EPA did not produce sufficient evidence that co-disposal of MGP wastes from remediation sites with municipal solid waste (MSW) has happened or is likely to happen. On March 13, 2002, in response to the court vacatur, EPA codified language exempting MGP waste from the toxicity characteristic regulation (67 FR 11251).

To recap, determining whether a waste exhibits the toxicity characteristic involves two principal steps: (1) creating a leachate sample using the TCLP; and (2) evaluating the concentration of 39 chemicals in that sample against the regulatory levels listed below in Table 1. If a waste exhibits the TC, it carries the waste code associated with the compound or element that exceeded the regulatory level. The following table presents the toxicity characteristic waste codes, regulated constituents, and regulatory levels. This table and the regulations describing the characteristic of toxicity are codified at §261.24.

Table 1
TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS

Waste Code	Contaminants	Concentration
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol*	200.0
D024	m-Cresol*	200.0
D025	p-Cresol*	200.0
D026	Total Cresols*	200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex)	1.0
D043	Vinyl chloride	0.2

*If o-, m-, and p-cresols cannot be individually measured, the regulatory level for total cresols is used.

2.5 WASTES LISTED SOLELY FOR EXHIBITING THE CHARACTERISTIC OF IGNITABILITY, CORROSIVITY, AND/OR REACTIVITY

Hazardous wastes listed solely for exhibiting the characteristic of ignitability, corrosivity, and/or reactivity are not regulated the same way that other listed hazardous wastes are regulated under RCRA. When wastes are generated that meet a listing description for one of the 29 wastes listed only for exhibiting the characteristic of ignitability, corrosivity, and/or reactivity, the waste is not hazardous if it does not exhibit a characteristic (66 FR 27266, 27283; May 16, 2001). This concept is consistent with the mixture and derived-from rules, which will be discussed in detail later in this module. For example, F003 is listed for the characteristic of ignitability. If a waste is generated and meets the listing description for F003 but does not exhibit the characteristic of ignitability, it is not regulated as a hazardous waste. However, such wastes are still subject to the land disposal restrictions unless they do not exhibit a characteristic at the point of generation.

2.6 THE MIXTURE AND DERIVED-FROM RULES

So far, this module has introduced the fundamentals of the hazardous waste identification process and an overview of the hazardous waste listings and characteristics. You should now be able to explain in general terms which solid wastes are hazardous wastes. Now we analyze a new question: "When do these hazardous wastes cease being regulated as hazardous wastes?" The regulations governing this issue are commonly known as the mixture and derived-from rules.

BACKGROUND

When EPA first developed the RCRA regulations and the definition of hazardous waste in the late 1970s, the Agency focused on establishing the listings and characteristics, criteria allowing industry to identify which wastes deserved regulation as hazardous wastes. Commenters on EPA's original proposed regulations brought up other key questions about the hazardous waste identification process. For example, these commenters asked, "once a waste is identified as hazardous, what happens if that waste changes in some way? If the hazardous waste is changed, either by mixing it with other wastes or by treating it to modify its chemical composition, should it still be regulated as hazardous?" Faced with a short time frame for answering this difficult question, EPA developed a fairly simple and strict answer and presented it in the mixture and derived-from rules.

LISTED HAZARDOUS WASTES

The mixture and derived-from rules operate differently for listed waste and characteristic wastes. The mixture rule for listed wastes states that a mixture made up of any amount of a nonhazardous solid waste and any amount of a listed hazardous waste is considered a listed hazardous waste. In other words, if a small vial of listed waste is mixed with a large quantity of nonhazardous waste, the resulting mixture bears the same waste code and regulatory status as the original listed component of the mixture. This principle applies regardless of the actual health

Facility Inspection-MONTHLY

Date and Time:	Inspected By:

General Facility

Yes	No	N/A	Item	Comments
			Emergency Response Equipment	
			Security Fence & Access Gates	
			Survey control monuments & grid markers	

Cover Inspection

Yes	No	N/A	Item	Comments
			Erosion on protective cover?	
			Vegetation present on protective cover?	
			Anchor Trench runout exposed?	
			Geosynthetics damage?	
			Exposed geosynthetics?	
			Ponded water on slopes?	
			Erosion rills or gullies?	
			Settlement or animal holes or damage?	
			Slope instability, cracks or slides?	
			Soil washout around edge of crown?	
			Erosion on swales, terraces, down spouts?	
			Woody plants or saplings on slope?	
			Vegetation coverage problem >100 sq ft?	
			Botanical disease or weather stress?	
			Vegetation coverage in surrounding ditches?	

Leachate Collection System

Yes	No	N/A	Item	Comments
			Flow meters in working condition?	
			Leachate pipes in working condition?	
			Fluid in Cell 1 leachate sump? If so how much?	Verify < 12 inches.
			Fluid in Cell 1 leak detection sump? If so how much?	If any fluid, take sample & notify.
			Fluid in Cell 2 leachate sump? If so how much?	Verify < 12 inches.
			Fluid in Cell 2 leak detection sump? If so how much?	If any fluid, take sample & notify.
			Fluid in Cell 3 leachate sump? If so how much?	Verify < 12 inches.
			Fluid in Cell 3 leak detection sump? If so how much?	If any fluid, take sample & notify.
			Fluid in Drying Pad 1 leak detection sump? If so how much?	If any fluid, take sample & notify.
			Fluid in Drying Pad 2 leak detection sump? If so how much?	If any fluid, take sample & notify.
			Fluid in Drying Pad 3 leak detection sump? If so how much?	If any fluid, take sample & notify.
			Fluid in Truck Wash leak detection sump? If so how much?	If any fluid, take sample & notify.
			Fluid in Leachate Pond leak detection sump? If so how much?	If any fluid, take sample & notify.
			Indications of piping leaks?	
			Valves in working condition?	
			Flanges leaking?	
			Pumps in working condition?	
			Secondary containment clean?	
			Liquid level gauges in working condition?	

Stormwater Conveyance Systems

Yes	No	N/A	Item	Comments
			Buildup of silt deposits?	
			Washouts/obstructions in culverts?	
			Erosion/obstructions in drainage structures?	
			Excess sediment in drainage structures?	
			Damage to drainage terraces?	
			Damage to letdown structures?	
			Damage to perimeter channels?	
			Access road integrity sufficient?	
			Damage to surrounding vegetation?	
			Contaminants in stormwater pond?	
			Water flowing outside of drainage ditch?	

Vadose Zone Monitoring

Yes	No	N/A	Item	Comments
			Monitor well #1 condition	Attach Vadose Zone Monitoring Record
			Monitor well #2 condition	Attach Vadose Zone Monitoring Record
			Monitor well #3 condition	Attach Vadose Zone Monitoring Record
			Monitor well #4 condition	Attach Vadose Zone Monitoring Record
			Monitor well #5 condition	Attach Vadose Zone Monitoring Record

Leachate Evaporation Pond

	Item	Comments
	Wind speed (mph)	
	Wind direction	
	Precipitation last 24 hrs (in)	
	H2S-Air (<1 ppm OK)	
	Pond level (ft)	
	Pond color, sheen	
	Water temperature (deg F)	
	pH	
	H2S-Dissolved (<1 ppm OK)	
	Vegetation	
	Animal activity	
	Bird control measures	

WASTE LISTED SOLELY FOR EXHIBITING THE CHARACTERISTIC OF IGNITABILITY, CORROSIVITY, AND/OR REACTIVITY

All wastes listed solely for exhibiting the characteristic of ignitability, corrosivity and/or reactivity characteristic (including mixtures, derived-from, and as-generated wastes) are not regulated as hazardous wastes once they no longer exhibit a characteristic (66 FR 27266, 27268; May 16, 2001). EPA can list a waste as hazardous if that waste typically exhibits one or more of the four hazardous waste characteristics. If a hazardous waste listed only for the characteristics of ignitability, corrosivity and/or reactivity is mixed with a solid waste, the original listing does not carry through to the resulting mixture if that mixture does not exhibit any hazardous waste characteristics. For example, EPA listed the F003 spent solvents as hazardous because these wastes typically display the ignitability characteristic. If F003 waste is treated by mixing it with another waste, and the resulting mixture does not exhibit a characteristic, the F003 listing no longer applies. (Be aware, however, that for the land disposal restrictions, the Agency places certain controls on how hazardous wastes can be treated or mixed with other wastes. Any hazardous waste mixing must be consistent with these rules.)

If a waste derived from the treatment, storage, or disposal of a hazardous waste listed for the characteristics of ignitability, corrosivity, and/or reactivity, no longer exhibits one of those characteristics, it is not a hazardous waste (§261.3(g)(2)(ii)). For example, if a sludge is generated from the treatment of F003, and that sludge does not exhibit the characteristic of ignitability, corrosivity, or reactivity, the F003 listing will not apply to the sludge.

MIXTURE RULE EXEMPTIONS

There are a few situations in which EPA does not require strict application of the mixture and derived-from rules. EPA determined that certain mixtures involving listed wastes and certain residues from the treatment of listed wastes typically do not pose enough of a health or environmental threat to deserve regulation as listed wastes. The principal regulatory exclusions from the mixture and derived-from rules are summarized below.

There are eight exemptions from the mixture rule. The first exemption from the mixture rule applies to mixtures of characteristic wastes and specific mining wastes excluded under §261.4(b)(7). This narrow exemption allows certain mixtures to qualify as nonhazardous wastes, even if the mixtures exhibit one or more hazardous waste characteristics. The module entitled Solid and Hazardous Waste Exclusions will explain in more detail the mining waste or Bevill exclusion.

The remaining exemptions from the mixture rule apply to certain listed hazardous wastes that are discharged to wastewater treatment facilities (§261.3(a)(2)(iv)). Many industrial facilities produce large quantities of nonhazardous wastewaters as their primary wastestreams. These wastewaters are typically discharged to a water body or local sewer system after being treated to remove pollutants, as required by the Clean Water Act. At many of these large facilities, on-site cleaning, chemical spills, or laboratory operations also create relatively small secondary wastestreams that are hazardous due to listings or characteristics. For example, a textile plant producing large quantities of nonhazardous wastewater can generate a secondary wastestream of listed spent solvents from cleaning equipment. Routing such secondary hazardous wastestreams to the facility's wastewater treatment system is a practical way of treating and getting rid of these wastes. This management option triggers the mixture rule, however, since even a very small amount of a listed wastestream combined with very large volumes of nonhazardous wastewater causes the entire mixture to be listed. EPA provided exemptions from the mixture rule for a number of these situations where relatively small quantities of listed hazardous wastes are routed to large-volume wastewater treatment systems. To qualify for this exemption from the mixture rule, the amount of listed waste introduced into a wastewater treatment system must be very small (or de minimis) relative to the total amount of wastewater treated in the system, and the wastewater system must be regulated under the Clean Water Act.

DERIVED-FROM RULE EXEMPTIONS

There are five regulatory exemptions from the derived-from rule. The first of these derived-from rule exemptions applies to materials that are reclaimed from hazardous wastes and used beneficially. Many listed and characteristic hazardous wastes can be recycled to make new products or be processed to recover usable materials with economic value. Such products derived from recycled hazardous wastes are no longer solid wastes. Using the hazardous waste identification process discussed at the beginning of this module, if the materials are not solid wastes, then whether they are derived from listed wastes or whether they exhibit hazardous characteristics is irrelevant. The module entitled Definition of Solid Waste and Hazardous Waste Recycling will explain which residues derived from hazardous wastes actually cease to be wastes and qualify for this exemption.

The other four exemptions from the derived-from rule apply to residues from the treatment of specific wastes using specific treatment processes. For example, K062 describes spent pickle liquor from the iron and steel industry. Pickle liquor is an acid solution used to finish the surface of steel. When pickle liquor is spent and becomes a waste, it usually contains acids and toxic heavy metals. This waste can be treated by mixing it with lime to form a sludge. This treatment, called stabilization, neutralizes the acids in the pickle liquor and makes the metals less dangerous by chemically binding them within the sludge. EPA studied this process and determined that K062 treated in this manner no longer poses enough of a threat to warrant hazardous waste regulation. Therefore, lime-stabilized waste pickle liquor sludge derived from K062 is not a listed hazardous waste. The other exemptions from the derived-from rule for listed wastes are also quite specific and include: waste derived-from the burning of exempt recyclable fuels, biological treatment sludge derived-from treatment of K156 and K157, catalyst inert support media separated from K171 and K172, and residues from high temperature metal recovery of K061, K062, and F006, provided certain conditions are met.

DELISTING

The RCRA regulations provide another form of relief from the mixture and derived-from rule principles for listed hazardous wastes. Through a site-specific process known as "delisting," a waste handler can submit to EPA a petition demonstrating that while a particular wastestream generated at their facility may meet a hazardous waste listing description, it does not pose sufficient hazard to deserve RCRA regulation (§260.22). If EPA grants such a petition, the particular wastestream at that facility will not be regulated as a listed hazardous waste. Because the delisting process is difficult, time-consuming, and expensive, it is not considered a readily available exception to the mixture and derived-from from rules.

The hazardous waste listings, the hazardous waste characteristics, and the mixture and derived-from rules are all essential parts of the definition of hazardous waste, but these key elements are all described in different sections of the RCRA regulations. Only one regulatory section, §261.3, unites all four elements to establish the formal definition of hazardous waste. This section is entitled Definition of Hazardous Waste. Section 261.3 states that all solid wastes exhibiting one of the four hazardous characteristics defined in Part 261, Subpart C, are hazardous wastes. This section also states that all solid wastes listed on one of the four hazardous waste lists in Part 261, Subpart D, are hazardous wastes. Finally, this section explains in detail the mixture and derived-from rules and the regulatory exemptions from these rules. Thus, although §261.3 is entitled Definition of Hazardous Waste, it serves primarily as a guide to the mixture and derived-from rules. Substantive rules about the two most crucial elements of the hazardous waste definition, the listings and characteristics, are found elsewhere.

2.7 THE CONTAINED-IN POLICY

The contained-in policy is a special, more flexible version of the mixture and derived-from rules that applies to environmental media and debris contaminated with hazardous waste. Environmental media (singular, "medium") is the term EPA uses to describe soil, sediments, and groundwater. Debris is a term EPA uses to describe a broad category of larger manufactured and naturally occurring objects that are commonly discarded (§268.2(g)). Examples of debris include:

- dismantled construction materials such as used bricks, wood beams, and chunks of concrete
- decommissioned industrial equipment such as pipes, pumps, and dismantled tanks
- other discarded manufactured objects such as personal protective equipment (e.g., gloves, coveralls, eyewear)
- large, naturally occurring objects such as tree trunks and boulders.

Environmental media and debris are contaminated with hazardous waste in a number of ways. Environmental media are usually contaminated through accidental spills of hazardous waste or spills of product chemicals which, when spilled, become hazardous wastes. Debris can also be contaminated through spills. Most debris in the form of industrial equipment and personal protective gear becomes contaminated with waste or product chemicals during normal industrial operations. Contaminated media and debris are primary examples of "remediation wastes." In other words, they are not wastestreams created during normal industrial or manufacturing operations. They are typically created during cleanups of contaminated sites and during the decommissioning of factories. Handlers of contaminated media and debris usually cannot control or predict the composition of these materials, which have become contaminated though accidents or past negligence. In contrast, handlers of "as-generated wastes," the term often used to describe chemical wastestreams created during normal industrial or manufacturing operations, can usually predict or control the creation of these wastes through the industrial process. Examples of as-generated wastes include concentrated spent chemicals, industrial wastewaters, and pollution control residues such as sludges.

The hazardous waste identification principles you have learned, including the mixture and derived-from rules, apply to as-generated industrial wastes. EPA decided that a more flexible version of these principles should apply to the primary remediation wastes: environmental media and debris. In particular, EPA determined that strict application of the mixture and derived-from rules was inappropriate for media and debris, especially when listed wastes were involved. Applying the mixture and derived-from rules to media and debris would present certain disadvantages, as the following examples illustrate. First, under the traditional mixture and derived-from rules, environmental media and debris contaminated with any amount of listed hazardous waste would be forever regulated as hazardous. Such a strict regulatory interpretation would require excavated or dismantled materials to be handled as listed hazardous wastes and could discourage environmental cleanup efforts. Second, most spills of chemicals into soil or groundwater produce very large quantities of these media containing relatively low concentrations of chemicals. Strict application of the mixture and derived-from principles to media would therefore cause many tons of soil to be regulated as listed hazardous waste despite containing low concentrations of chemicals and posing little actual health threat. Finally, one of the main benefits of the mixture and derived-from rules is not relevant to media and debris. The mixture and derived-from principles encourage handlers of as-generated wastes to keep their listed wastes segregated from less hazardous wastestreams to avoid creating more listed wastes. Handlers of contaminated media and debris generally have no control over the process by which these materials come into contact with hazardous waste.

For all of the above reasons, EPA chose to apply a special, more flexible, version of the mixture and derived-from rules to environmental media and debris. Contaminated soil, groundwater, and debris can still present health threats if they are not properly handled and/or disposed. Therefore, EPA requires that any medium and debris contaminated with a listed waste or exhibiting a hazardous characteristic be regulated like any other hazardous waste. Media and debris contaminated with listed hazardous wastes can, however, lose their listed status and become nonhazardous. This occurs after a demonstration that the particular medium or debris in question no longer poses a sufficient health threat to deserve RCRA regulation. The requirements for making this demonstration are explained below. Once the demonstration is made, the medium or debris in question is no longer considered to "contain" a listed hazardous waste and is no longer regulated. In addition, contaminated media that contain a waste listed solely for the characteristics of ignitability, corrosivity, and/or reactivity, would no longer be managed as a hazardous waste when no longer exhibiting a characteristic (66 FR 27266, 27286; May 16, 2001). This concept that media and debris can contain or cease to contain a listed hazardous waste accounts for the name of the policy.

The contained-in policy for environmental media is not actually codified in the RCRA regulations. In legal terms, it is merely a special interpretation of the applicability of the mixture and derived-from rules to soil and groundwater that has been upheld in federal court. These principles for the management of contaminated media are therefore known as a policy instead of a rule. The terms of the contained-in policy are relatively general. In order for environmental medium contaminated with a listed waste to no longer be considered hazardous, the handler of that media must demonstrate to EPA's satisfaction that it no longer poses a sufficient health threat to deserve RCRA regulation. Although handlers of listed media must obtain EPA's concurrence before disposing of such media as nonhazardous, the current contained-in policy provides no guidelines on how this demonstration to EPA should be made. The contained-in policy is a far easier option for eliminating unwarranted hazardous waste regulation for low-risk listed wastes than the process of delisting a hazardous waste mentioned previously. The delisting process demands extensive sampling and analysis, submission of a formal petition, and a complete rulemaking by EPA. A determination that an environmental medium no longer contains a listed hazardous waste can be granted on a site-specific basis by EPA officials without any regulatory procedure.

Debris contaminated with hazardous waste has traditionally been governed by the same nonregulatory contained-in policy explained above. In 1992, EPA codified certain aspects of the contained-in policy for debris in the definition of hazardous waste regulations in §261.3(f) (57 FR 37194, 34225; August 18, 1992). In particular, EPA included a regulatory passage that explains the process by which handlers of debris contaminated with listed hazardous waste can demonstrate that the debris is nonhazardous. This passage also references certain treatment technologies for decontaminating listed debris so that it no longer contains a listed waste. Thus, the term contained-in policy is now something of a misnomer for contaminated debris, since a contained-in rule for debris now exists.

3. REGULATORY DEVELOPMENTS

The hazardous waste identification process is subject to critical review, and adjusted accordingly to reflect technology changes and new information. The hazardous waste listings are particularly dynamic as the Agency conducts further research to incorporate new listings. The following is a brief discussion of several developments to hazardous waste identification.

3.1 THE HAZARDOUS WASTE IDENTIFICATION RULES

EPA proposed to significantly impact the RCRA hazardous waste identification process through a rulemaking effort called the Hazardous Waste Identification Rules (HWIR). The first rule, HWIR-media, was finalized on November 30, 1998, and addressed contaminated media (63 FR 65874). The second rule, HWIR-waste, was finalized on May 16, 2001, and modified the mixture and derived-from rules, as well as the contained-in policy for listed wastes (66 FR 27266). Both the HWIR-media rule, and the HWIR-waste rule, attempt to increase flexibility to the hazardous waste identification system by providing a regulatory mechanism for certain hazardous wastes with low concentrations of hazardous constituents to exit the Subtitle C universe.

The final HWIR-media rule addresses four main issues. First, the Agency promulgated a streamlined permitting process for remediation sites that will simplify and expedite the process of obtaining a permit. Second, EPA created a new unit, called a "staging pile," that allows more flexibility when storing remediation wastes during cleanups. Third, the Agency promulgated an exclusion for dredged materials permitted under the Clean Water Act, or the Marine Protection, Research, and Sanctuaries Act. Fourth, the rule finalized provisions that enable states to more easily receive authorization when their RCRA programs are updated in order to incorporate revisions to the federal RCRA regulations. The HWIR-media rule did not incorporate the provisions that would have removed low risk remediation waste from Subtitle C regulations because of fundamental disagreements between stakeholders.

On July 18, 2000, the Agency released HWIR-waste exemption levels for 36 chemicals that were developed using a risk model known as the Multimedia, Multipathway and Multireceptor Risk Assessment (3MRA) Model (65 FR 44491). EPA is currently reviewing the public comments and will decide whether further revisions to the model are necessary. After completion of independent testing, EPA submitted the model to EPA's Science Advisory Board (SAB) for review during 2003.

The May 16, 2001, HWIR-waste rule revised and retained the hazardous waste mixture and derived-from rules as previously discussed in this module. In addition, the rule finalized provisions that conditionally exempt mixed waste (waste that is both radioactive and hazardous), if the mixed waste meets certain conditions in Part 266 (66 FR 27266).

3.2 FINAL HAZARDOUS WASTE LISTING DETERMINATIONS

EPA first signed a proposed consent decree with the Environmental Defense Fund (EDF) on June 18, 1991, following a suit concerning EPA's obligations to take certain actions pursuant to RCRA. A consent decree is a legally binding agreement, approved by the Court, which details the agreements of the parties in settling a suit. The proposed consent decree, commonly known as the "mega-deadline," settles some of the outstanding issues from the case by creating a schedule for EPA to take action on its RCRA obligations. The consent decree, which has been periodically updated, requires EPA to evaluate specified wastestreams and determine whether or not to add them to the hazardous waste listings.

On November 8, 2000, EPA listed as hazardous two wastes generated by the chlorinated aliphatics industry (65 FR 67068). The two wastes are K174, wastewater treatment sludges from the production of ethylene dichloride or vinyl chloride monomer (EDC/VCM), and K175, wastewater treatment sludges from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process. For K174, EPA finalized a contingent-management listing approach which specifies that the waste will not be listed if it is sent to a Subtitle C landfill or a non-hazardous landfill licensed or permitted by the state or federal government.

On November 20, 2001, EPA published a final rule listing three wastes generated from inorganic chemical manufacturing processes as hazardous wastes (66 FR 58257). The three wastes are K176, baghouse filters from the production of antimony oxide; K177, slag from the production of antimony oxide that is speculatively accumulated or disposed; and K178, residues from manufacturing and manufacturing-site storage of ferric chloride from acids formed during the production of titanium dioxide using the chloride-ilmenite process.

EPA proposed a concentration-based hazardous waste listing for certain waste solids and liquids (K180 and K179) generated from the production of paint on February 13, 2001 (66 FR 10060). Following a review of the public comments and supplemental analyses based on those public comments, EPA determined that the paint wastes identified in the proposal do not present a substantial hazard to human health or the environment. Therefore, EPA did not list these paint production wastes as hazardous. See the April 4, 2002, final determination regarding these hazardous waste listings (67 FR 16261) for additional information.

On February 24, 2005, EPA published a final rule listing nonwastewaters from the production of certain dyes, pigments, and food, drug, and cosmetic colorants (70 FR 9138) as hazardous (K181) using a mass loading-based approach. Under the mass loading approach, these wastes are hazardous if they contain any of the constituents of concern at annual mass loading levels that meet or exceed the regulatory levels. The K181 listing focuses on seven hazardous constituents: aniline, o-anisidine, 4-chloroaniline, p-cresidine, 1,2-phenylenediamine, 1,3-phenylenediamine, and 2,4-dimethylaniline. Waste that contains less than the specified threshold levels of constituents of concern are not hazardous. The K181 listing is EPA’s final obligation under the consent decree.

3.3 PROPOSED REVISION TO WASTEWATER TREATMENT EXEMPTION FOR HAZARDOUS WASTE MIXTURES

On April 8, 2003, EPA proposed to add benzene and 2-ethoxyethanol to the list of solvents whose mixtures with wastewater are exempted from the definition of hazardous waste (68 FR 17234). EPA is proposing to provide flexibility in the way compliance with the rule is determined by adding the option of directly measuring solvent chemical levels at the headworks of the wastewater treatment system. In addition, EPA is proposing to include scrubber waters derived from the combustion of spent solvents to the headworks exemption. Finally, EPA is proposing to extend the de minimis exemption to wastes listed in §§261.31 and 261.32 when released in de minimis quantities and to non-manufacturing facilities if certain conditions are met. The final rule is scheduled to be published in the Fall of 2005.

ATTACHMENT C

Referenced Regulations

TITLE 19 NATURAL RESOURCES AND WILDLIFE
CHAPTER 15 OIL AND GAS
PART 29 RELEASES

19.15.29.1 ISSUING AGENCY: Oil Conservation Commission.
[19.15.29.1 NMAC - Rp, 19.15.29.1 NMAC, 8/14/2018]

19.15.29.2 SCOPE: 19.15.29 NMAC applies to persons engaged in oil and gas development and production within New Mexico.
[19.15.29.2 NMAC - Rp, 19.15.29.2 NMAC, 8/14/2018]

19.15.29.3 STATUTORY AUTHORITY: 19.15.29 NMAC is adopted pursuant to the Oil and Gas Act, Section 70-2-11 NMSA 1978 (1977) and Section 70-2-12 NMSA 1978 (2004).
[19.15.29.3 NMAC - Rp, 19.15.29.3 NMAC, 8/14/2018]

19.15.29.4 DURATION: Permanent.
[19.15.29.4 NMAC - Rp, 19.15.29.4 NMAC, 8/14/2018]

19.15.29.5 EFFECTIVE DATE: August 14, 2018, unless a later date is cited at the end of a section.
[19.15.29.5 NMAC - Rp, 19.15.29.5 NMAC, 8/14/2018]

19.15.29.6 OBJECTIVE: To prohibit releases and require persons who operate or control the release or the location of the release to report the unauthorized release of oil, gases, produced water, condensate or oil field waste including regulated NORM or other oil field related chemicals, contaminants or mixtures of those chemicals or contaminants that occur during drilling, producing, storing, disposing, injecting, transporting, servicing or processing and to establish procedures for reporting, site assessment, remediation, closure, variance and enforcement.
[19.15.29.6 NMAC - Rp, 19.15.29.6 NMAC, 8/14/2018; A, 8/24/2021]

19.15.29.7 DEFINITIONS:

A. **"Major release"** means:

(1) an unauthorized release of a volume, excluding gases, of 25 barrels or more;

(2) an unauthorized release of a volume that:

(a) results in a fire or is the result of a fire;

(b) may with reasonable probability reach a watercourse;

(c) may with reasonable probability endanger public health; or

(d) substantially damages property or the environment;

(3) an unauthorized release of gases exceeding 500 MCF; or

(4) a release of a volume that may with reasonable probability be detrimental to fresh water.

B. **"Minor release"** means an unauthorized release, which is not a major release and is a volume greater than five barrels but less than 25 barrels; or for gases, greater than 50 MCF but less than 500 MCF.

C. **"Responsible party"** means the operator, as defined in 19.15.2 NMAC. Notwithstanding the foregoing, the division, in its sole discretion, may also consider a person causing the release, or controlling the location of the release as the responsible party.

D. **"Wellstream"** means the gas, oil, water, suspended constituents, or any combination thereof, which comes from the wellbore.
[19.15.29.7 NMAC - Rp, 19.15.29.7 NMAC, 8/14/2018]

19.15.29.8 RELEASES:

A. **Prohibition.** Except as provided in 19.15.27 NMAC or 19.15.28 NMAC, major releases and minor releases are prohibited.

B. **Requirements.** For all releases regardless of volume, the responsible party shall comply with 19.15.29.8 NMAC and shall remediate the release. For major and minor releases, the responsible party shall also comply with 19.15.29.9, 19.15.29.10, 19.15.29.11, 19.15.29.12 and 19.15.29.13 NMAC.

C. **Initial response.** The responsible party must take the following immediate actions unless the actions could create a safety hazard that would result in injury.

(1) **Source elimination and site security.** The responsible party must take appropriate measures to stop the source of the release and limit access to the site as necessary to protect human health and the environment.

(2) **Containment.** Once the site is secure, the responsible party must contain the materials released by construction of berms or dikes, the use of absorbent pads or other containment actions to limit the area affected by the release and prevent potential fresh water contaminants from migrating to watercourses or areas that could pose a threat to public health and environment. The responsible party must monitor the containment to ensure that it is effectively containing the material and not being degraded by weather or onsite activity.

(3) **Site stabilization.** After containment, the responsible party must recover any free liquids and recoverable materials that can be physically removed from the surface within the containment area. The responsible party must deliver material removed from the site to a division-approved facility.

(4) **Remediation.** The responsible party may commence remediation immediately.

[19.15.29.8 NMAC - Rp, 19.15.29.8 NMAC, 8/14/2018; A, 8/24/2021]

19.15.29.9 RELEASE NOTIFICATION:

A. The responsible party must notify the division on form C-141 of a major or minor release occurring during the drilling, producing, storing, disposing, injecting, transporting, servicing or processing of oil, gases, produced water, condensate or oil field waste including regulated NORM, or other oil field related chemicals, contaminants or mixture of the chemicals or contaminants, in accordance with the requirements of 19.15.29 NMAC.

B. If state, federal or tribal lands are involved, the responsible party must send a copy of the form C-141 to the appropriate land managing agency including the state land office, the BLM or tribal authority, as applicable.

[19.15.29.9 NMAC - Rp, 19.15.29.9 NMAC, 8/14/2018]

19.15.29.10 RELEASE NOTIFICATION REPORTING REQUIREMENTS: The responsible party must notify the division of releases in 19.15.29.9 NMAC as follows.

A. **Reporting a major release.**

(1) The responsible party must notify the division's environmental bureau chief and the appropriate division district office verbally or by e-mail within 24 hours of discovery of the release. The notification must provide the information required on form C-141.

(2) The responsible party must also notify the appropriate division district office in writing within 15 days of discovering the release by completing and filing form C-141. The written notification must verify the prior verbal or e-mail notification and include additions or corrections to the information contained in the prior verbal or e-mail notification.

B. **Reporting a minor release.** The responsible party must notify the appropriate division district office in writing within 15 days of discovery of the release by completing and filing form C-141.

[19.15.29.10 NMAC - Rp, 19.15.29.10 NMAC, 8/14/2018]

19.15.29.11 SITE ASSESSMENT/CHARACTERIZATION: After the responsible party has removed all free liquids and recoverable materials, the responsible party must assess soils both vertically and horizontally for potential environmental impacts from any major or minor release containing liquids.

A. **Characterization requirements.** The responsible party must submit information characterizing the release to the appropriate division district office within 90 days of discovery of the release or characterize the release by submitting a final closure report within 90 days of discovery of the release in accordance with Subsection E of 19.15.29.12 NMAC. The responsible party may seek an extension of time to submit characterization information for good cause as determined by the division. The responsible party must submit the following information to the division.

(1) **Site map.** The responsible party must provide a scaled diagram that shows the potentially impacted area, significant surface features including roads and site infrastructure, location of borings, sample points, monitoring wells and subsurface features such as known pipelines to the extent known at the time of submittal including the source of information regarding subsurface features.

(2) **Depth to ground water.** The responsible party must determine the depth to ground water where the release occurred. If the exact depth to ground water is unknown, the responsible party must provide a reasonable determination of probable ground water depth using data generated by numeric models, cathodic well lithology, water well data, published information or other tools as approved by the appropriate division district office. If the responsible party uses water well data, the responsible party must provide all pertinent well information.

(3) **Wellhead protection area.** The responsible party must determine the horizontal distance from all known water sources within a half mile of the release including private and domestic water sources. Water sources are wells, springs or other sources of fresh water extraction. Private and domestic water sources are those water sources used by less than five households for domestic or stock purposes.

(4) **Distance to nearest significant watercourse.** The responsible party must determine the horizontal distance to the nearest significant watercourse as defined in Subsection P of 19.15.17.7 NMAC within a half mile of any horizontal boundary of the release.

(5) **Soil/waste characteristics.** The responsible party must determine the lateral and vertical extents of soil contamination, as follows.

(a) If the release occurred within a lined containment area, the responsible party must demonstrate liner integrity after affected material is removed and the affected area of the liner is exposed and provide:

(i) certification on form C-141 that the responsible party has visually inspected the liner where the release occurred and the liner remains intact and had the ability to contain the leak in question; and

(ii) at least two business days' notice to the appropriate division district office before conducting the liner inspection.

(b) If the responsible party is unable to demonstrate liner integrity or the release occurred outside of a lined containment area, the responsible party must delineate the release horizontally and vertically using Table I of 19.15.29.12 NMAC constituents or as required by Subparagraph (e) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC based on the type of release. The responsible party shall use one or more of the following soil sampling methods for characterization:

(i) NRCS Field Guide;

(ii) EPA SW-846;

(iii) ASTM Method 4547;

(iv) EPA 600; or

(v) or other division-approved methods.

(c) In addition to Subparagraph (b) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, if the release occurred outside of a lined containment area and is in an area where depth to ground water is greater than 50 feet and less than or equal to 100 feet, the responsible party must delineate the vertical extent of the release to the greater of 600 mg/kg chloride or background chloride level, if:

(i) the release contains produced water that exceeds 10,000 mg/l of chloride (if the responsible party contends the fluid is less than 10,000 mg/l, the responsible party must provide current sample results to the division); and

(ii) the release is of an unknown quantity or results in greater than 200 barrels of unrecovered produced water.

(d) If the conditions are met in Subparagraph (c) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, the responsible party must submit at least two soil samples for laboratory analysis from each borehole or sample point (highest observed contamination and deepest depth investigated). Field screening and assessment techniques are acceptable (headspace, titration, electrical conductivity [include algorithm for validation purposes], electromagnetics, etc.), but the sampling procedures must be clearly defined. The responsible party must submit copies of field notes attributable to field sampling and provide copies of the actual laboratory results including chain of custody documentation.

(e) If a known release of other oil field related chemicals occurs that is not included in Table I of 19.15.29.12 NMAC, and does not include oil, gas, produced water or other fluids from the wellstream, the standards for remediation shall be as follows:

(i) if the constituent appears on Table 1 of 40 C.F.R. 261.24(b), then that constituent shall be remediated according to 40 C.F.R. 261.24;

(ii) if the constituent is not identified in Table 1 of 40 C.F.R. 261.24(b), but is identified in the New Mexico environment department's Risk Assessment Guidance for Site Investigations and Remediation Volumes I and II (assessment), the division will determine the appropriate Assessment Volume and remediation shall occur pursuant to the assessment;

(iii) if the constituent is not identified in Items (i) or (ii) of Subparagraph (e) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, the division shall consult with the responsible party to determine appropriate remediation of the release.

B. Unless the site characterization report includes completed efforts at remediation, the report must include a proposed remediation plan in accordance with 19.15.29.12 NMAC, which includes the anticipated timelines for beginning and completing the remediation.

C. If the division determines that more information is needed to understand the character of the release and its potential impact on fresh water, public health and the environment, the division may request the responsible party submit additional information. Should the division request additional information, it must do so in writing to the responsible party within 30 days from receipt of the characterization report or remediation plan with what specific information the division is requesting and reasons why the additional information is needed. The responsible party has 14 days to respond to a written request for additional information. If the responsible party disagrees with the request for additional information, it may consult with the division, or file an application for hearing pursuant to 19.15.4 NMAC within 30 days of the issuance of the request for additional information.

[19.15.29.11 NMAC - Rp, 19.15.29.11 NMAC, 8/14/2018]

19.15.29.12 REMEDIATION AND CLOSURE:

A. The responsible party must remediate all releases regardless of volume.

B. Remediation requirements.

(1) Unless remediation is completed, and a final closure report submitted, within 90 days of discovery of the release, the responsible party must complete division-approved remediation for releases either pursuant to a remediation plan approved pursuant to 19.15.29.12 NMAC or pursuant to an abatement plan in accordance with 19.15.30 NMAC. If the director determines that the release has caused water pollution in excess of the standards and requirements of 19.15.30 NMAC, the director may notify the responsible party that an abatement plan may be required pursuant to 19.15.30 NMAC.

(2) Any remediation under 19.15.29 NMAC should be completed as soon as practicable. Any remediation that exceeds 90 days must follow the division-approved timeline in the remediation plan. The responsible party may request an extension of time to remediate upon a showing of good cause as determined by the division.

C. Remediation plan requirements. The responsible party must take the following action for any major or minor release containing liquids.

(1) The responsible party must submit a detailed description of proposed remediation measures in accordance with the findings of the site assessment/characterization plan that includes:

(a) delineation results, including laboratory analysis;

(b) a scaled sitemap showing release area with horizontal and vertical delineation points;

(c) estimated volume of impacted material to be remediated;

(d) proposed remediation technique; and

(e) proposed timeline for remediation activities.

(2) The responsible party shall restore the impacted surface area of a release occurring on a developed well pad, central tank battery, drilling site, compressor site or other exploration, development, production or storage sites to meet the standards of Table I of 19.15.29.12 NMAC or other applicable remediation standards and restore and reclaim the area pursuant to 19.15.29.13 NMAC. If contamination is located in areas immediately under or around production equipment such as production tanks, wellheads and pipelines where remediation could cause a major facility deconstruction, the remediation, restoration and reclamation may be deferred with division written approval until the equipment is removed during other operations, or when the well or facility is plugged or abandoned, whichever comes first. The deferral may be granted so long as the contamination is fully delineated and does not cause an imminent risk to human health, the environment, or ground water. Final remediation and reclamation shall take place in accordance with 19.15.29.12 and 19.15.29.13 NMAC once the site is no longer being used for oil and gas operations.

(3) The responsible party shall remediate the impacted surface area of a release not occurring on a lined, bermed or otherwise contained exploration, development, production or storage site to meet the standards of Table I of 19.15.29.12 NMAC or other applicable remediation standards and restore and reclaim the area pursuant to 19.15.29.13 NMAC.

(4) If a release occurs within the following areas, the responsible party must treat the release as if it occurred less than 50 feet to ground water in Table I of 19.15.29.12 NMAC:

(a) within

(i) 300 feet of any continuously flowing watercourse or any other significant watercourse, or

(ii) 200 feet of any lakebed, sinkhole or playa lake (measured from the ordinary high-water mark);

(b) within 300 feet from an occupied permanent residence, school, hospital, institution or church;

(c) within

(i) 500 feet of a spring or a private, domestic fresh water well used by less than five households for domestic or stock watering purposes, or

(ii) 1000 feet of any fresh water well or spring;

(d) within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to Section 3-27-3 NMSA 1978 as amended, unless the municipality specifically approves;

(e) within 300 feet of a wetland;

(f) within the area overlying a subsurface mine;

(g) within an unstable area; or

(h) within a 100-year floodplain.

(5) The division has 60 days from receipt of the proposed remediation plan to review and approve, approve with conditions or deny the remediation plan. If 60 days have lapsed without response from the division, then the plan is deemed denied. If the plan is approved with conditions or affirmatively denied, the division shall provide a written summary of deficiencies on which the decision is based. If the responsible party disagrees with any conditions of approval or denial of the plan, it shall consult with the division or file an application for hearing pursuant to 19.15.4 NMAC within 30 days of the denial or issuance of the conditions.

D. **Closure requirements.** The responsible party must take the following action for any major or minor release containing liquids.

(1) The responsible party must test the remediated areas for contamination with representative five-point composite samples from the walls and base, and individual grab samples from any wet or discolored areas. The samples must be analyzed for the constituents listed in Table I of 19.15.29.12 NMAC or constituents from other applicable remediation standards.

(a) The responsible party must verbally notify the appropriate division district office two business days prior to conducting final sampling. If the division district office does not respond to the notice within the two business days, the responsible party may proceed with final sampling. The responsible party may request a variance from this requirement upon a showing of good cause as determined by the division.

(b) The responsible party may submit a composite and grab sample plan for the division's review and approval separately or with the remediation plan.

(c) Alternately, without division approval, the responsible party may elect to perform a composite and grab sample plan of the remediated area where each composite sample is not representative of more than 200 square feet.

(2) If all composite and grab sample concentrations are less than or equal to the parameters listed in Table I of 19.15.29.12 NMAC or any conditions of approval, then the responsible party may proceed to backfill any excavated areas.

E. **Closure reporting.** The responsible party must take the following action for any major or minor release containing liquids.

(1) The responsible party must submit to the division a closure report on form C-141, including required attachments, to document all closure activities including sampling results and the details on any backfilling, capping or covering, where applicable. The responsible party must certify that all information in the closure report and attachments is correct and that the responsible party has complied with all applicable closure requirements and conditions specified in division rules or directives. The responsible party must submit closure report along with form C-141 to the division within 90 days of the remediation plan approval. The responsible party may apply for additional time to submit the final closure report upon a showing of good cause as determined by the division. The final report must include:

(a) a scaled site and sampling diagram;

(b) photographs of the remediated site prior to backfill;

(c) laboratory analyses of final sampling; and

(d) a description of all remedial activities.

(2) The division district office has 60 days to review and approve or deny the closure report. If 60 days have lapsed without response from the division, then the report is deemed denied. If the report is affirmatively denied, the division shall provide a written summary of deficiencies on which the decision is based. If the responsible party disagrees with denial of the closure report, it may consult with the division or file an application for hearing pursuant to 19.15.4 NMAC within 30 days of the denial.

Table I Closure Criteria for Soils Impacted by a Release			
Minimum depth below any point within the horizontal boundary of the release to	Constituent	Method*	Limit**

ground water less than 10,000 mg/l TDS			
≤ 50 feet	Chloride***	EPA 300.0 or SM4500 Cl B	600 mg/kg
	TPH (GRO+DRO+MRO)	EPA SW-846 Method 8015M	100 mg/kg
	BTEX	EPA SW-846 Method 8021B or 8260B	50 mg/kg
	Benzene	EPA SW-846 Method 8021B or 8260B	10 mg/kg
51 feet-100 feet	Chloride***	EPA 300.0 or SM4500 Cl B	10,000 mg/kg
	TPH (GRO+DRO+MRO)	EPA SW-846 Method 8015M	2,500 mg/kg
	GRO+DRO	EPA SW-846 Method 8015M	1,000 mg/kg
	BTEX	EPA SW-846 Method 8021B or 8260B	50 mg/kg
	Benzene	EPA SW-846 Method 8021B or 8260B	10 mg/kg
>100 feet	Chloride***	EPA 300.0 or SM4500 Cl B	20,000 mg/kg
	TPH (GRO+DRO+MRO)	EPA SW-846 Method 8015M	2,500 mg/kg
	GRO+DRO	EPA SW-846 Method 8015M	1,000 mg/kg
	BTEX	EPA SW-846 Method 8021B or 8260B	50 mg/kg
	Benzene	EPA SW-846 Method 8021B or 8260B	10 mg/kg

*Or other test methods approved by the division.
**Numerical limits or natural background level, whichever is greater.
***This applies to releases of produced water or other fluids, which may contain chloride.
[19.15.29.12 NMAC - N, 8/14/2018]

19.15.29.13 RESTORATION, RECLAMATION AND RE-VEGETATION:

A. The responsible party must substantially restore the impacted surface areas to the condition that existed prior to the release or their final land use. Restoration of the site must include the replacement of removed material and must be replaced to the near original relative positions and contoured to achieve erosion control, long-term stability and preservation of surface water flow patterns.

B. Areas reasonably needed for production operations or for subsequent drilling operations must be compacted, covered, paved or otherwise stabilized and maintained in such a way as to minimize dust and erosion to the extent practical.

C. The responsible party must construct the soil cover to the site's existing grade and prevent ponding of water and erosion of the cover material.

D. **Reclamation of areas no longer in use.** The responsible party shall reclaim all areas disturbed by the remediation and closure, except areas reasonably needed for production operations or for subsequent drilling operations, as early and as nearly as practical to their original condition or their final land use and maintain those areas to control dust and minimize erosion to the extent practical.

(1) The reclamation must contain a minimum of four feet of non-waste containing, uncontaminated, earthen material with chloride concentrations less than 600 mg/kg as analyzed by EPA Method 300.0, or other test methods approved by the division. The soil cover must include a top layer, which is either the background thickness of topsoil or one foot of suitable material to establish vegetation at the site, whichever is greater.

(2) The responsible party must reseed disturbed area in the first favorable growing season following closure of the site.

(3) The division will consider reclamation of all disturbed areas complete when uniform vegetative cover has been established that reflects a life-form ratio of plus or minus fifty percent of pre-disturbance levels and a total percent plant cover of at least seventy percent of pre-disturbance levels, excluding noxious weeds.

(4) For any major or minor release containing liquids, the responsible party must notify the division when reclamation and re-vegetation are complete.

E. The surface restoration, reclamation and re-vegetation obligations imposed by federal or state agencies or tribes on lands managed or owned by those agencies supersede these provisions and govern the obligations of any responsible party subject to those provisions, provided that the other requirements provide equal or better protection of fresh water, human health and the environment.
[19.15.29.13 NMAC - N, 8/14/2018]

19.15.29.14 VARIANCES:

A. A responsible party may file a written request for a variance from any requirement of 19.15.29 NMAC with the appropriate division district office. The variance request must include:

(1) a detailed statement explaining the need for a variance; and

(2) a detailed written demonstration that the variance will provide equal or better protection of fresh water, public health and the environment.

B. The division district office must approve or deny the variance in writing within 60 days of receipt. If the division district office denies the variance, it must provide the responsible party with the reasons for denial.

C. If the division district office does not approve or deny a request for variance from the requirements of 19.15.29 NMAC within 60 days of the date the request for variance is received by the division district office, then the request for variance is deemed denied and the responsible party may file an application for a hearing pursuant to 19.15.4 NMAC within 30 days of the denial.

D. If the responsible party requests a hearing pursuant to 19.15.4 NMAC within 30 days after receipt of notice, the division must set the matter for hearing with notice to the responsible party and appropriate division district office.

E. In addition to the notice provisions in 19.15.4 NMAC, the responsible party must provide notice of the hearing on the request for variance to the surface owner of the site by certified mail, return receipt requested, at least 20 days prior to the date of the hearing.

F. Variances must receive division approval prior to implementation.

[19.15.29.14 NMAC - N, 8/14/2018]

19.15.29.15 ENFORCEMENT:

A. The responsible party must comply with all the requirements of 19.15.29 NMAC. The division may take enforcement action pursuant to 19.15.5.10 NMAC against any responsible party who does not comply with 19.15.29 NMAC.

B. A responsible party may enter a stipulated final order with the division for any violation of 19.15.29 NMAC, except for 19.15.29.9 NMAC. An agreed compliance order may be entered prior to or after the filing of an application by the division or any other party for an administrative compliance proceeding. Any administrative compliance order will have the same force and effect as a compliance order issued after an adjudicatory hearing.

C. The director or the director’s designee may deny any application or permit, including but not limited to, a permit to drill, deepen or plug back a well if the responsible party is not in compliance with a court order or final order arising from 19.15.29 NMAC.

[19.15.29.15 NMAC - N, 8/14/2018; A, 8/24/2021]

19.15.29.16 TRANSITIONAL PROVISIONS:

A. Responsible parties with current ongoing corrective actions/remediation with approved plans and timelines as of August 14, 2018 do not have to submit revised plans.

B. Responsible parties with ongoing corrective actions/remediation without approved timelines or plans as of August 14, 2018 must submit a characterization plan or corrective action/remediation plan with proposed timeframes within 90 days of August 14, 2018.

[19.15.29.16 NMAC - N, 8/14/2018]

HISTORY of 19.15.29 NMAC:

History of Repealed Material:

19.15.3 NMAC, Drilling (filed 10/29/2001) repealed 12/1/2008.

19.15.29 NMAC, Release Notification (filed 12/1/2008) was repealed effective 8/14/2018.

NMAC History:

That applicable portion of 19.15.3 NMAC, Drilling (Section 116) (filed 10/29/2001) was replaced by 19.15.29 NMAC, Release Notification, effective 12/1/2008.

19.15.29 NMAC, Release Notification (filed 12/1/2008) was repealed and replaced by 19.15.29, Releases, effective 8/14/2018.

TITLE 19 NATURAL RESOURCES AND WILDLIFE
CHAPTER 15 OIL AND GAS
PART 36 SURFACE WASTE MANAGEMENT FACILITIES

19.15.36.1 ISSUING AGENCY: Energy, Minerals and Natural Resources Department, Oil Conservation Division.
[19.15.36.1 NMAC - N, 2/14/2007; A, 12/1/08]

19.15.36.2 SCOPE: 19.15.36 NMAC applies to persons or entities that operate surface waste management facilities as defined in Subsection S of 19.15.2.7 NMAC.
[19.15.36.2 NMAC - N, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.3 STATUTORY AUTHORITY: 19.15.36 NMAC is adopted pursuant to the Oil and Gas Act, NMSA 1978, Section 70-2-6, Section 70-2-11 and Section 70-2-12, which grants the division jurisdiction and authority over the disposition of wastes resulting from oil and gas operations.
[19.15.36.3 NMAC - N, 2/14/2007; A, 12/1/08]

19.15.36.4 DURATION: Permanent.
[19.15.36.4 NMAC - N, 2/14/2007]

19.15.36.5 EFFECTIVE DATE: February 14, 2007, unless a later date is cited at the end of a section.
[19.15.36.5 NMAC - N, 2/14/2007; A, 12/1/08]

19.15.36.6 OBJECTIVE: To regulate the disposal of oil field waste and the construction, operation, closure and post closure of surface waste management facilities.
[19.15.36.6 NMAC - N, 2/14/2007; A, 6/30/16]

19.15.36.7 DEFINITIONS:

A. Definitions relating to types of surface waste management facilities.

(1) "Centralized facility" means a surface waste management facility:

(a) that is used exclusively by one generator subject to New Mexico's Oil and Gas Conservation Tax Act, NMSA 1978, Section 7-30-1, as amended;

(b) where the generator or operator does not receive compensation for oil field waste management at that facility; and

(c) receives exclusively oil field wastes that are generated from production units or leases the generator, or an affiliate of the generator, operates (for this provision's purposes, an affiliate of a generator is a person who controls, is controlled by or is under common control with the generator).

(2) "Commercial facility" means a surface waste management facility that is not a centralized facility.

(3) "Landfarm" means a discrete area of land designated and used for the remediation of petroleum hydrocarbon-contaminated soils and drill cuttings.

(4) "Landfill" means a discrete area of land or an excavation designed for permanent disposal of exempt or non-hazardous waste.

(5) "Small landfarm" means a centralized landfarm of two acres or less that has a total capacity of 2000 cubic yards or less in a single lift of eight inches or less, remains active for a maximum of three years from the date of its registration and that receives only petroleum hydrocarbon-contaminated soils (excluding drill cuttings) that are exempt or non-hazardous waste.

B. Other definitions.

(1) "Active portion" means that part of a surface waste management facility that has received or is receiving oil field waste and has not been closed.

(2) "Cell" means a confined area engineered for the disposal or treatment of oil field waste.

(3) "Composite liner" means a liner that may consist of multiple layers of geosynthetics and low-permeability soils. The different layers of a composite liner may have different material properties and may be applied at different stages of landfill liner installation.

(4) "Geosynthetic" means the general classification of synthetic materials used in geotechnical applications, including the following classifications:

(a) "geocomposite" means a manufactured material using geotextiles, geogrids or geomembranes, or combinations thereof, in a laminated or composite form;

(b) "geogrid" means a deformed or non-deformed, netlike polymeric material used to provide reinforcement to soil slopes;

(c) "geomembrane" means an impermeable polymeric sheet material that is impervious to liquid and gas as long as it maintains its integrity, and is used as an integral part of an engineered structure designed to limit the movement of liquid or gas in a system;

(d) "geonet" means a type of geogrid that allows planar flow of liquids and serves as a drainage system;

(e) "geosynthetic clay liner (GCL)" means a relatively thin layer of processed clay (typically bentonite) that is either bonded to a geomembrane or fixed between two sheets of geotextile; and

(f) "geotextile" means a sheet material that is less impervious to liquid than a geomembrane but more resistant to penetration damage, and is used as part of an engineered structure or system to serve as a filter to prevent the movement of soil fines into a drainage system, to provide planar flow for drainage, to serve as a cushion to protect geomembranes or to provide structural support.

(5) "Leachate" means the liquid that has passed through or emerged from oil field waste and contains soluble, suspended or miscible materials.

(6) "Landfarm cell" means a bermed area of 10 acres or less within a landfarm.

(7) "Landfarm lift" means an accumulation of soil or drill cuttings predominately contaminated by petroleum hydrocarbons that is placed into a landfarm cell for treatment.

(8) "Lower explosive limit" means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 77 degrees fahrenheit and atmospheric pressure.

(9) "Major modification" means a modification of a surface waste management facility that involves an increase in the land area that the permitted surface waste management facility occupies; a change in the design capacity or nature of the permitted oil field waste stream; addition of a new treatment process; an exception to, waiver of or change to a numerical standard provided in 19.15.36 NMAC; or other modification that the division determines is sufficiently substantial that public notice and public participation in the application process are appropriate.

(10) "Minor modification" means a modification of a surface waste management facility that is not a major modification.

(11) "Operator" means the person who owns the surface waste management facility.

(12) "Poor foundation conditions" are features that indicate that a natural or human-induced event may result in inadequate foundational support for a surface waste management facility's structural components.

(13) "Run-off" means rainwater, leachate or other liquid that drains over land from any part of a surface waste management facility.

(14) "Structural components of a landfill" are liners, leachate collection and removal systems, final covers, run-on/run-off systems and other components used in a landfill's construction or operation that are necessary for protection of fresh water, public health or the environment.

[19.15.36.7 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.8 SURFACE WASTE MANAGEMENT FACILITY PERMITS AND APPLICATION REQUIREMENTS:

A. Permit required. No person shall operate a surface waste management facility (other than a small landfarm registered pursuant to Paragraph (1) of Subsection A of 19.15.36.16 NMAC) except pursuant to and in accordance with the terms and conditions of a division-issued surface waste management facility permit. The applicant for a permit or permit modification, renewal or transfer shall be the operator of the surface waste management facility. The operator is responsible for the actions of the operator's officers, employees, consultants, contractors and subcontractors as they relate to the operation of the surface waste management facility. Any person who is involved in a surface waste management facility's operation shall comply with 19.15.36 NMAC and the permit.

B. Permitting requirements. Except for small landfarms registered pursuant to Paragraph (1) of Subsection A of 19.15.36.16 NMAC, new commercial or centralized facilities prior to commencement of construction, and existing commercial or centralized facilities prior to modification or permit renewal, shall be permitted by the division in accordance with the applicable requirements of Subsection C of 19.15.36.8 NMAC and 19.15.36.11 NMAC.

C. Application requirements for new facilities, major modifications and permit renewals. An applicant or operator shall file an application, form C-137, for a permit for a new surface waste management facility, to modify an existing surface waste management facility or for permit renewal with the environmental bureau in the division's Santa Fe office. The application shall include:

(1) the names and addresses of the applicant and principal officers and owners of twenty-five percent or more of the applicant;

(2) a plat and topographic map showing the surface waste management facility's location in relation to governmental surveys (quarter-quarter section, township and range); highways or roads giving access to the surface waste management facility site; watercourses; fresh water sources, including wells and springs; and inhabited buildings within one-half mile of the site's perimeter based upon the records of the applicable county clerk or clerk's office;

(3) the names and addresses of the surface owners of the real property on which the surface waste management facility is sited and surface owners of the real property within one mile of the site's perimeter;

(4) a description of the surface waste management facility with a diagram indicating the location of fences and cattle guards, and detailed construction/installation diagrams of pits, liners, dikes, piping, sprayers, tanks, roads, fences, gates, berms, pipelines crossing the surface waste management facility, buildings and chemical storage areas;

(5) engineering designs, certified by a registered professional engineer, including technical data on the design elements of each applicable treatment, remediation and disposal method and detailed designs of surface impoundments;

(6) a plan for management of approved oil field wastes that complies with the applicable requirements contained in 19.15.36.13 NMAC, 19.15.36.14 NMAC, 19.15.36.15 NMAC and 19.15.36.17 NMAC;

(7) an inspection and maintenance plan that complies with the requirements contained in Subsection L of 19.15.36.13 NMAC;

(8) a hydrogen sulfide prevention and contingency plan that complies with those provisions of 19.15.11 NMAC that apply to surface waste management facilities;

(9) a closure and post closure plan, including a responsible third party contractor's cost estimate, sufficient to close the surface waste management facility in a manner that will protect fresh water, public health and the environment, and to comply with the closure and post closure requirements contained in Subsections A through F of 19.15.36.18 NMAC;

(10) a contingency plan that complies with the requirements of Subsection N of 19.15.36.13 NMAC and with NMSA 1978, Sections 12-12-1 through 12-12-30, as amended;

(11) a plan to control run-on water onto the site and run-off water from the site that complies with the requirements of Subsection M of 19.15.36.13 NMAC;

(12) in the case of an application to permit a new or expanded landfill, a leachate management plan that describes the anticipated amount of leachate that will be generated and the leachate's handling, storage, treatment and disposal, including final post closure options;

(13) in the case of an application to permit a new or expanded landfill, a gas safety management plan that complies with the requirements of Subsection O of 19.15.36.13 NMAC;

(14) a best management practice plan to ensure protection of fresh water, public health and the environment;

(15) geological/hydrological data including:

(a) a map showing names and location of streams, springs or other watercourses, and water wells within one mile of the site;

(b) laboratory analyses, performed by an independent commercial laboratory, for major cations and anions; BTEX; RCRA metals; and TDS of ground water samples of the shallowest fresh water aquifer beneath the proposed site;

(c) depth to, formation name, type and thickness of the shallowest fresh water aquifer;

(d) soil types beneath the proposed surface waste management facility, including a lithologic description of soil and rock members from ground surface down to the top of the shallowest fresh water aquifer;

(e) geologic cross-sections;

(f) potentiometric maps for the shallowest fresh water aquifer; and

(g) porosity, permeability, conductivity, compaction ratios and swelling characteristics for the sediments on which the contaminated soils will be placed;

(16) certification by the applicant that information submitted in the application is true, accurate and complete to the best of the applicant's knowledge, after reasonable inquiry; and

(17) other information that the division may require to demonstrate that the surface waste management facility's operation will not adversely impact fresh water, public health or the environment and that the surface waste management facility will comply with division rules and orders.

D. Application requirements for minor modifications. Before making a minor modification, the operator of an existing surface waste management facility shall file a form C-137A with the environmental bureau in the division's Santa Fe office describing the proposed change. Minor modifications are not subject to Subsection C of 19.15.36.8 NMAC. If the division denies the application for a minor modification, the operator may request a hearing pursuant to Subsection B of 19.15.36.10 NMAC.

[19.15.36.8 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.9 APPLICATION PROCESS AND NOTICE REQUIREMENTS FOR NEW SURFACE WASTE MANAGEMENT FACILITIES, MAJOR MODIFICATIONS OR RENEWALS AND ISSUANCE OF A FINAL DECISION:

A. Submittal of application. The applicant shall submit three copies (two paper copies and one electronic copy) of the application to the division's Santa Fe office for consideration of approval. Upon receipt of an application for a new surface waste management facility, or a renewal or major modification of an existing permit, the division shall post a notice on the division's website that lists the type of facility, type of application, county or municipality where the facility is located and name of the applicant, and provides information on where the application can be viewed and whom to contact to be placed on a mailing list for notice regarding a proposed decision.

B. Division review: Within 90 days after the receipt of an application, the division shall review the application and determine if the application is approvable, approval with conditions or not approvable.

(1) Upon completion of the division's review, if the division determines the application is approvable, the division shall, within 30 days following such determination, prepare a proposed decision, which may include conditions, and mail notice of the proposed approval, together with a copy of the proposed decision, by certified mail, return receipt requested, to the applicant. The division shall post the proposed decision on the division's website.

(2) Upon completion of the division's review, if the division determines the application is not approvable, the division shall, within 60 days of such determination, mail a deficiency letter by certified mail, return receipt requested, to the applicant. The deficiency letter shall identify and address all of the division's concerns regarding the application in specific detail allowing the applicant the opportunity to correct the deficiencies by submitting a revised application.

(3) If the division issues a deficiency letter, the applicant shall have 60 days from the division's issuance of the deficiency letter to submit a revised application. The applicant may request, in writing, additional time to submit a revised application. The division shall grant additional time for good cause. The applicant may notify the division that it will not submit a revised application. Within 10 days of receipt of the notification the division shall deny the application without prejudice. If the applicant fails to timely submit a revised application or notify the division that it will not submit a revised application, the division shall deny the application without prejudice within 10 days after the 60 day time limit for the applicant to respond to the deficiency letter has expired.

(4) If the applicant timely submits a revised application, within 90 days of the receipt of the revised application the division shall review the revised application and determine if the revised application is approvable, approvable with conditions or not approvable. The division shall mail notice of denial or the proposed approval with or without conditions, together with a copy of the decision to deny or the proposed decision to approve with or without conditions, by certified mail, return receipt requested, to the applicant. A denial letter shall identify and address all of the division's reasons for denial of the revised application. The division shall post the decision to deny the application or the proposed decision to approve the application with or without conditions on the division's website.

(5) The process provided in Subsection B of 19.15.36.9 NMAC is not intended to limit informal informational exchanges during the application review period or prior to submission of an application. The process also does not prohibit an applicant from withdrawing an application and submitting a new application under Subsection A of 19.15.36.9 NMAC.

C. Upon receipt of a proposed decision to approve an application with or without conditions, the applicant shall provide a division-approved notice of the proposed approval by:

(1) giving written notice, by certified mail, return receipt requested, of the division's proposed decision to approve the application with or without conditions to the surface owners within one-half mile of the surface waste facility;

(2) publishing in a newspaper of general circulation in the county or counties where the surface waste management facility is or will be located;

(3) mailing notice by first class mail or e-mail to persons, as identified to the applicant by the division, who have requested notification of applications generally, or of the particular application, and who have provided a legible return address or e-mail address; and

(4) mailing notice by first class or e-mail to affected local, state, federal or tribal governmental agencies, as determined and identified to the applicant by the division.

D. This notice issued pursuant to Subsection C of 19.15.36.9 NMAC shall include:

(1) the applicant's name and address;

(2) the surface waste management facility's location, including a street address if available, and sufficient information to locate the surface waste management facility with reference to surrounding roads and landmarks;

(3) a brief description including the type of facility (*i.e.* landfarm, landfill, treating plant, etc.) of the proposed surface waste management facility;

(4) the depth to, and TDS concentration of, the ground water in the shallowest aquifer beneath the surface waste management facility site;

(5) a statement that the division's proposed decision to approve the application with or without conditions is available on the division's website, or, upon request, from the division clerk, including the division clerk's name, address and telephone number;

(6) a division-approved description of alternatives, exceptions or waivers that may be under consideration in accordance with Subsection F of 19.15.36.18 NMAC or 19.15.36.19 NMAC; and

(7) a statement of the procedures for requesting a hearing on the application pursuant to 19.15.4 NMAC.

E. The applicant shall mail notice that is required to be mailed on or before publication of the notice that is published in a newspaper of general circulation in the county or counties where the surface waste management facility is or will be located.

F. The applicant shall provide the division with proof that the public notice requirements of Subsections C and D of 19.15.36.9 NMAC have been met prior to the division scheduling a hearing pursuant to 19.15.36.10 NMAC or issuing the permit.

G. If after the applicant provides notice as required herein, no requests for hearing are timely filed with the division as provided by 19.15.36.10 NMAC, or any such requests for hearing are filed by persons the division determines lack standing, and the division does not otherwise schedule a hearing pursuant to 19.15.36.10 NMAC, the division's proposed decision to approve the application with or without conditions shall become final and the division shall issue the permit upon the applicant providing financial assurance as provided in 19.15.36.10 NMAC.

[19.15.36.9 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; Repealed, 6/30/16; 19.15.36.9 NMAC - N, 6/30/16]

19.15.36.10 COMMENTS AND HEARING ON APPLICATION:

A. A person who wishes to comment or request a hearing shall file comments or request a hearing on the proposed approval of an application with the division clerk within 90 days after the date of the newspaper publication provided in Subsection C of 19.15.36.9 NMAC. A request for a hearing shall be in writing and shall state specifically the reasons why a hearing should be held. The director may deny a request for hearing if the director determines the person requesting the hearing lacks standing.

B. If the division denies an application pursuant to Paragraphs (3) or (4) of Subsection B of 19.15.39.9 NMAC, the applicant may request a hearing within 30 days of the receipt of the notice of denial and the division shall schedule a hearing.

C. In addition to the requests for hearing provided in Subsections A and B of 19.15.36.10 NMAC, the division shall schedule a hearing on the application if:

(1) the division's proposed decision to approve the application includes conditions not expressly required by rule, and the applicant requests a hearing within 90 days of receipt of the notice of proposed approval;

(2) the director determines that there is significant public interest in the application;

(3) the director determines that comments have raised objections that have probable technical merit; or

(4) approval of the application requires that the division make a finding, pursuant to Paragraph (3) of Subsection F of 19.15.2.7 NMAC, whether a water source has a present or reasonably foreseeable beneficial use that contamination would impair.

D. If the division schedules a hearing on an application, the hearing shall be conducted according to 19.15.4 NMAC.

[19.15.36.10 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.11 FINANCIAL ASSURANCE REQUIREMENTS:

A. Centralized facilities. Upon notification by the division that it has approved a permit but prior to the division issuing the permit, an applicant for a new centralized facility permit shall submit acceptable financial assurance in the amount of $25,000 per centralized facility, or a statewide “blanket” financial assurance in the amount of $50,000 to cover all of that applicant’s centralized facilities, unless such applicant has previously posted a blanket financial assurance for centralized facilities.

B. New commercial facilities or major modifications of existing commercial facilities. Upon notification by the division that it has approved a permit for a new commercial facility or a major modification of an existing commercial facility but prior to the division issuing the permit, the applicant shall submit acceptable financial assurance in the amount of the commercial facility’s estimated closure and post closure cost, or $25,000, whichever is greater. The commercial facility’s estimated closure and post closure cost shall be the amount provided in the closure and post closure plan the applicant submitted pursuant to Paragraph (9) of Subsection C of 19.15.36.8 NMAC unless the division determines that such estimate does not reflect a reasonable and probable closure and post closure cost to implement the closure and post closure plan, in which event, the division shall determine the estimated closure and post closure cost and shall include such determination in its proposed decision. If the applicant disagrees with the division’s determination of estimated closure and post closure cost, the applicant may request a hearing as provided in 19.15.36.10 NMAC. If the applicant so requests, and no other person files a request for a hearing regarding the proposed decision, the hearing shall be limited to determination of estimated closure and post closure cost.

C. Terms of financial assurance. The financial assurance shall be on division-prescribed forms, or forms otherwise acceptable to the division, payable to the energy, minerals and natural resources department, oil conservation division and conditioned upon the surface waste management facility’s proper operation, site closure and post closure operations in compliance with state of New Mexico statutes, division rules, applicable division orders and the surface waste management facility permit terms. The division may require proof that the individual signing for an entity on a financial assurance document or any amendment thereto has the authority to obligate that entity.

D. Forfeiture of financial assurance. The division shall give the operator 20 days’ notice and an opportunity for a hearing prior to forfeiting financial assurance. All forfeitures the division demands pursuant to 19.15.36 NMAC shall be made payable to the energy, minerals and natural resources department, oil conservation division upon demand by the division.

E. Forms of financial assurance. The division may accept the following forms of financial assurance.

(1) Surety bonds. A surety bond shall be executed and notarized by the applicant and by a corporate surety licensed by the superintendent of insurance to do business in the state. All surety bonds shall be non-cancelable and payable to the energy, minerals and natural resources department, oil conservation division within 45 days after demand is made by the division. All surety bonds shall be governed by the laws of the state of New Mexico.

(2) Letters of credit. A letter of credit shall be issued by a national or state-chartered banking association, shall be irrevocable for a term of not less than five years and shall provide for automatic renewal for successive, like terms upon expiration, unless the issuer has notified the division in writing of non-renewal at least 120 days before its expiration date. All letters of credit shall be governed by the laws of the state of New Mexico. If a letter of credit is not replaced by an approved financial assurance within 30 days of notice of non-renewal provided to the division, the division may demand and collect a letter of credit.

(3) Cash accounts. An operator may provide financial assurance in the form of a federally insured or equivalently protected cash account or accounts in a financial institution, provided that the operator and the financial institution shall execute as to each such account a collateral assignment of the account to the division, which shall provide that only the division may authorize withdrawals from the account. In the event of forfeiture pursuant to 19.15.36 NMAC, the division may, at any time and from time to time, direct payment of all or part of the balance of such account (excluding interest accrued on the account) to itself or its designee for the surface waste management facility's closure and post closure. Any assignment of cash collateral shall be governed by the laws of the state of New Mexico and shall be on division-prescribed forms.

F. Replacement of financial assurance.

(1) The division may allow an operator to replace existing forms of financial assurance with other forms of financial assurance that provide equivalent coverage.

(2) The division shall not release existing financial assurance until the operator has submitted, and the division has approved, an acceptable replacement.

(3) Any time an operator changes the corporate surety, financial institution or amount of financial assurance, the operator shall file updated financial assurance documents on division-prescribed forms within 30 days. Notwithstanding the foregoing, if an operator makes other changes to its financial assurance documents, the division may require the operator to file updated financial assurance documents on division-prescribed forms within 45 days after notice to the operator from the division.

G. Review of adequacy of financial assurance. The division may at any time not less than five years after initial acceptance of financial assurance for a commercial facility, or whenever the operator applies for a major modification of the commercial facility's permit, and at least once during every successive five-year period, initiate a review of such financial assurance's adequacy. Additionally, whenever the division determines that a landfarm operator has not achieved the closure standards specified in Paragraph (3) of Subsection G of 19.15.36.15 NMAC, the division may review the adequacy of the landfarm operator's financial assurance, without regard to the date of its last review. Upon determination, after notice to the operator and an opportunity for a hearing, that the financial assurance is not adequate to cover the reasonable and probable cost of a commercial facility's closure and post closure operations, the division may require the operator to furnish additional financial assurance sufficient to cover such reasonable and probable cost.

H. Duty to report. Any operator who files for bankruptcy shall provide notice to the division, through the process provided for under the rules of the United States bankruptcy court, and the New Mexico attorney general.

[19.15.36.11 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 6/30/16]

19.15.36.12 PERMIT APPROVAL, DENIAL, REVOCATION, SUSPENSION, MODIFICATION OR TRANSFER:

A. Granting of permit.

(1) The division may issue a permit for an new surface waste management facility or major modification upon finding that an acceptable application has been filed, that the conditions of 19.15.36.9 NMAC and 19.15.36.11 NMAC have been met and that the surface waste management facility or modification can be constructed and operated in compliance with applicable statutes and rules and without endangering fresh water, public health or the environment.

(2) Each permit the division issues for a new surface waste management facility shall remain in effect for 10 years from the date of its issuance. If the division grants a permit for a major modification of a surface waste management facility, the permit for that surface waste management facility shall remain in effect for 10 years from the date the division approves the major modification.

(a) A surface waste management facility permit may be renewed for successive 10-year terms. If the holder of a surface waste management facility permit submits an application for permit renewal at least 120 days before the surface waste management facility permit expires, and the operator is not in violation of the surface waste management facility permit on the date of its expiration, then the existing surface waste management facility permit for the same activity shall not expire until the division has approved or denied an application for renewal. If the division has not notified the operator of a violation, if the operator is diligently pursuing procedures to contest a violation or if the operator and the division have signed an agreed compliance order providing for remedying the violation, then the surface waste management facility permit shall continue in effect as above provided notwithstanding the surface waste management facility permit violation's existence. A surface waste management facility permit continued under this provision remains fully effective and enforceable.

(b) An application for permit renewal shall include and adequately address the information necessary for evaluation of a new surface waste management facility permit as provided in Subsection C of 19.15.36.8 NMAC. Previously submitted materials may be included by reference provided they are current, readily available to the division and sufficiently identified so that the division may retrieve them.

(c) Upon receipt of a proposed decision to approve a renewal application, the operator shall give public notice in the manner prescribed by 19.15.36.9 NMAC. The division shall grant an application for renewal if the division finds that an acceptable application has been filed, that the conditions of 19.15.36.9 NMAC and 19.15.36.11 NMAC have been met and that the surface waste management facility can be operated in compliance with applicable statutes and rules and without endangering fresh water, public health or the environment.

(3) The division shall review each surface waste management facility permit at least once during the 10-year term, and shall review surface waste management facility permits to which Paragraph (2) of Subsection A of 19.15.36.12 NMAC does not apply at least every five years. The review shall address the operation, compliance history, financial assurance and technical requirements for the surface waste management facility. The division, after notice to the operator and an opportunity for a hearing, may require appropriate modifications of the surface waste management facility permit, including modifications necessary to make the surface waste management facility permit terms and conditions consistent with statutes, rules or judicial decisions.

B. Denial of permit. The division may deny an application for a surface waste management facility permit or modification of a surface waste management facility permit if it finds that the proposed surface waste management facility or modification may be detrimental to fresh water, public health or the environment. The division may also deny an application for a surface waste management facility permit if the applicant, an owner of twenty-five percent or greater interest in the applicant or an affiliate of the applicant has a history of failure to comply with division rules and orders or state or federal environmental laws; is subject to a division or commission order, issued after notice and hearing, finding such entity to be in violation of an order requiring corrective action; or has a penalty assessment for violation of division or commission rules or orders that is unpaid more than 70 days after issuance of the order assessing the penalty. An affiliate of an applicant, for purposes of Subsection B of 19.15.36.12 NMAC, shall be a person who controls, is controlled by or under is common control with the applicant or a twenty-five percent or greater owner of the applicant.

C. Additional requirements. The division may impose conditions or requirements, in addition to the operational requirements set forth in 19.15.36 NMAC, that it determines are necessary and proper for the protection of fresh water, public health or the environment. The division shall incorporate such additional conditions or requirements into the surface waste management facility permit.

D. Revocation, suspension or modification of a permit. The division may revoke, suspend or impose additional operating conditions or limitations on a surface waste management facility permit at any time, for good cause, after notice to the operator and an opportunity for a hearing. The division may suspend a surface waste management facility permit or impose additional conditions or limitations in an emergency to forestall an imminent threat to fresh water, public health or the environment, subject to the provisions of NMSA 1978, Section 70-2-23, as amended. If the division initiates a major modification it shall provide notice in accordance with 19.15.36.9 NMAC. Suspension of a surface waste management facility permit may be for a fixed period of time or until the operator remedies the violation or potential violation. If the division suspends a surface waste management facility's permit, the surface waste management facility shall not accept oil field waste during the suspension period.

E. Transfer of a permit. The operator shall not transfer a permit without the division's prior written approval. A request for transfer of a permit shall identify officers, directors and owners of twenty-five percent or greater in the transferee. Unless the director otherwise orders, public notice or hearing are not required for the transfer request's approval. If the division denies the transfer request, it shall notify the operator and the proposed transferee of the denial by certified mail, return receipt requested, and either the operator or the proposed transferee may request a hearing with 10 days after receipt of the notice. Until the division approves the transfer and the required financial assurance is in place, the division shall not release the transferor's financial assurance.
[19.15.36.12 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.13 SITING AND OPERATIONAL REQUIREMENTS APPLICABLE TO ALL PERMITTED SURFACE WASTE MANAGEMENT FACILITIES: Except as otherwise provided in 19.15.36 NMAC.

A. Depth to ground water.

(1) No landfill shall be located where ground water is less than 100 feet below the lowest elevation of the design depth at which the operator will place oil field waste.

(2) No landfarm that accepts soil or drill cuttings with a chloride concentration that exceeds 500 mg/kg shall be located where ground water is less than 100 feet below the lowest elevation at which the operator will place oil field waste. See Subsection A of 19.15.36.15 NMAC for oil field waste acceptance criteria.

(3) No landfarm that accepts soil or drill cuttings with a chloride concentration that is 500 mg/kg or less shall be located where ground water is less than 50 feet below the lowest elevation at which the operator will place oil field waste.

(4) No small landfarm shall be located where ground water is less than 50 feet below the lowest elevation at which the operator will place oil field waste.

(5) No other surface waste management facility shall be located where ground water is less than 50 feet below the lowest elevation at which the operator will place oil field waste.

B. No surface waste management facility shall be located:

(1) within 200 feet of a watercourse, lakebed, sinkhole or playa lake;

(2) within an existing wellhead protection area or 100-year floodplain;

(3) within, or within 500 feet of, a wetland;

(4) within the area overlying a subsurface mine;

(5) within 500 feet from the nearest permanent residence, school, hospital, institution or church in existence at the time of initial application; or

(6) within an unstable area, unless the operator demonstrates that engineering measures have been incorporated into the surface waste management facility design to ensure that the surface waste management facility's integrity will not be compromised.

C. No surface waste management facility shall exceed 500 acres.

D. The operator shall not accept oil field wastes transported by motor vehicle at the surface waste management facility unless the transporter has a form C-133, authorization to move liquid waste, approved by the division.

E. The operator shall not place oil field waste containing free liquids in a landfill or landfarm cell. The operator shall use the paint filter test, as prescribed by the EPA (EPA SW-846, method 9095) to determine conformance of the oil field waste to this criterion.

F. Surface waste management facilities shall accept only exempt or non-hazardous waste, except as provided in Paragraph (3) of Subsection F of 19.15.36.13 NMAC. The operator shall not accept hazardous waste at a surface waste management facility. The operator shall not accept wastes containing NORM at a surface waste management facility except as provided in 19.15.35 NMAC. The operator shall require the following documentation for accepting oil field wastes, and both the operator and the generator shall maintain and make the documentation available for division inspection.

(1) Exempt oil field wastes. The operator shall require a certification on form C-138, signed by the generator or the generator's authorized agent, that represents and warrants that the oil field wastes are generated from oil and gas exploration and production operations, are exempt waste and are not mixed with non-exempt waste. The operator shall have the option to accept such certifications on a monthly, weekly or per load basis. The operator shall maintain and shall make the certificates available for the division's inspection.

(2) Non-exempt, non-hazardous, oil field wastes. The operator shall require a form C-138, oil field waste document, signed by the generator or its authorized agent. This form shall be accompanied by acceptable documentation to determine that the oil field waste is non-hazardous.

(3) Emergency non-oil field wastes. The operator may accept non-hazardous, non-oil field wastes in an emergency if ordered by the department of public safety. The operator shall complete a form C-138, oil field waste document, describing the waste, and maintain the same, accompanied by the department of public safety order, subject to division inspection.

G. The operator of a commercial facility shall maintain records reflecting the generator, the location of origin, the location of disposal within the commercial facility, the volume and type of oil field waste, the date of disposal and the hauling company for each load or category of oil field waste accepted at the commercial facility. The operator shall maintain such records for a period of not less than five years after the commercial facility's closure, subject to division inspection.

H. Disposal at a commercial facility shall occur only when an attendant is on duty unless loads can be monitored or otherwise isolated for inspection before disposal. The surface waste management facility shall be secured to prevent unauthorized disposal.

I. To protect migratory birds, tanks exceeding eight feet in diameter, and exposed pits and ponds shall be screened, netted or covered. Upon the operator's written application, the division may grant an exception to screening, netting or covering upon the operator's showing that an alternative method will protect migratory birds or that the surface waste management facility is not hazardous to migratory birds. Surface waste management facilities shall be fenced in a manner approved by the division.

J. Surface waste management facilities shall have a sign, readable from a distance of 50 feet and containing the operator's name; surface waste management facility permit or order number; surface waste management facility location by unit letter, section, township and range; and emergency telephone numbers.

K. The operators shall comply with the spill reporting and corrective action provisions of 19.15.30 NMAC or 19.15.29 NMAC.

L. Each operator shall have an inspection and maintenance plan that includes the following:

(1) monthly inspection of leak detection sumps including sampling if fluids are present with analyses of fluid samples furnished to the division; and maintenance of records of inspection dates, the inspector and the leak detection system's status;

(2) semi-annual inspection and sampling of monitoring wells as required, with analyses of ground water furnished to the division; and maintenance of records of inspection dates, the inspector and ground water monitoring wells' status; and

(3) inspections of the berms and the outside walls of pond levees quarterly and after a major rainfall or windstorm, and maintenance of berms in such a manner as to prevent erosion.

M. Each operator shall have a plan to control run-on water onto the site and run-off water from the site, such that:

(1) the run-on and run-off control system shall prevent flow onto the surface waste management facility's active portion during the peak discharge from a 25-year storm; and

(2) run-off from the surface waste management facility's active portion shall not be allowed to discharge a pollutant to the waters of the state or United States that violates state water quality standards.

N. Contingency plan. Each operator shall have a contingency plan. The operator shall provide the division's environmental bureau with a copy of an amendment to the contingency plan, including amendments required by Paragraph (8) of Subsection N of 19.15.36.13 NMAC; and promptly notify the division's environmental bureau of changes in the emergency coordinator or in the emergency coordinator's contact information. The contingency plan shall be designed to minimize hazards to fresh water, public health or the environment from fires, explosions or an unplanned sudden or non-sudden release of contaminants or oil field waste to air, soil, surface water or ground water. The operator shall carry out the plan's provisions immediately whenever there is a fire, explosion or release of contaminants or oil field waste constituents that could threaten fresh water, public health or the environment; provided that the emergency coordinator may deviate from the plan as necessary in an emergency situation. The contingency plan for emergencies shall:

(1) describe the actions surface waste management facility personnel shall take in response to fires, explosions or releases to air, soil, surface water or ground water of contaminants or oil field waste containing constituents that could threaten fresh water, public health or the environment;

(2) describe arrangements with local police departments, fire departments, hospitals, contractors and state and local emergency response teams to coordinate emergency services;

(3) list the emergency coordinator's name; address; and office, home and mobile phone numbers (where more than one person is listed, one shall be named as the primary emergency coordinator);

(4) include a list, which shall be kept current, of emergency equipment at the surface waste management facility, such as fire extinguishing systems, spill control equipment, communications and alarm systems and decontamination equipment, containing a physical description of each item on the list and a brief outline of its capabilities;

(5) include an evacuation plan for surface waste management facility personnel that describes signals to be used to begin evacuation, evacuation routes and alternate evacuation routes in cases where fire or releases of wastes could block the primary routes;

(6) include an evaluation of expected contaminants, expected media contaminated and procedures for investigation, containment and correction or remediation;

(7) list where copies of the contingency plan will be kept, which shall include the surface waste management facility; local police departments, fire departments and hospitals; and state and local emergency response teams;

(8) indicate when the contingency plan will be amended, which shall be within five working days whenever:

(a) the surface waste management facility permit is revised or modified;

(b) the plan fails in an emergency;

(c) the surface waste management facility changes design, construction, operation, maintenance or other circumstances in a way that increases the potential for fires, explosions or releases of oil field waste constituents that could threaten fresh water, public health or the environment or change the response necessary in an emergency;

(d) the list of emergency coordinators or their contact information changes; or

(e) the list of emergency equipment changes;

(9) describe how the emergency coordinator or the coordinator's designee, whenever there is an imminent or actual emergency situation, will immediately;

(a) activate internal surface waste management facility alarms or communication systems, where applicable, to notify surface waste management facility personnel; and

(b) notify appropriate state and local agencies with designated response roles if their assistance is needed;

(10) describe how the emergency coordinator, whenever there is a release, fire or explosion, will immediately identify the character, exact source, amount and extent of released materials (the emergency coordinator may do this by observation or review of surface waste management facility records or manifests, and, if necessary, by chemical analysis) and describe how the emergency coordinator will concurrently assess possible hazards to fresh water, public health or the environment that may result from the release, fire or explosion (this assessment shall consider both the direct and indirect hazard of the release, fire or explosion);

(11) describe how, if the surface waste management facility stops operations in response to fire, explosion or release, the emergency coordinator will monitor for leaks, pressure buildup, gas generation or rupture in valves, pipes or the equipment, wherever this is appropriate;

(12) describe how the emergency coordinator, immediately after an emergency, will provide for treating, storing or disposing of recovered oil field waste, or other material that results from a release, fire or explosion at a surface waste management facility;

(13) describe how the emergency coordinator will ensure that no oil field waste, which may be incompatible with the released material, is treated, stored or disposed of until cleanup procedures are complete; and

(14) provide that the emergency coordinator may amend the plan during an emergency as necessary to protect fresh water, public health or the environment.

O. Gas safety management plan. Each operator of a surface waste management facility that includes a landfill shall have a gas safety management plan that describes in detail procedures and methods that will be used to prevent landfill-generated gases from interfering or conflicting with the landfill's operation and protect fresh water, public health and the environment. The plan shall address anticipated amounts and types of gases that may be generated, an air monitoring plan that includes the vadose zone and measuring, sampling, analyzing, handling, control and processing methods. The plan shall also include final post closure monitoring and control options.

P. Training program. Each operator shall conduct an annual training program for key personnel that includes general operations, permit conditions, emergencies proper sampling methods and identification of exempt and non-exempt waste and hazardous waste. The operator shall maintain records of such training, subject to division inspection, for five years.

[19.15.36.13 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.14 SPECIFIC REQUIREMENTS APPLICABLE TO LANDFILLS:

A. General operating requirements.

(1) The operator shall confine the landfill's working face to the smallest practical area and compact the oil field waste to the smallest practical volume. The operator shall not use equipment that may damage the integrity of the liner system in direct contact with a geosynthetic liner.

(2) The operator shall prevent unauthorized access by the public and entry by large animals to the landfill's active portion through the use of fences, gates, locks or other means that attain equivalent protection.

(3) The operator shall prevent and extinguish fires.

(4) The operator shall control litter and odors.

(5) The operator shall not excavate a closed cell or allow others to excavate a closed cell except as approved by the division.

(6) The operator shall provide adequate cover for the landfill's active face as needed to control dust, debris, odors or other nuisances, or as otherwise required by the division.

(7) For areas of the landfill that will not receive additional oil field waste for one month or more, but have not reached the final waste elevation, the operator shall provide intermediate cover that shall be:

(a) approved by the division;

(b) stabilized with vegetation; and

(c) inspected and maintained to prevent erosion and manage infiltration or leachate during the oil field waste deposition process.

(8) When the operator has filled a landfill cell, the operator shall close it pursuant to the conditions contained in the surface waste management facility permit and the requirements of Paragraph (2) of

Subsection C of 19.15.36.18 NMAC. The operator shall notify the division's environmental bureau at least three working days prior to a landfill cell's closure.

B. Ground water monitoring program. If fresh ground water exists at a site, the operator shall, unless otherwise approved by the division, establish a ground water monitoring program, approved by the division's environmental bureau, which shall include a ground water monitoring work plan, a sampling and analysis plan, a ground water monitoring system and a plan for reporting ground water monitoring results. The ground water monitoring system shall consist of a sufficient number of wells, installed at appropriate locations and depths, to yield ground water samples from the uppermost aquifer that:

(1) represent the quality of background ground water that leakage from a landfill has not affected; and

(2) represent the quality of ground water passing beneath and down gradient of the surface waste management facility.

C. Landfill design specification. New landfill design systems shall include a base layer and a lower geomembrane liner (*e.g.*, composite liner), a leak detection system, an upper geomembrane liner, a leachate collection and removal system, a leachate collection and removal system protective layer, an oil field waste zone and a top landfill cover.

(1) The base layer shall, at a minimum, consist of two feet of clay soil compacted to a minimum ninety percent standard proctor density (ASTM D-698)(Copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. This document is available for public viewing at the New Mexico state records center and archives and may not be reproduced, in full or in part. A copy of this publication may be obtained from ASTM International, www.astm.org.) with a hydraulic conductivity of 1 x 10^{-7} cm/sec or less. In areas where no ground water is present, the operator may propose an alternative base layer design, subject to division approval.

(2) The lower geomembrane liner shall consist of a 30-mil flexible PVC or 60-mil HDPE liner, or an equivalent liner approved by the division.

(3) The operator shall place the leak detection system, which shall consist of two feet of compacted soil with a saturated hydraulic conductivity of 1 x 10^{-5} cm/sec or greater, between the lower and upper geomembrane liners. The leak detection system shall consist of a drainage and collection system placed no more than six inches above the lower geomembrane liner in depressions and sloped so as to facilitate the earliest possible leak detection at designated collection points. Drainage piping shall be designed to withstand chemical attack from oil field waste and leachate and structural loading and other stresses and disturbances from overlying oil field waste, cover materials, equipment operation, expansion or contraction, and to facilitate clean-out maintenance. The material placed between the pipes and laterals shall be sufficiently permeable to allow the transport of fluids to the drainage pipe. The slope of the landfill sub-grade and drainage pipes and laterals shall be at least two percent grade; *i.e.*, two feet of vertical drop per 100 horizontal feet. The piping collection network shall be comprised of solid and perforated pipe having a minimum diameter of four inches and a minimum wall thickness of schedule 80. The operator shall seal a solid drainage pipe to convey collected liquids to a corrosion-proof sump or sumps located outside the landfill's perimeter for observation, storage, treatment or disposal. The operator may install alternative designs as approved by the division.

(4) The operator shall place the upper geomembrane liner, which shall consist of a 30-mil flexible PVC or 60-mil HDPE liner, or an equivalent liner approved by the division, over the leak detection system.

(5) The operator shall place the leachate collection and removal system, which shall consist of at least two feet of compacted soil with a saturated hydraulic conductivity of 1 x 10^{-2} cm/sec or greater, over the upper geomembrane liner to facilitate drainage. The leachate collection and removal system shall consist of a drainage and collection and removal system placed no more than six inches above the upper geomembrane liner in depressions and sloped so as to facilitate the maximum leachate collection. Piping shall be designed to withstand chemical attack from oil field waste or leachate and structural loading and other stresses and disturbances from overlying oil field waste, cover materials, equipment operation, expansion or contraction and to facilitate clean-out maintenance. The material placed between the pipes and laterals shall be sufficiently permeable to allow the transport of fluids to the drainage pipe. The slope of the upper geomembrane liner and drainage lines and laterals shall be at least two percent grade; *i.e.*, two feet of vertical drop per 100 horizontal feet. The piping collection network shall be comprised of solid and perforated pipe having a minimum diameter of four inches and a minimum wall thickness of schedule 80. The operator shall seal a solid drainage pipe to convey collected fluids outside the landfill's perimeter for storage, treatment and disposal. The operator may install alternative designs as approved by the division.

(6) The operator shall place the leachate collection and removal system protection layer, which shall consist of a soil layer at least one foot thick with a saturated hydraulic conductivity of 1 x 10^{-2} cm/sec or greater, over the leachate collection and removal system.

(7) The operator shall place oil field waste over the leachate collection and removal system protective layer.

(8) The top landfill cover design shall consist of the following layers (top to bottom): a soil erosion layer composed of at least 12 inches of fertile topsoil re-vegetated in accordance with the post closure provisions of Subparagraph (b) of Paragraph (2) of Subsection C of 19.15.36.18 NMAC; a protection or frost protection layer composed of 12 to 30 inches of native soil; a drainage layer composed of at least 12 inches of sand or gravel with a saturated hydraulic conductivity of 1 x 10^{-2} cm/sec or greater and a minimum bottom slope of four percent, a hydraulic barrier-layer-geomembrane (minimum of a 30-mil flexible PVC or 60-mil HDPE liner, or an equivalent liner approved by the division); and a gas vent or foundation layer composed of at least 12 inches of sand or gravel above oil field waste with soils compacted to the minimum eighty percent Standard Proctor Density. The operator shall install the top landfill cover within one year of achieving the final landfill cell waste elevation. The operator shall ensure that the final landfill design elevation of the working face of the oil field waste is achieved in a timely manner with the date recorded in a field construction log. The operator shall also record the date of top landfill cover installation to document the timely installation of top landfill covers. The operator shall provide a minimum of three working days' notice to the division in advance of the top landfill cover's installation to allow the division to witness the top landfill cover's installation.

(9) Alternatively, the operator may propose a performance-based landfill design system using geosynthetics or geocomposites, including geogrids, geonets, geosynthetic clay liners, composite liner systems, etc., when supported by EPA's "hydrologic evaluation of landfill performance" (HELP) model or other division-approved model. The operator shall design the landfill to prevent the "bathtub effect". The bathtub effect occurs when a more permeable cover is placed over a less permeable bottom liner or natural subsoil.

(10) External piping, *e.g.*, leachate collection, leak detection and sump removal systems shall be designed for installation of a sidewall riser pipe. Pipes shall not penetrate the liner with the exception of gas vent or collection wells where the operator shall install a flexible clamped pipe riser through the top landfill cover liner that will accommodate oil field waste settling and will prevent tears.

D. Liner specifications and requirements.

(1) General requirements.

(a) Geomembrane liner specifications. Geomembrane liners shall consist of a 30-mil flexible PVC or 60-mil HDPE liner, or an equivalent liner approved by the division. Geomembrane liners shall have a hydraulic conductivity no greater than 1 x 10^{-9} cm/sec. Geomembrane liners shall be composed of impervious, geosynthetic material that is resistant to petroleum hydrocarbons, salts and acidic and alkaline solutions. Liners shall also be resistant to ultraviolet light, or the operator shall make provisions to protect the material from sunlight. Liner compatibility shall comply with EPA SW-846 method 9090A.

(b) Liners shall be able to withstand projected loading stresses, settling and disturbances from overlying oil field waste, cover materials and equipment operations.

(c) The operator shall construct liners with a minimum of two percent slope to promote positive drainage and to facilitate leachate collection and leak detection.

(2) Additional requirements for geomembranes.

(a) Geomembranes shall be compatible with the oil field waste to be disposed. Geomembranes shall be resistant to chemical attack from the oil field waste or leachate. The operator shall demonstrate this by means of the manufacturer's test reports, laboratory analyses or other division-approved method.

(b) Geosynthetic material the operator installs on a slope greater than twenty-five percent shall be designed to withstand the calculated tensile forces acting upon the material. The design shall consider the maximum friction angle of the geosynthetic with regard to a soil-geosynthetic or geosynthetic-geosynthetic interface and shall ensure that overall slope stability is maintained.

(c) The operator shall thermally seal (hot wedge) field seams in geosynthetic material with a double track weld to create an air pocket for non-destructive air channel testing. In areas where double-track welding cannot be achieved, the operator may propose alternative thermal seaming methods. A stabilized air pressure of 35psi, plus or minus one percent, shall be maintained for at least five minutes. The operator shall overlap liners four to six inches before seaming, and shall orient seams parallel to the line of maximum slope; *i.e.*, oriented along, not across, the slope. The operator shall minimize the number of field seams in corners and irregularly shaped areas. The operator shall use factory seams whenever possible. The operator shall not install horizontal seams within five feet of the slope's toe. Qualified personnel shall perform all field seaming.

E. Requirements for the soil component of composite liners.

(1) The operator shall place and compact the base layer to ninety percent standard proctor density on a prepared sub-grade.

(2) The soil surface upon which the operator installs a geosynthetic shall be free of stones greater than one half inch in any dimension, organic matter, local irregularities, protrusions, loose soil and abrupt changes in grade that could damage the geosynthetic.

(3) The operator shall compact a clay soil component of a composite liner to a minimum of ninety percent standard proctor density, which shall have, unless otherwise approved by the division, a plasticity index greater than ten percent, a liquid limit between twenty-five and fifty percent, a portion of material passing the no. 200 sieve (0.074 mm and less fraction) greater than forty percent by weight; and a clay content greater than eighteen percent by weight.

F. The leachate collection and removal system protective layer and the soil component of the leak detection system shall consist of soil materials that shall be free of organic matter, shall have a portion of material passing the no. 200 sieve no greater than five percent by weight and shall have a uniformity coefficient (Cu) less than 6, where Cu is defined as D60/D10. Geosynthetic materials or geocomposites including geonets and geotextiles, if used as components of the leachate collection and removal or leak detection system, shall have a hydraulic conductivity, transmissivity and chemical and physical qualities that oil field waste placement, equipment operation or leachate generation will not adversely affect. These geosynthetics or geocomposites, if used in conjunction with the soil protective cover for liners, shall have a hydraulic conductivity designed to ensure that the liner's hydraulic head never exceeds one foot.

G. Landfill gas control systems. If the gas safety management plan or requirements of other federal, state or local agencies require the installation of a gas control system at a landfill, the operator shall submit a plan for division approval, which shall include the following:

(1) the system's design, indicating the location and design of vents, barriers, collection piping and manifolds and other control measures that the operator will install (gas vent or collection wells shall incorporate a clamped and seamed pipe riser design through the top cover liner);

(2) if gas recovery is proposed, the design of the proposed gas recovery system and the system's major on-site components, including storage, transportation, processing, treatment or disposal measures required in the management of generated gases, condensates or other residues;

(3) if gas processing is proposed, a processing plan designed in a manner that does not interfere or conflict with the activities on the site or required control measures or create or cause danger to persons or property;

(4) if gas disposal is proposed, a disposal plan designed:

(a) in a manner that does not interfere or conflict with the activities on the site or with required control measures;

(b) so as not to create or cause danger to persons or property; and

(c) with active forced ventilation, using vents located at least one foot above the landfill surface at each gas vent's location;

(5) physical and chemical characterization of condensates or residues that are generated and a plan for their disposal;

(6) means that the operator will implement to prevent gas' generation and lateral migration such that:

(a) the concentration of the gases the landfill generates does not exceed twenty-five percent of the lower explosive limit for gases in surface waste management facility structures (excluding gas control or recovery system components); and

(b) the concentration of gases does not exceed the lower explosive limit for gases at the surface waste management facility boundary; and

(7) a routine gas monitoring program providing for monitoring at least quarterly; the specific type and frequency of monitoring to be determined based on the following:

(a) soil conditions;

(b) the hydrogeologic and hydraulic conditions surrounding the surface waste management facility; and

(c) the location of surface waste management facility structures and property lines.

H. Landfill gas response. If gas levels exceed the limits specified in Paragraph (6) of Subsection G of 19.15.36.14 NMAC, the operator shall:

(1) immediately take all necessary steps to ensure protection of fresh water, public health and the environment and notify the division;

(2) within seven days of detection, record gas levels detected and a description of the steps taken to protect fresh water, public health and the environment;

(3) within 30 days of detection, submit a remediation plan for gas releases that describes the problem's nature and extent and the proposed remedy; and

(4) within 60 days after division approval, implement the remediation plan and notify the division that the plan has been implemented.

[19.15.36.14 NMAC - N, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.15 SPECIFIC REQUIREMENTS APPLICABLE TO LANDFARMS:

A. Oil field waste acceptance criteria. Only soils and drill cuttings predominantly contaminated by petroleum hydrocarbons shall be placed in a landfarm. The division may approve placement of tank bottoms in a landfarm if the operator demonstrates that the tank bottoms do not contain economically recoverable petroleum hydrocarbons. Soils and drill cuttings placed in a landfarm shall be sufficiently free of liquid content to pass the paint filter test, and shall not have a chloride concentration exceeding 500 mg/kg if the landfarm is located where ground water is less than 100 feet but at least 50 feet below the lowest elevation at which the operator will place oil field waste or exceeding 1000 mg/kg if the landfarm is located where ground water is 100 feet or more below the lowest elevation at which the operator will place oil field waste. The person tendering oil field waste for treatment at a landfarm shall certify, on form C-138, that representative samples of the oil field waste have been subjected to the paint filter test and tested for chloride content, and that the samples have been found to conform to these requirements. The landfarm's operator shall not accept oil field waste for landfarm treatment unless accompanied by this certification.

B. Background testing. Prior to beginning operation of a new landfarm or to opening a new cell at an existing landfarm at which the operator has not already established background, the operator shall take, at a minimum, 12 composite background soil samples, with each consisting of 16 discrete samples from areas that previous operations have not impacted at least six inches below the original ground surface, to establish background soil concentrations for the entire surface waste management facility. The operator shall analyze the background soil samples for TPH, as determined by EPA method 418.1 or other EPA method approved by the division; BTEX, as determined by EPA SW-846 method 8021B or 8260B; chlorides; and other constituents listed in Subsections A and B of 20.6.2.3103 NMAC, using approved EPA methods.

C. Operation and oil field waste treatment.

(1) The operator shall berm each landfarm cell to prevent rainwater run-on and run-off.

(2) The operator shall not place contaminated soils received after the effective date of 19.15.36 NMAC within 100 feet of the surface waste management facility's boundary.

(3) The operator shall not place contaminated soils received at a landfarm after the effective date of 19.15.36 NMAC within 20 feet of a pipeline crossing the landfarm.

(4) With 72 hours after receipt, the operator shall spread and disk contaminated soils in eight-inch or less lifts or approximately 1000 cubic yards per acre per eight-inch lift or biopile.

(5) The operator shall ensure that soils are disked biweekly and biopiles are turned at least monthly.

(6) The operator shall add moisture, as necessary, to enhance bioremediation and to control blowing dust.

(7) The application of microbes for the purposes of enhancing bioremediation requires prior division approval.

(8) Pooling of liquids in the landfarm is prohibited. The operator shall remove freestanding water within 24 hours.

(9) The operator shall maintain records of the landfarm's remediation activities in a form readily accessible for division inspection.

(10) The division's environmental bureau may approve other treatment procedures if the operator demonstrates that they provide equivalent protection for fresh water, public health and the environment.

D. Treatment zone monitoring. The operator shall spread contaminated soils on the surface in eight-inch or less lifts or approximately 1000 cubic yards per acre per eight-inch lift. The operator shall conduct treatment zone monitoring to ensure that prior to adding an additional lift the TPH concentration of each lift, as determined by

EPA SW-846 method 8015M or EPA method 418.1 or other EPA method approved by the division, does not exceed 2500 mg/kg and that the chloride concentration, as determined by EPA method 300.1, does not exceed 500 mg/kg if the landfarm is located where ground water is less than 100 feet but at least 50 feet below the lowest elevation at which the operator will place oil field waste or 1000 mg/kg if the landfarm is located where ground water is 100 feet or more below the lowest elevation at which the operator will place oil field waste. The operator shall collect and analyze at least one composite soil sample, consisting of four discrete samples, from the treatment zone at least semi-annually using the methods specified below for TPH and chlorides. The maximum thickness of treated soils in a landfarm cell shall not exceed two feet or approximately 3000 cubic yards per acre. When that thickness is reached, the operator shall not place additional oil field waste in the landfarm cell until it has demonstrated by monitoring the treatment zone at least semi-annually that the contaminated soil has been treated to the standards specified in Subsection F of 19.15.36.15 NMAC or the contaminated soils have been removed to a division-approved surface waste management facility.

E. Vadose zone monitoring.

(1) Sampling. The operator shall monitor the vadose zone beneath the treatment zone in each landfarm cell. The operator shall take the vadose zone samples from soils between three and four feet below the cell's original ground surface.

(2) Semi-annual monitoring program. The operator shall collect and analyze a minimum of four randomly selected, independent samples from the vadose zone at least semi-annually using the methods specified below for TPH, BTEX and chlorides and shall compare each result to the higher of the PQL or the background soil concentrations to determine whether a release has occurred.

(3) Five year monitoring program. The operator shall collect and analyze a minimum of four randomly selected, independent samples from the vadose zone, using the methods specified below for the constituents listed in Subsections A and B of 20.6.2.3103 NMAC at least every five years and shall compare each result to the higher of the PQL or the background soil concentrations to determine whether a release has occurred.

(4) Record keeping. The operator shall maintain a copy of the monitoring reports in a form readily accessible for division inspection.

(5) Release response. If vadose zone sampling results show that the concentrations of TPH, BTEX or chlorides exceed the higher of the PQL or the background soil concentrations, then the operator shall notify the division's environmental bureau of the exceedance, and shall immediately collect and analyze a minimum of four randomly selected, independent samples for TPH, BTEX, chlorides and the constituents listed in Subsections A and B of 20.6.2.3103 NMAC. The operator shall submit the results of the re-sampling event and a response action plan for the division's approval within 45 days of the initial notification. The response action plan shall address changes in the landfarm's operation to prevent further contamination and, if necessary, a plan for remediating existing contamination.

F. Treatment zone closure performance standards. After the operator has filled a landfarm cell to the maximum thickness of two feet or approximately 3000 cubic yards per acre, the operator shall continue treatment until the contaminated soil has been remediated to the higher of the background concentrations or the following closure performance standards. The operator shall demonstrate compliance with the closure performance standards by collecting and analyzing a minimum of one composite soil sample, consisting of four discrete samples.

(1) Benzene, as determined by EPA SW-846 method 8021B or 8260B, shall not exceed 0.2 mg/kg.

(2) Total BTEX, as determined by EPA SW-846 method 8021B or 8260B, shall not exceed 50 mg/kg.

(3) The GRO and DRO combined fractions, as determined by EPA SW-846 method 8015M, shall not exceed 500 mg/kg. TPH, as determined by EPA method 418.1 or other EPA method approved by the division, shall not exceed 2500 mg/kg.

(4) Chlorides, as determined by EPA method 300.1, shall not exceed 500 mg/kg if the landfarm is located where ground water is less than 100 feet but at least 50 feet below the lowest elevation at which the operator will place oil field waste or 1000 mg/kg if the landfarm is located where ground water is 100 feet or more below the lowest elevation at which the operator will place oil field waste.

(5) The concentration of constituents listed in Subsections A and B of 20.6.2.3103 NMAC shall be determined by EPA SW-846 methods 6010B or 6020 or other methods approved by the division. If the concentration of those constituents exceed the PQL or background concentration, the operator shall either perform a site specific risk assessment using EPA approved methods and shall propose closure standards based upon individual site conditions that protect fresh water, public health and the environment, which shall be subject to division approval or remove pursuant to Paragraph (2) of Subsection G of 19.15.36.15 NMAC.

G. Disposition of treated soils.

(1) If the operator achieves the closure performance standards specified in Subsection F of 19.15.36.15 NMAC, then the operator may either leave the treated soils in place, or, with prior division approval, dispose or reuse of the treated soils in an alternative manner.

(2) If the operator cannot achieve the closure performance standards specified in Subsection F of 19.15.36.15 NMAC within five years or as extended by the division, then the operator shall remove contaminated soils from the landfarm cell and properly dispose of it at a division-permitted landfill, or reuse or recycle it in a manner approved by the division.

(3) If the operator cannot achieve the closure performance standards specified in Subsection F of 19.15.36.15 NMAC within five years or as extended by the division, then the division may review the adequacy of the operator's financial assurance, as provided in Subsection G of 19.15.36.11 NMAC. In that event, the division may require the operator to modify its financial assurance to provide for the appropriate disposition of contaminated soil in a manner acceptable to the division.

(4) The operator may request approval of an alternative soil closure standard from the division, provided that the operator shall give division-approved public notice of an application for alternative soil closure standards in the manner provided in 19.15.36.9 NMAC. The division may grant the request administratively if no person files an objection thereto within 30 days after publication of notice; otherwise the division shall set the matter for hearing.

H. Environmentally acceptable bioremediation endpoint approach.

(1) A landfarm operator may use an environmentally acceptable bioremediation endpoint approach to landfarm management in lieu of compliance with the requirements of Paragraph (3) of Subsection F of 19.15.36.15 NMAC. The bioremediation endpoint occurs when TPH, as determined by EPA method 418.1 or other EPA method approved by the division, is reduced to a minimal concentration as a result of bioremediation and is dependent upon the bioavailability of residual hydrocarbons. An environmentally acceptable bioremediation endpoint occurs when the TPH concentration has been reduced by at least eighty percent by a combination of physical, biological and chemical processes and the rate of change in the reduction in the TPH concentration is negligible. The environmentally acceptable bioremediation endpoint in soil is determined statistically by the operator's demonstration that the rate of change in the reduction of TPH concentration is negligible.

(2) In addition to the requirements specified in Subsection C of 19.15.36.8 NMAC, an operator who plans to use an environmentally acceptable bioremediation endpoint approach shall submit for the division's review and approval a detailed landfarm operation plan for those landfarm cells exclusively dedicated to the use of the environmentally acceptable bioremediation endpoint approach. At a minimum, the operations plan shall include detailed information on the native soils, procedures to characterize each lift of contaminated soil, operating procedures and management procedures that the operator shall follow.

(3) In addition to other operational requirements specified in 19.15.36.15 NMAC, the operator using an environmentally acceptable bioremediation endpoint approach shall comply with the following.

(a) Native soil information required. The operator shall submit detailed information on the soil conditions present for each of its landfarm cells immediately prior to the application of the petroleum hydrocarbon-contaminated soils, including: treatment cell size, soil porosity, soil bulk density, soil pH, moisture content, field capacity, organic matter concentration, soil structure, SAR, EC, soil composition, soil temperature, soil nutrient (C:N:P) (calcium, nitrogen and phosphate) concentrations and oxygen content.

(b) Characterization of contaminated soil. The operator shall submit a description of the procedures that it will follow to characterize each lift of contaminated soil or drill cuttings, prior to treating each lift of contaminated soil or drill cuttings, for petroleum hydrocarbon loading factor, TPH, BTEX, chlorides, constituents listed in Subsections A and B of 20.6.2.3103 NMAC, contaminated soil moisture, contaminated soil pH and API gravity of the petroleum hydrocarbons.

(c) Operating procedures. The operator shall submit a description of the procedures, including a schedule, that it shall follow to properly monitor and amend each lift of contaminated soil in order to maximize bioremediation, including tilling procedures and schedule; procedures to limit petroleum hydrocarbon loading to less than five percent; procedures to maintain pH between six and eight; procedures to monitor and apply proper nutrients; procedures to monitor, apply and maintain moisture to sixty to eighty percent of field capacity; and procedures to monitor TPH concentrations.

(d) Management procedures. The operator shall submit a description of the management procedures that it shall follow to properly schedule landfarming operations, including modifications during cold weather, record keeping, sampling and analysis, statistical procedures, routine reporting, determination

and reporting of achievement of the environmentally acceptable bioremediation endpoint and closure and post-closure plans.
[19.15.36.15 NMAC - N, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.16 SMALL LANDFARMS: Small landfarms as defined in Paragraph (5) of Subsection A of 19.15.36.7 NMAC are exempt from 19.15.36 NMAC except for the requirements specified in 19.15.36.16 NMAC.

A. General requirements.

(1) Registration. Prior to establishment of a new small landfarm, the operator shall file a form C-137 EZ, small landfarm registration, with the environmental bureau in the division's Santa Fe office. If the operator is not the surface estate owner at the proposed site, the operator shall furnish with its form C-137 EZ its certification it has a written agreement with the surface estate owner authorizing the site's use for the proposed small landfarm. The division shall issue the operator a registration number no more than 30 days from receipt of the properly completed form.

(2) Limitation. The operator shall operate only one active small landfarm per governmental section at any time. No small landfarm shall be located more than one mile from the operator's nearest oil or gas well or other production facility.

B. General operating procedures. The operator shall:

(1) comply with the siting requirements of Subsections A and B of 19.15.36.13 NMAC;

(2) accept only exempt or non-hazardous wastes consisting of soils (excluding drill cuttings) generated as a result of accidental releases from production operations, that are predominantly contaminated by petroleum hydrocarbons, do not contain free liquids, would pass the paint filter test and where testing shows chloride concentrations are 500 mg/kg or below;

(3) berm the landfarm to prevent rainwater run-on and run-off; and

(4) post a sign at the site readable from a distance of 50 feet and listing the operator's name; small landfarm registration number; location by unit letter, section, township and range; expiration date; and an emergency contact telephone number.

C. Oil field waste management standards. The operator shall spread and disk contaminated soils in a single eight inch or less lift within 72 hours of receipt. The operator shall conduct treatment zone monitoring to ensure that the TPH concentration, as determined by EPA SW-846 method 8015M or EPA method 418.1 or other EPA method approved by the division, does not exceed 2500 mg/kg and that the chloride concentration, as determined by EPA method 300.1, does not exceed 500 mg/kg. The operator shall treat soils by disking at least once a month and by watering and adding bioremediation enhancing materials when needed.

D. Record-keeping requirements. The operator shall maintain records reflecting the generator, the location of origin, the volume and type of oil field waste, the date of acceptance and the hauling company for each load of oil field waste received. The division shall post on its website each small landfarm's location, operator and registration date. In addition, the operator shall maintain records of the small landfarm's remediation activities in a form readily accessible for division inspection. The operator shall maintain all records for five years following the small landfarm's closure.

E. Small landfarm closure.

(1) Closure performance standards and disposition of soils. If the operator achieves the closure performance standards specified below, then the operator may return the soil to the original generation site, leave the treated soil in place at the small landfarm or, with prior division approval, dispose or reuse the treated soil in an alternative manner. If the operator cannot achieve the closure performance standards within three years from the registration date, then the operator shall remove contaminated soil from the landfarm and properly dispose of it at a permitted landfill, unless the division authorizes a specific alternative disposition. The following standards shall apply:

(a) benzene, as determined by EPA SW-846 method 8021 B or 8260B, shall not exceed 0.2 mg/kg;

(b) Total BTEX, as determined by EPA SW-846 method 8021 B or 8260B, shall not exceed 50 mg/kg;

(c) TPH, as determined by EPA SW-846 method 418.1 or other EPA method approved by the division, shall not exceed 2500 mg/kg; the GRO and DRO combined fraction, as determined by EPA SW-846 method 8015M, shall not exceed 500 mg/kg; and

(d) chlorides, as determined by EPA method 300.1, shall not exceed 500 mg/kg.

(2) Closure requirements. The operator shall:

(a) re-vegetate soils remediated to the closure performance standards if left in place in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC;

(b) remove landfarmed soils that have not or cannot be remediated to the closure performance standards within three years to a division-approved surface waste management facility, and re-vegetate the cell filled in with native soil to the standards in Paragraph (6) of Subsection A of 19.15.36.18 NMAC;

(c) if the operator returns remediated soils to the original site, or with division permission, recycles them, re-vegetate the cell filled in with native soil to the standards in Paragraph (6) of Subsection A of 19.15.36.18 NMAC;

(d) remove berms on the small landfarm and buildings, fences, roads and equipment; and

(e) clean up the site and collect one vadose zone soil sample from three to five feet below the middle of the treatment zone, or in an area where liquids may have collected due to rainfall events; the vadose zone soil sample shall be collected and analyzed using the methods specified above for TPH, BTEX and chlorides.

F. Final report. The operator shall submit a final closure report on a form C-137 EZ, together with photographs of the closed site, to the environmental bureau in the division's Santa Fe office. The division, after notice to the operator and an opportunity for a hearing if requested, may require additional information, investigation or clean up activities.

[19.15.36.16 NMAC - N, 2/14/2007; A, 12/1/08]

19.15.36.17 SPECIFIC REQUIREMENTS APPLICABLE TO EVAPORATION, STORAGE, TREATMENT AND SKIMMER PONDS:

A. Engineering design plan. An applicant for a surface waste management facility permit or modification requesting inclusion of a skimmer pit; an evaporation, storage or treatment pond; or a below-grade tank shall submit with the surface waste management facility permit application a detailed engineering design plan, certified by a registered profession engineer, including operating and maintenance procedures; a closure plan; and a hydrologic report that provides sufficient information and detail on the site's topography, soils, geology, surface hydrology and ground water hydrology to enable the division to evaluate the actual and potential effects on soils, surface water and ground water. The plan shall include detailed information on dike protection and structural integrity; leak detection, including an adequate fluid collection and removal system; liner specifications and compatibility; freeboard and overtopping prevention; prevention of nuisance and hazardous odors such as H2S; an emergency response plan, unless the pit is part of a surface waste management facility that has an integrated contingency plan; type of oil field waste stream, including chemical analysis; climatological factors, including freeze-thaw cycles; a monitoring and inspection plan; erosion control; and other pertinent information the division requests.

B. Construction, standards.

(1) In general. The operator shall ensure each pit, pond and below-grade tank is designed, constructed and operated so as to contain liquids and solids in a manner that will protect fresh water, public health and the environment.

(2) Liners required. Each pit or pond shall contain, at a minimum, a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions.

(3) Liner specifications. Liners shall consist of a 30-mil flexible PVC or 60-mil HDPE liner, or an equivalent liner approved by the division. Synthetic (geomembrane) liners shall have a hydraulic conductivity no greater than 1×10^{-9} cm/sec. Geomembrane liners shall be composed of an impervious, synthetic material that is resistant to petroleum hydrocarbons, salts and acidic and alkaline solutions. Liner materials shall be resistant to ultraviolet light, or the operator shall make provisions to protect the material from sunlight. Liner compatibility shall comply with EPA SW-846 method 9090A.

(4) Alternative liner media. The division may approve other liner media if the operator demonstrates to the division's satisfaction that the alternative liner protects fresh water, public health and the environment as effectively as the specified media.

(5) Each pit or pond shall have a properly constructed foundation or firm, unyielding base, smooth and free of rocks, debris, sharp edges or irregularities, in order to prevent rupture or tear of the liner and an adequate anchor trench; and shall be constructed so that the inside grade of the levee is no steeper than 2H:1V. Levees shall have an outside grade no steeper than 3H:1V. The levees' tops shall be wide enough to install an anchor trench and provide adequate room for inspection and maintenance. The operator shall minimize liner seams and orient them up and down, not across a slope. The operator shall use factory seams where possible. The operator shall ensure field seams in geosynthetic material are thermally seamed (hot wedge) with a double track weld to create an air pocket for non-destructive air channel testing. A stabilized air pressure of 35 psi, plus or minus one percent, shall be maintained for at least five minutes. The operator shall overlap liners four to six inches before seaming, and orient seams parallel to the line of maximum slope, i.e., oriented along, not across, the slope. The operator shall minimize the number of field seams in corners and irregularly shaped areas. There shall be no horizontal seams within five feet of the slope's toe. Qualified personnel shall perform field seaming.

(6) At a point of discharge into or suction from the lined pit, the liner shall be protected from excessive hydrostatic force or mechanical damage, and external discharge lines shall not penetrate the liner.

(7) Primary liners shall be constructed of a synthetic material.

(8) A secondary liner may be a synthetic liner or an alternative liner approved by the division. Secondary liners constructed with compacted soil membranes, i.e., natural or processed clay and other soils, shall be at least three feet thick, placed in six-inch lifts and compacted to ninety-five percent of the material's standard proctor density, or equivalent. Compacted soil membranes used in a liner shall undergo permeability testing in conformity with ASTM standards and methods approved by the division before and after construction. Compacted soil membranes shall have a hydraulic conductivity of no greater than 1×10^{-8} cm/sec. The operator shall submit results of pre-construction testing to the division for approval prior to construction.

(9) The operator shall place a leak detection system between the lower and upper geomembrane liners that consists of two feet of compacted soil with a saturated hydraulic conductivity of 1×10^{-5} cm/sec or greater to facilitate drainage. The leak detection system shall consist of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped so as to facilitate the earliest possible leak detection. Piping used shall be designed to withstand chemical attack from oil field waste or leachate; structural loading from stresses and disturbances from overlying oil field waste, cover materials, equipment operation or expansion or contraction; and to facilitate clean-out maintenance. The material placed between the pipes and laterals shall be sufficiently permeable to allow the transport of fluids to the drainage pipe. The slope of the interior sub-grade and of drainage lines and laterals shall be at least a two percent grade, i.e., two feet vertical drop per 100 horizontal feet. The piping collection system shall be comprised of solid and perforated pipe having a minimum diameter of four inches and a minimum wall thickness of schedule 80. The operator shall seal a solid sidewall riser pipe to convey collected fluids to a collection, observation and disposal system located outside the perimeter of the pit or pond. The operator may install alternative methods as approved by the division.

(10) The operator shall notify the division at least 72 hours prior to the primary liner's installation so that a division representative may inspect the leak detection system before it is covered.

(11) The operator shall construct pits and ponds in a manner that prevents overtopping due to wave action or rainfall, and maintain a three foot freeboard at all times.

(12) The maximum size of an evaporation or storage pond shall not exceed 10 acre-feet.

C. Operating standards.

(1) The operator shall ensure that only produced fluids or non-hazardous waste are discharged into or stored in a pit or pond; and that no measurable or visible oil layer is allowed to accumulate or remain anywhere on a pit's surface except an approved skimmer pit.

(2) The operator shall monitor leak detection systems pursuant to the approved surface waste management facility permit conditions, maintain monitoring records in a form readily accessible for division inspection and report discovery of liquids in the leak detection system to the division within 24 hours.

(3) Fencing and netting. The operator shall fence or enclose pits or ponds to prevent unauthorized access and maintain fences in good repair. Fences are not required if there is an adequate perimeter fence surrounding the surface waste management facility. The operator shall screen, net, cover or otherwise render non-hazardous to migratory birds tanks exceeding eight feet in diameter and exposed pits and ponds. Upon written application, the division may grant an exception to screening, netting or covering requirements upon the operator's showing that an alternative method will adequately protect migratory birds or that the tank or pit is not hazardous to migratory birds.

(4) The division may approve spray systems to enhance natural evaporation. The operator shall submit engineering designs for spray systems to the division's environmental bureau for approval prior to installation. The operator shall ensure that spray evaporation systems are operated so that spray-borne suspended or dissolved solids remain within the perimeter of the pond's lined portion.

(5) The operator shall use skimmer pits or tanks to separate oil from produced water prior to water discharge into a pond. The operator shall install a trap device in connected ponds to prevent solids and oils from transferring from one pond to another unless approved in the surface waste management facility permit.

D. Below-grade tanks and sumps.

(1) The operator shall construct below-grade tanks with secondary containment and leak detection. The operator shall not allow below-grade tanks to overflow. The operator shall install only below-grade tanks of materials resistant to the tank's particular contents and to damage from sunlight.

(2) The operator shall test sumps' integrity annually, and shall promptly repair or replace a sump that does not demonstrate integrity. The operator may test sumps that can be removed from their emplacements by visual inspection. The operator shall test other sumps by appropriate mechanical means. The operator shall maintain records of sump inspection and testing and make such records available for division inspection.

E. Closure required. The operator shall properly close pits, ponds and below-grade tanks within six months after cessation of use.

[19.15.36.17 NMAC - N, 2/14/2007; A, 6/30/16]

19.15.36.18 CLOSURE AND POST CLOSURE:

A. Surface waste management facility closure by operator.

(1) The operator shall notify the division's environmental bureau at least 60 days prior to cessation of operations at the surface waste management facility and provide a proposed schedule for closure. Upon receipt of such notice and proposed schedule, the division shall review the current closure and post closure plan (post closure is not required for oil treating plants) for adequacy and inspect the surface waste management facility.

(2) The division shall notify the operator within 60 days after the date of cessation of operations specified in the operator's closure notice of modifications of the closure and post closure plan and proposed schedule or additional requirements that it determines are necessary for the protection of fresh water, public health or the environment.

(3) If the division does not notify the operator of additional closure or post closure requirements within 60 days as provided, the operator may proceed with closure in accordance with the approved closure and post closure plan; provided that the director may, for good cause, extend the time for the division's response for an additional period not to exceed 60 days by written notice to the operator.

(4) The operator shall be entitled to a hearing concerning a modification or additional requirement the division seeks to impose if it files an application for a hearing within 10 days after receipt of written notice of the proposed modifications or additional requirements.

(5) Closure shall proceed in accordance with the approved closure and post closure plan and schedule and modifications or additional requirements the division imposes. During closure operations the operator shall maintain the surface waste management facility to protect fresh water, public health and the environment.

(6) Upon completion of closure, the operator shall re-vegetate the site unless the division has approved an alternative site use plan as provided in Subsection F of 19.15.36.18 NMAC. Re-vegetation, except for landfill cells, shall consist of establishment of a vegetative cover equal to seventy percent of the native perennial vegetative cover (un-impacted by overgrazing, fire or other intrusion damaging to native vegetation) or scientifically documented ecological description consisting of at least three native plant species, including at least one grass, but not including noxious weeds, and maintenance of that cover through two successive growing seasons.

B. Release of financial assurance.

(1) When the division determines that closure is complete it shall release the financial assurance, except for the amount needed to maintain monitoring wells for the applicable post closure care period, to perform semi-annual analyses of such monitoring wells and to re-vegetate the site. Prior to the partial release of the financial assurance covering the surface waste management facility, the division shall inspect the site to determine that closure is complete.

(2) After the applicable post closure care period has expired, the division shall release the remainder of the financial assurance if the monitoring wells show no contamination and the re-vegetation in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC is successful. If monitoring wells or other monitoring or leak detection systems reveal contamination during the surface waste management facility's operation or in the applicable post closure care period following the surface waste management facility's closure the division shall not release the financial assurance until the contamination is remediated in accordance with 19.15.30 NMAC and 19.15.29 NMAC, as applicable.

(3) In any event, the division shall not finally release the financial assurance until it determines that the operator has successfully re-vegetated the site in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC, or, if the division has approved an alternative site use plan, until the landowner has obtained the necessary regulatory approvals and begun implementation of the use.

C. Surface waste management facility and cell closure and post closure standards. The following minimum standards shall apply to closure and post closure of the installations indicated, whether the entire surface waste management facility is being closed or only a part of the surface waste management facility.

(1) Oil treating plant closure. The operator shall ensure that:

(a) tanks and equipment used for oil treatment are cleaned and oil field waste is disposed of at a division-approved surface waste management facility (the operator shall reuse, recycle or remove tanks and equipment from the site within 90 days of closure);

(b) the site is sampled, in accordance with the procedures specified in chapter nine of EPA publication SW-846, test methods for evaluating solid waste, physical/chemical methods, for TPH, BTEX, major cations and anions and RCRA metals, in accordance with a gridded plat of the site containing at least four equal sections that the division has approved; and

(c) sample results are submitted to the environmental bureau in the division's Santa Fe office.

(2) Landfill cell closure.

(a) The operator shall properly close landfill cells, covering the cell with a top cover pursuant to Paragraph (8) of Subsection C of 19.15.36.14 NMAC, with soil contoured to promote drainage of precipitation; side slopes shall not exceed a twenty-five percent grade (four feet horizontal to one foot vertical), such that the final cover of the landfill's top portion has a gradient of two percent to five percent, and the slopes are sufficient to prevent the ponding of water and erosion of the cover material.

(b) The operator shall re-vegetate the area overlying the cell with native grass covering at least seventy percent of the landfill cover and surrounding areas, consisting of at least two grasses and not including noxious weeds or deep rooted shrubs or trees, and maintain that cover through the post closure period.

(3) Landfill post closure. Following landfill closure, the post closure care period for a landfill shall be 30 years.

(a) A post closure care and monitoring plan shall include maintenance of cover integrity, maintenance and operation of a leak detection system and leachate collection and removal system and operation of gas and ground water monitoring systems.

(b) The operator or other responsible entity shall sample existing ground water monitoring wells annually and submit reports of monitoring performance and data collected within 45 days after the end of each calendar year. The operator shall report any exceedance of a ground water standard that it discovers during monitoring pursuant to 19.15.29 NMAC.

(4) Landfarm closure. The operator shall ensure that:

(a) disking and addition of bioremediation enhancing materials continues until soils within the cells are remediated to the standards provided in Subsection F of 19.15.36.15 NMAC, or as otherwise approved by the division;

(b) soils remediated to the foregoing standards and left in place are re-vegetated in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC;

(c) landfarmed soils that have not been or cannot be remediated to the standards in Subsection F of 19.15.36.15 NMAC are removed to a division-approved surface waste management facility and the landfarm remediation area is filled in with native soil and re-vegetated in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC;

(d) if treated soils are removed, the cell is filled in with native soils and re-vegetated in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC;

(e) berms are removed;

(f) buildings, fences, roads and equipment are removed, the site cleaned-up and tests conducted on the soils for contamination;

(g) annual reports of vadose zone and treatment zone sampling are submitted to the division's environmental bureau until the division has approved the surface waste management facility's final closure; and

(h) for an operator who chooses to use the landfarm methods specified in Subsection H of 19.15.36.15 NMAC, that the soil has an ECs of less than or equal to 4.0 mmhos/cm (dS/m) and a SAR of less than or equal to 13.0.

D. Pond and pit closure. The operator shall ensure that:

(1) liquids in the ponds or pits are removed and disposed of in a division-approved surface waste management facility;

(2) liners are disposed of in a division-approved surface waste management facility;

(3) equipment associated with the surface waste management facility is removed;

(4) the site is sampled, in accordance with the procedures specified in chapter nine of EPA publication SW-846, test methods for evaluating solid waste, physical/chemical methods for TPH, BTEX, metals and other inorganics listed in Subsections A and B of 20.6.2.3103 NMAC, in accordance with a gridded plat of the site containing at least four equal sections that the division has approved; and

(5) sample results are submitted to the environmental bureau in the division's Santa Fe office.

E. Landfarm and pond and pit post closure. The post-closure care period for a landfarm or pond or pit shall be three years if the operator has achieved clean closure. During that period the operator or other responsible entity shall regularly inspect and maintain required re-vegetation. If there has been a release to the vadose zone or to ground water, then the operator shall comply with the applicable requirements of 19.15.30 NMAC and 19.15.29 NMAC.

F. Alternatives to re-vegetation. If the landowner contemplates use of the land where a cell or surface waste management facility is located for purposes inconsistent with re-vegetation, the landowner may, with division approval, implement an alternative surface treatment appropriate for the contemplated use, provided that the alternative treatment will effectively prevent erosion. If the division approves an alternative to re-vegetation, it shall not release the portion of the operator’s financial assurance reserved for post-closure until the landowner has obtained necessary regulatory approvals and begun implementation of such alternative use.

G. Surface waste management facility closure initiated by the division. Forfeiture of financial assurance.

(1) For good cause, the division may, after notice to the operator and an opportunity for a hearing, order immediate cessation of a surface waste management facility’s operation when it appears that cessation is necessary to protect fresh water, public health or the environment, or to assure compliance with statutes or division rules and orders. The division may order closure without first having a hearing in the event of an emergency, subject to Section 70-2-23 NMSA 1978, as amended.

(2) If the operator refuses or is unable to conduct operations at a surface waste management facility in a manner that protects fresh water, public health and the environment; refuses or is unable to conduct or complete an approved closure and post closure plan; is in material breach of the terms and conditions of its surface waste management facility permit; or the operator defaults on the conditions under which the division accepted the surface waste management facility’s financial assurance; or if disposal operations have ceased and there has been no significant activity at the surface waste management facility for six months the division may take the following actions to forfeit all or part of the financial assurance:

(a) send written notice by certified mail, return receipt requested, to the operator and the surety, if any, informing them of the decision to close the surface waste management facility and to forfeit the financial assurance, including the reasons for the forfeiture and the amount to be forfeited, and notifying the operator and surety that a hearing request or other response shall be made within 20 days of receipt of the notice; and

(b) advise the operator and surety of the conditions under which they may avoid the forfeiture; such conditions may include but are not limited to an agreement by the operator or another party to perform closure and post closure operations in accordance with the surface waste management facility permit conditions, the closure and post closure plan (including modifications or additional requirements imposed by the division) and division rules, and satisfactory demonstration that the operator or other party has the ability to perform such agreement.

(3) The division may allow a surety to perform closure and post closure if the surety can demonstrate an ability to timely complete the closure and post closure in accordance with the approved plan.

(4) If the operator and the surety do not respond to a notice of proposed forfeiture within the time provided, or fail to satisfy the specified conditions for non-forfeiture, the division shall proceed, after hearing if the operator or surety has timely requested a hearing, to declare the financial assurance’s forfeiture. The division may then proceed to collect the forfeited amount and use the funds to complete the closure and post closure, or, at the division's election, to close the surface waste management facility and collect the forfeited amount as reimbursement.

(a) The division shall deposit amounts collected as a result of forfeiture of financial assurance in the oil and gas reclamation fund.

(b) In the event the amount forfeited and collected is insufficient for closure and post closure, the operator shall be liable for the deficiency. The division may complete or authorize completion of closure and post closure and may recover from the operator reasonably incurred costs of closure and post closure and forfeiture in excess of the amount collected pursuant to the forfeiture.

(c) In the event the amount collected pursuant to the forfeiture was more than the amount necessary to complete closure and post closure, including remediation costs, and forfeiture costs, the division shall return the excess to the operator or surety, as applicable, reserving such amount as may be reasonably necessary for post closure operations and re-vegetation in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC. The division shall return excess of the amount retained over the actual cost of post closure operations and re-vegetation to the operator or surety at the later of the conclusion of the applicable post closure period or when the site re-vegetation in accordance with Paragraph (6) of Subsection A of 19.15.36.18 NMAC is successful.

(5) If the operator abandons the surface waste management facility or cannot fulfill the conditions and obligations of the surface waste management facility permit or division rules, after notice and an opportunity for hearing, the state of New Mexico, its agencies, officers, employees, agents, contractors and other entities designated by the state shall have all rights of entry into, over and upon the surface waste management facility property, including all necessary and convenient rights of ingress and egress with all materials and equipment to conduct operation, termination and closure of the surface waste management facility, including but not limited to the temporary storage of equipment and materials, the right to borrow or dispose of materials and all other rights necessary for the surface waste management facility's operation, termination and closure in accordance with the surface waste management facility permit and to conduct post closure operations.
[19.15.36.18 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 12/1/08; A, 6/30/16]

19.15.36.19 EXCEPTIONS AND WAIVERS:

A. In a surface waste management facility permit application, the applicant may propose alternatives to requirements of 19.15.36 NMAC, and the division may approve such alternatives if it determines that the proposed alternatives will provide equivalent protection of fresh water, public health and the environment.

B. The division may grant exceptions to, or waivers of, or approve alternatives to requirements of 19.15.36 NMAC in an emergency without notice or hearing. The operator requesting an exception or waiver, except in an emergency, shall apply for a surface waste management facility permit modification in accordance with Subsection C of 19.15.36.8 NMAC. If the requested modification is a major modification, the operator shall provide notice of the request in accordance with 19.15.36.9 NMAC.
[19.15.36.19 NMAC - N, 2/14/2007; A, 6/30/16]

19.15.36.20 TRANSITIONAL PROVISIONS: Existing permitted facilities. Surface waste management facilities in operation prior to the effective date of 19.15.36 NMAC pursuant to division permits or orders may continue to operate in accordance with such permits or orders, subject to the following provisions.

A. Existing surface waste management facilities shall comply with the financial assurance, operational, monitoring, waste acceptance and closure and post closure requirements provided in 19.15.36 NMAC, except as otherwise specifically provided in the applicable permit or order, or in a specific waiver, exception or agreement that the division has granted in writing to the particular surface waste management facility.

B. The division shall not require financial assurance for a commercial facility permitted prior to the effective date of 19.15.36 NMAC that exceeds $250,000 until such time as:

(1) the division reviews the commercial facility's permit pursuant to Paragraph (3) of Subsection A of 19.15.36.12 NMAC, at which time the division may require the operator to submit a closure and post closure plan; which shall include a responsible third party contractor's cost estimate to complete closure and post closure of the surface waste management facility pursuant to the requirements of Subsections A through F of 19.15.36.18 NMAC:

(a) if the division determines that such estimate does not reflect a reasonable and probable closure and post closure cost, the division shall determine the estimated closure and post closure cost and shall provide its determination of estimated closure and post closure cost to the operator;

(b) if the operator disagrees with the division's determination of estimated closure and post closure cost, the operator may request a hearing, which shall be conducted according to 19.15.4 NMAC; or

(2) the commercial facility applies for a major modification.

C. Major modification of an existing surface waste management facility and a new landfarm cells constructed at an existing surface waste management facility shall comply with the requirements provided in 19.15.36 NMAC.
[19.15.36.20 NMAC - Rp, 19.15.9.711 NMAC, 2/14/2007; A, 6/30/16]

History of 19.15.36 NMAC:

Pre-NMAC History:
Material in the part was derived from that previously filed with the commission of public records - state records center and archives:
Rule 711, Commercial Surface Waste Disposal Facilities, filed 6-6-88;
Rule 711, Commercial Surface Waste Disposal Facilities, filed 10-11-89;
Rule 711, Commercial Surface Waste Disposal Facilities, filed 2-5-91;
Rule 711, Applicable to Surface Waste Management Facilities Only, filed 7-27-95;
Rule 711, Applicable to Surface Waste Management Facilities Only, filed 12-18-95.

History of Repealed Material:
Repeal of Section 711 of 19.15.9 NMAC, 2/14/2007.

Other History:
Rule 711, Applicable to Surface Waste Management Facilities Only (filed 12-18-95) renumbered and reformatted into that portion of 19 NMAC 15.I, effective 02-01-1996.
19 NMAC 15.I, Secondary or Other Enhanced Recovery, Pressure Maintenance, Salt Water Disposal, and Underground Storage (filed 01-18-96) was renumbered, reformatted and amended **to** 19.15.9 NMAC, effective 11-30-2000.
Section 711 of 19.15.9 NMAC was renumbered to and replaced by 19.15.36 NMAC, Surface Waste Management Facilities, effective 2/14/2007.

This rule was filed as 20 NMAC 3.1 Subpart 14.

TITLE 20 ENVIRONMENTAL PROTECTION
CHAPTER 3 RADIATION PROTECCTION
PART 14 NATURALLY OCCURING RADIOACTIVE MATERIALS (NORM) IN THE OIL AND GAS INDUSTRY

20.3.14.1 ISSUING AGENCY: Environmental Improvement Board.
[Recompiled 11/27/01]

20.3.14.2 SCOPE:

A. The regulations of this Subpart [Part] and other applicable subparts of these regulations apply to any person who engages in the extraction, transfer, transport, storage or disposal of NORM, or in the enhancement of NORM, in the oil and gas industry by altering the chemical properties, physical state or concentration of the NORM or its potential exposure pathways to humans.

B. The regulations of this Subpart [Part] and other applicable subparts of these regulations also apply to sludges and scale deposits in tubulars and equipment and to scale deposits from cleaning added to the environment. The regulations of this Subpart [Part] and other applicable subparts of these regulations also apply to NORM deposits in soil, water and the environment unless otherwise regulated.

C. The regulations of this Subpart and other applicable subparts of these regulations also address Regulated NORM management, transfer, storage, and disposal with regard to facilities involved in storage and/or cleaning of tubulars and equipment.
[8-2-95; 20.3.14.2 NMAC – Rn, 20 NMAC 3.1.14.1401, Recompiled 11/27/01]

20.3.14.3 STATUTORY AUTHORITY: [RESERVED]

20.3.14.4 DURATION: [RESERVED]

20.3.14.5 EFFECTIVE DATE: [RESERVED]

20.3.14.6 [OBJECTIVE]: PURPOSE: This Subpart [Part] establishes radiation protection standards for the possession, use, transfer, transport, storage and disposal of naturally occurring radioactive materials (NORM) associated with the oil and gas industry, and which are not subject to regulation under the Atomic Energy Act of 1954, as amended. Nothing in these regulations relieves a licensee from abiding by the regulations of the New Mexico Water Quality Control Commission, other applicable state and federal laws and regulations including those of the New Mexico Oil Conservation Commission, or the terms and conditions of the Rocky Mountain Low Level Radioactive Waste Compact.
[8-2-95; 20.3.14.6 NMAC – Rn, 20 NMAC 3.1.14.1400, Recompiled 11/27/01]

20.3.14.7 DEFINITIONS:

A. "Accessible point" means any external location on a piece of equipment, or place on a facility where NORM or Regulated NORM may be present. This includes any internal location which can be reached through an opening, by removal of a plate, lid or hatch or which is made accessible as a result of structural modification;

B. "Centralized facility" means a facility that is operated by one person or more than one person under an operating agreement for the purpose of disposing of Regulated NORM generated exclusively by that person or persons. This definition does not include plugged and abandoned wells and-or Underground Injection Control (UIC) wells used for disposal of Regulated NORM as provided in 1407.D.3 and 4, [Paragraph (3) and (4), Subsection D., Section 1407 of 20.3.14.1407 NMAC].

C. "Commercial facility" means any facility that receives compensation to receive, store, treat and-or dispose of Regulated NORM pursuant to applicable Department and Division rules and regulations;

D. "Decontamination" means the removal of media containing Regulated NORM from equipment or facilities solely for the intended purpose of reducing levels of radiation to levels below Regulated NORM levels in order to release equipment, materials, or land for unrestricted use in accordance with these regulations;

E. "Department" means the New Mexico Environment Department or its designated representative(s);

F. "Division" means the New Mexico Oil Conservation Division or its designated representative(s);

G. "Equipment" means tubulars (i.e., pipe), wellheads, separators, tanks, condensers, or any other related apparatus that have been in contact with produced gas or fluids associated with the oil and gas industry;

H. "Facility" means any land or structures, including appurtenances, and improvements on land or water used in or related to the oil and gas industry;

I. "General environment" means the total terrestrial, atmospheric, and aquatic environments outside the boundary of a facility;

J. "Naturally occurring radioactive material (NORM)" means any nuclide which is radioactive in its natural physical state (i.e., not manmade) but does not include byproduct, source or special nuclear material;

K. "Oil and Gas Industry" means any person(s) engaged in exploring, producing, gathering, trading, servicing, supplying, refining, and transporting of crude hydrocarbons, or their by-products and waste, or facilities associated with such activities;

L. "Produced water" means those waters produced in conjunction with the production of crude oil and-or natural gas and commonly collected at field storage, processing or disposal facilities, including, but not limited to: lease tanks, commingled tank batteries, burn pits, LACT units, dehydrators and community or lease salt water disposal systems, and which may be collected at gas processing plants, pipeline drips and other processing or transportation facilities;

M. "Product" means something produced, made, manufactured, refined, or beneficiated;

N. "Regulated NORM" means NORM contained in any oil-field soils, equipment, sludges or any other materials related to oil-field operations or processes exceeding the radiation levels specified in 1403 [Section 1403 of 20.3.14.1403 NMAC];

O. "Storage" means the collection and containment of Regulated NORM for the purpose of and prior to disposal. Storage does not include the accumulation of Regulated NORM in operating vessels; and

P. "Treatment" means any commercial method, technique, or process, including neutralization, designed to change the physical, chemical form or composition of Regulated NORM. This definition does not refer to treatment as defined in the Resource Conservation Recovery Act (RCRA), nor does it refer to processing of Regulated NORM for disposal in plugged and abandoned wells.

[8-2-95; 20.3.14.7 NMAC – Rn, 20 NMAC 3.1.14.1402, Recompiled 11/27/01]

20.3.14.9 through 20.3.14.1402 [Reserved]

20.3.14.1403 EXEMPTIONS:

A. For release for unrestricted use, persons who receive, possess, use, process, transfer, distribute, transport, store or dispose of NORM are exempt from the requirements of these regulations if: the NORM present is at concentrations of 30 picocuries per gram or less of radium 226, above background, or 150 picocuries per gram or less of any other NORM radionuclide, above background, in soil, in 15 cm layers, averaged over 100 square meters. Samples should be taken if gamma radiation readings (mR/hr) are equal to or exceed twice background readings when surveyed at a distance of 1 cm from the surface of the soil, in accordance with Department guidelines.

B. The possession and use of natural gas and natural gas products and crude oil and crude oil products as fuels are exempt from the requirements of this Subpart [Part].

C. NORM not otherwise exempted and equipment from oil, gas, and water production containing NORM are exempt from the requirements of this Subpart if the maximum radiation exposure reading at any accessible point does not exceed 50 microroentgens per hour (mR/hr) (0.5 mSv/hr), including background radiation levels. Sludges and scales contained in oil, gas and water production equipment are exempt from the requirements of this Subpart if the maximum radiation exposure reading within 1 cm of the surface of the sludge or scale does not exceed 50 microroentgens per hour (50 mR/hr) (0.5 mSv/hr), including background radiation levels. If the radiation readings exceed 50 mR/hr (0.5 mSv/hr), removable sludges and scales are exempt from the requirements of these regulations if the concentration of Radium 226, in a representative sample, does not exceed 30 picocuries per gram.

D. NORM not otherwise exempted and equipment from gas processing, fractionation, and dry gas distribution containing NORM are exempt from the requirements of this Subpart [Part] if the removable surface NORM contamination does not exceed 1000 dpm/100 cm2 and otherwise conforms with the requirements of 1403.A [Subsection A., Section 1403 of 20.3.14.1403 NMAC]. Removable scale from gas processing fractionating, and dry gas distribution is exempt from the requirements of this Subpart [Part] if the concentration of Lead 210, in a representative sample, does not exceed 150 picocuries per gram.

E. Produced water is exempt from the requirements of these regulations if it is reinjected into a Class I or Class II Underground Injection Control (UIC) well permitted by the Division and/or stored or disposed in a double, synthetically lined surface impoundment permitted by the Division.

[8-2-95; 20.3.14.1403 NMAC – Rn, 20 NMAC 3.1.14.1403, Recompiled 11/27/01]

20.3.14.1404 RADIATION SURVEY INSTRUMENTS:

A. Radiation survey instruments used to determine exemptions pursuant to 1403.C [Subsection C., Section 1403 of 20.3.14.1403 NMAC] shall be capable of measuring from 1 microroentgen per hour through at least 500 microroentgens per hour. Laboratory analytical instrumentation used in accordance with 1406 [Section 1406 of 20.3.14.1406 NMAC] must have a radiation detection system with an efficiency such that it is capable of measuring 1000 dpm/100 cm2 on filter paper. The efficiency of portable survey instruments must be such that when cpm is equated to dpm, the 1000 dpm/100cm2 limit is not exceeded.

B. Radiation survey instruments used to make surveys required by this Subpart shall be calibrated to an appropriate standard and operable according to Department guidelines for operability checks on a regular basis.

C. Each radiation survey instrument shall be calibrated:

(1) by a qualified person or by the manufacturer provided the person or the manufacturer is certified by the Department;

(2) at intervals not to exceed twelve (12) months and after each instrument servicing other than battery replacement; and

(3) to demonstrate an accuracy within plus or minus 20 percent.

D. Records of required calibrations shall be maintained for Department inspection for five years after the calibration date.

[8-2-95; 20.3.14.1404 NMAC – Rn, 20 NMAC 3.1.14.1404, Recompiled 11/27/01]

20.3.14.1405 PROTECTION OF WORKERS DURING OPERATIONS:

A. All general and specific licensees shall conduct operations:

(1) in compliance with the standards for radiation protection set forth in Subparts 4 and 10 [Parts 4 and 10], except for releases of radioactivity in effluents, which shall be regulated under 1406 [Section 1406 of 20.3.14.1406 NMAC], and disposal, which shall be regulated under 1407 [Section 1407 of 20.3.14.1407 NMAC], and;

(2) pursuant to a Worker Protection Plan prepared according to applicable Department guidelines and maintained by the licensee and

made available upon request of employees or representatives of the Department. The licensee shall post official notices to employees in areas where employees will have sufficient access to and notification of the Plan.

B. The Department will prepare and issue worker protection guidelines and notices to employees no later than six (6) months from the effective date of these regulations. The Worker Protection Plan prepared by the licensee pursuant to 1405.A.2 [Paragraph (2), Subsection A., Section 1405 of 20.3.14.1405 NMAC] shall be no less stringent than the Department's worker protection guidelines.

C. Licensees shall incorporate hazard identification and training into their hazard communication programs as required by the Occupational Safety and Health Administration (OSHA) or by the Board pursuant to the Occupational Health and Safety Act, and as required under Subpart [Part] 10 for personnel working on or around equipment and materials that contain Regulated NORM. Regulated NORM material that has been removed from equipment and containerized shall be labeled as per the requirement of 430 and 431 [Sections 430 and 431 of 20.3.4.430 and 431 NMAC]`.

D. Licensees operating at more than one location may prepare a single Worker Protection Plan to cover all facilities and operations in New Mexico, provided that the Plan is readily accessible to all employees.

E. The total radiation dose in any one year to any General Licensee employee from Regulated NORM shall not exceed the standards for exposure to members of the public as set forth in Subpart [Part] 4. Employees engaged in an activity subject to a Specific License as required by 1411 [Section 1411 of 20.3.14.1411 NMAC], shall not exceed the limits for radiation workers as specified in Subpart [Part] 4. Any worker engaged in an activity subject to a Specific License and who is likely to receive in one year an accumulative dose in excess of 500 mrem (5 mSv) shall be monitored.

[8-2-95; 20.3.14.1405 NMAC – Rn, 20 NMAC 3.1.14.1405, Recompiled 11/27/01]

20.3.14.1406 PROTECTION OF THE GENERAL POPULATION FROM RELEASES OF RADIOACTIVITY:

A. All licensees shall conduct operations in compliance with the standards for radiation protection set forth in Subpart [Part] 4 and in such a manner that concentrations of radioactive materials which are released to the general environment do not result in an annual dose exceeding 100 mrem (1 mSv) in a year. The dose in any unrestricted area from external sources shall not exceed 2 mrem (20 mSv) in any one hour. If the licensee permits members of the public to have access to restricted areas the limits for members of the public continue to apply to those individuals.

B. All licensees shall assure that any equipment released for unrestricted use shall not exceed the exposure limits specified in 1403 [Section 1403 of 20.3.14.1403 NMAC].

C. The licensee shall provide the recipient of transferred equipment, the inside of which is not accessible through any opening, plate, lid or hatch, with a notice that required surveys have been performed, that equipment meets the standards of 1403.C or D [Subsections C. or D., Section 1403 of 20.3.14.1403 NMAC], and that further surveys may be necessary if the equipment is structurally modified following transfer. The licensee shall retain copies of all notices of transfer.

[8-2-95; 20.3.14.1406 NMAC – Rn, 20 NMAC 3.1.14.1406, Recompiled 11/27/01]

20.3.14.1407 DISPOSAL AND TRANSFER OF REGULATED NORM FOR DISPOSAL:

A. Disposal of Regulated NORM on or near the surface of the ground shall be done pursuant to a general license issued under 1410 [Section 1410 of 20.3.14.1410 NMAC] and Subpart [Part] 13 and pursuant to NMOCD Rule 711. A general licensee may blend or disc Regulated NORM contaminated soils in place provided that:

(1) the soils were contaminated at that site and prior to promulgation of this Subpart [Part]; and

(2) the limits established in 1403.A [Subsection A., Section 1403 of 20.3.14.1403 NMAC] are met.

B. Disposal of Regulated NORM in nonretrieved flowlines and pipelines, in plugged and abandoned wells or by deep-well injection shall be done pursuant to a general license issued under 1410 [Section 1410 of 20.3.14.1410 NMAC] and pursuant to applicable Division rules and regulations.

C. All licensees shall store, transfer and/or dispose of Regulated NORM in accordance with the Worker Protection Plan required under 1405 [Section 1405 of 20.3.14.1405 NMAC]. All requirements of this Worker Protection Plan shall be available for inspection by the Department.

D. Regulated NORM shall only be disposed by the methods enumerated below, except that the Department will consider and approve alternative methods of disposal if the applicant demonstrates that such alternative method(s) will protect the environment, public health and fresh waters, and otherwise is consistent with this Subpart [Part], with other provisions of this Part and with applicable Division rules and regulations.

(1) Disposal in Non-retrieved Flowlines and Pipelines: Non-retrieved flowlines and pipelines which are buried are authorized by the Department to be left in place in accordance with Division rules and regulations.

(2) Disposal at Commercial and Centralized Facilities: Before a commercial or centralized facility may accept Regulated NORM for treatment and/or disposal, the operator of the facility shall obtain both a specific license issued by the Department pursuant to the requirements of this Subpart [Part] and a permit from the Division, and must be in compliance with Subpart [Part] 13.

(3) Disposal in Plugged and Abandoned Wells: The Department allows downhole disposal of NORM solids and NORM contaminated equipment in wells which are to be plugged and abandoned, provided such procedures are performed in a manner to protect the environment, public health, and fresh waters; are conducted in accordance with applicable Division rules and regulations; and occur below the lowermost underground source of drinking water. The allowable form shall be media-laden fluid with a minimum density of nine (9.0) pounds per gallon and with the allowable volume for disposal dependent on the plug location required for a specific well.

(4) Disposal by Injection: The Department allows the injection of Regulated NORM into Underground Injection Control (UIC) Class

I nonhazardous and Class II wells pursuant to NMOCD rules and regulations. All UIC Class I nonhazardous and Class II injection wells shall be permitted by the Division.

(5) Other Disposal Methods: Each person subject to general or specific license requirements shall manage and dispose of Regulated NORM:

(a) in accordance with the applicable requirements of Subparts [Parts] 4 and 10;

(b) in accordance with the applicable requirements of the U.S. Environmental Protection Agency for disposal of such wastes;

(c) by transfer of the wastes for disposal to a land disposal facility licensed by the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State; or

(d) in accordance with alternate methods authorized in this Subpart [Part] or by the Department in writing upon application or upon the Department's initiative and in accordance with Division Regulations.

[8-2-95; 20.3.14.1407 NMAC – Rn, 20 NMAC 3.1.14.1407, Recompiled 11/27/01]

20.3.14.1408 RADIATION SURVEY REQUIREMENTS:

A. Persons subject to the general license established in 1410.A [Subsection A., Section 1410 of 20.3.14.1410 NMAC] shall conduct radiation surveys of equipment and facilities in their control or possession and maintain that information on file. Surveys would be conducted for all of the following events.

(1) Prior to working on facilities or equipment where potential release of regulated NORM could occur or where workers could be exposed to regulated NORM.

(2) Prior to any transfer of equipment to another operator, the general public, or a salvage firm.

(3) Prior to the movement or removal of equipment from any facility or facility reclamation.

(4) At facilities where pipe has been cleaned.

(5) At facilities where materials are known to have been spread, spilled or stockpiled.

.B Surveys required by this Subpart shall be conducted using instruments that meet the requirements of 1404 [Section 1404 of 20.3.14.1404 NMAC].

C. Surveys required by this Subpart shall be performed pursuant to guidelines issued by the Department and by persons who possess the knowledge and/or training to perform such surveys pursuant to Department and Division Guidelines.

[8-2-95; 20.3.14.1408 NMAC – Rn, 20 NMAC 3.1.14.1408, Recompiled 11/27/01]

20.3.14.1409 REQUIREMENTS FOR STORAGE OF REGULATED NORM:

A. Storage of Regulated NORM, whether under a general or specific license, will be done in such a manner as to prevent, to the extent practicable, release of NORM to unrestricted areas, and otherwise to protect human health and the environment.

B. Storage of Regulated NORM will be done in such a manner as to comply with the limits set forth in 413 and 425 [Sections 413 and 425 of 20.3.4.413 and 435 NMAC], including those specified in 461 [Section 461 of 20.3.4.461 NMAC], Table II, of these regulations.

C. Regulated NORM will be stored at all times:]

(1) In accordance with the recommended practices of Section 6 of the American Petroleum Institute's Bulletin E2 (edition of April 1, 1992, or most recent edition), including practices specified for facility security, management of uncontained NORM, containerization and labeling, signage and record keeping, except that the dose limits specified in Section 6 or Bulletin E2 shall not apply;

(2) NORM storage facilities must be designed to minimize or prevent release of Regulated NORM to the environment; and

(3) In accordance with applicable Department guidelines.

D. Licensing of Regulated NORM Storage Facilities:

(1) Effective August 2, 1995, storage of Regulated NORM for longer than one year must be under a specific license unless the Department grants an extension of a general license issued pursuant to 1410.A [Subsection A., Section 1410 of 20.3.14.1410 NMAC]. Such an extension must be requested by the licensee on an annual basis and maybe granted by the Department on an annual basis, not to exceed 10 years of storage under a general license; and

(2) In granting an extension of a general license for storage of Regulated NORM, the Department must certify that the licensee is in compliance with 1409.A, B., and C [Subsections A., B., and C., Section 1409 of 20.3.14.1409 NMAC] and has a valid reason or reasons why the Regulated NORM under his or her ownership will not be disposed within the next year. Factors the Department should consider in determining whether the licensee has a valid reason or reasons for receiving an extension include, but are not limited to, the volume and radioactivity of the Regulated NORM, and/or the location of the storage facility and its proximity to populated areas or sensitive environments.

E. Storage of Regulated NORM under a specific license will be done in accordance with the requirements of this Subpart [Part], any other applicable requirements of these regulations and any other conditions as may be imposed by the Department to ensure compliance with these regulations.

[8-2-95; 20.3.14.1409 NMAC – Rn, 20 NMAC 3.1.14.1409, Recompiled 11/27/01]

20.3.14.1410 GENERAL LICENSE:

A. A general license is hereby issued to extract, receive, possess, own, use, process and transport Regulated NORM without regard to quantity. A general license is hereby issued to store Regulated NORM in accordance with the requirements of 1409 [Section 1409 of 20.3.14.1409 NMAC], for one year or less and to dispose of Regulated NORM in plugged and abandoned wells or Class II UIC wells pursuant to 1407.D.3 and 1407.D.4 [Paragraphs (3) and (4), Subsection D., Section 1407 of 20.3.14.1407 NMAC]. A general licensee may, as part of routine operations, perform maintenance work on equipment that contains Regulated NORM provided that work practices conform to the Worker

Protection Plan and that employee exposures prescribed in 1405 [Section 1405 of 20.3.14.1405 NMAC] and Subpart [Part] 4 are not exceeded.

B. A general license does not authorize the manufacture or distribution of products containing Regulated NORM, does not allow the transfer for disposal of Regulated NORM between general licensees, and does not authorize the storage of Regulated NORM for compensation or other commercial purposes.

C. Facilities and equipment containing Regulated NORM shall not be released for unrestricted use.

D. No generally licensed facility, including plugged and abandoned wells used for NORM disposal, shall be transferred for unrestricted use where the concentration of radium-226 in soil averaged over 100 square meters exceeds 30 pCi/g above background in 15 cm layers.

E. Equipment containing Regulated NORM may be released for maintenance and/or overhaul provided the recipient is specifically licensed to perform such activity.

F. The transfer of Regulated NORM from one general licensee to another general licensee is authorized by the Department provided that the equipment and facilities containing Regulated NORM are to be used by the recipient for the same purpose or similar service.

G. Transfers of Regulated NORM do not relieve the transferring general licensee from the responsibilities of surveying pursuant to these requirements, informing the receiving general licensee of the results of such surveys, and maintaining records pursuant to these requirements.

H. Record keeping for NORM survey data is to be maintained for inspection by the Department.

I. The landowner shall be notified prior to on-site mixing of soil pursuant to 1407.A [Subsection A., Section 1407 of 20.3.14.1407 NMAC].

[8-2-95; 20.3.14.1410 NMAC – Rn, 20 NMAC 3.1.14.1410, Recompiled 11/27/01]

20.3.14.1411 SPECIFIC LICENSES:

A. Unless otherwise exempted under the provisions of 1403 [Section 1403 of 20.3.14.1403 NMAC], or licensed under the provisions of Subpart [Part] 3 of these regulations, the manufacturing and distribution of any material or product containing Regulated NORM shall be specifically licensed pursuant to the requirements of this Subpart [Part] or pursuant to equivalent regulations of another state.

B. The decontamination of equipment or facilities containing Regulated NORM shall be performed only by persons specifically licensed.

C. Persons conducting the following activities involving equipment or facilities containing Regulated NORM must be specifically licensed to:

(1) dispose of or treat the resulting Regulated NORM unless exempted under this Subpart [Part];

(2) transfer Regulated NORM for long-term storage, treatment and/or disposal; or

(3) after August 2, 1995, store Regulated NORM in accordance with the requirements of 1409 [Section 1409 of 20.3.14.1409 NMAC] for longer than one year.

[8-2-95; 20.3.14.1411 NMAC – Rn, 20 NMAC 3.1.14.1411, Recompiled 11/27/01]

20.3.14.1412 REQUIREMENTS FOR THE ISSUANCE OF SPECIFIC LICENSES: The licensee shall comply with the provisions of 308 [Section 308 of 20.3.3.308 NMAC].

[8-2-95; 20.3.14.1412 NMAC – Rn, 20 NMAC 3.1.14.1412, Recompiled 11/27/01]

20.3.14.1413 FILING APPLICATION FOR SPECIFIC LICENSES:

A. The licensee shall comply with the provisions of 307.A through F [Subsections A. through F., Section 307 of 20.3.3.307 NMAC].

B. An applicant for a specific license shall comply with the Public Notification requirements in 310 [Section 310 of 20.3.3.310 NMAC].

[8-2-95; 20.3.14.1413 NMAC – Rn, 20 NMAC 3.1.14.1413, Recompiled 11/27/01]

20.3.14.1414 CONDITIONS FOR ISSUANCE OF SPECIFIC LICENSES:

A. The licensee shall comply with the provisions of 316 and 317.A. through C [Subsections A. through C., Section 317 and Section 316 of 20.3.3.316 and 317 NMAC].

B. An application for a Specific License to decontaminate equipment or land not otherwise exempted under the provisions of 1403 [Section 1403 of 20.3.14.1403 NMAC] will be approved if:

(1) the applicant satisfies the requirements specified in 1413 [Section 1413 of 20.3.14.1413 NMAC]; and

(2) the applicant has adequately addressed the following items:

(a) procedures and equipment for monitoring and protection of workers;

(b) an evaluation of the radiation levels and concentrations of contamination expected during normal operations;

(c) operating and emergency procedures, including procedures for waste reduction and quality assurance of items released for unrestricted use; and

(d) a method of managing the Regulated NORM removed from contaminated equipment and facilities.

C. Each person licensed by the Department pursuant to this Part shall have met the financial surety requirements of 311.E [Subsection E., Section 311 of 20.3.3.311 NMAC].

D. Each person licensed by the Department pursuant to this Part shall manage and dispose of wastes containing Regulated NORM in accordance with 1407 [Section 1407 of 20.3.14.1407 NMAC].

[8-2-95; 20.3.14.1414 NMAC – Rn, 20 NMAC 3.1.14.1414, Recompiled 11/27/01]

20.3.14.1415 MODIFICATION, EXPIRATION AND TERMINATION OF LICENSES: The licensee shall comply with the provisions in 322 [Section 322 of 20.3.3.322 NMAC].
[8-2-95; 20.3.14.1415 NMAC – Rn, 20 NMAC 3.1.14.1415, Recompiled 11/27/01]

20.3.14.1416 RENEWAL OF LICENSES:
A. Applications for renewal of specific licenses shall be filed in accordance with 1413 [Section 1413 of 20.3.14.1413 NMAC].
B. In any case in which a licensee, not less than 30 days prior to expiration of an existing license, has filed an application in proper form for renewal or for a new license authorizing the same activities, such existing license shall not expire until final action by the Department.
[8-2-95; 20.3.14.1416 NMAC – Rn, 20 NMAC 3.1.14.1416, Recompiled 11/27/01]

20.3.14.1417 AMENDMENT OF LICENSES AT REQUEST OF SPECIFIC LICENSEE: Applications for amendment of a specific license shall be filed in accordance with 320 [Section 320 of 20.3.3.320 NMAC], and shall specify the respects in which the licensee desires the license to be amended and the grounds for such amendment.
[8-2-95; 20.3.14.1417 NMAC – Rn, 20 NMAC 3.1.14.1417, Recompiled 11/27/01]

20.3.14.1418 ACRONYMS:
A. Bq/kg Becquerels per kilogram
B. cm centimeters
C. dpm disintegrations per minute
D. LACT Lease Automated Custody Transfer
E. NORM Naturally Occurring Radioactive Material
F. P&A Plugged and Abandoned
G. pCi/g picocuries per gram
H. UIC Underground Injection Control
I. mR/hr microroentgens per hour
J. rem roentgen equivalent man
K. mR/hr milliroentgen per hour
L. RCRA Resource Conservation Recovery Act
M. cpm counts per minute
N. mSv millisievert
O. mSv microsievert
P. mSv/hr microsievert per hour
[8-2-95; 20.3.14.1418 NMAC – Rn, 20 NMAC 3.1.14.1418, Recompiled 11/27/01]

20.3.14.1419 RECIPROCAL RECOGNITION OF LICENSES: Recognition of Reciprocal Licenses shall be done in accordance with 324 [Section 324 of 20.3.3.324 NMAC].
[8-2-95; 20.3.14.1419 NMAC – Rn, 20 NMAC 3.1.14.1419, Recompiled 11/27/01]

20 3.14.1420 20.3.14.1499 NMAC [RESERVED]

HISTORY OF 20.3.14 NMAC:
Pre-NMAC History: The material in this Part was derived from that previously filed as follows: EIB 73-2, Regulations for Governing the Health and Environmental Aspects of Radiation filed on 7-9-73; EIB 73-2, Amendment 1, Regulations for Governing the Health and Environmental Aspects of Radiation filed on 4-17-78; EIB RPR-1, Radiation Protection Regulations filed on 4-21-80; EIB RPR-1, Amendment 1, Radiation Protection Regulations filed on 10-13-81; EIB RPR-1, Amendment 2, Radiation Protection Regulations filed on 12-15-82; and EIB RPR-1, Radiation Protection Regulations filed on 3-10-89.

History of Repealed Material: [Reserved]

Other History: EIB RPR 1, Radiation Protection Regulations, filed 03-10-1989 renumbered and reformatted to 20 NMAC 3.1, Radiation Materials And Radiation Machines, filed 04-03-1995. 20 NMAC 3.1, Radiation Materials And Radiation Machines, filed 06-17-1999 internally renumbered and reformatted replaced 20 NMAC 3.1, filed 04-03-1995. The material in this Part was derived from that previously filed as: 20 NMAC 3.1.Subpart 14, Naturally Occurring Radioactive Materials (NORM) In The Oil and Gas Industry, filed 06-17-99 recompiled as 20.3.14 NMAC, effective 11/27/01.

ATTACHMENT D
Bird Rescue Protocol

Bird Rescue Protocol
North Ranch Surface Waste Management Facility
NGL Waste Services, LLC

1. The bird's entire body is immersed in a one percent solution of Dawn and warm water (warm enough to approximate the bird's internal body temperature. Once wet, the bird is unable to thermo regulate) by one person while a second vigorously agitates the water into the bird's feathers.

2. A WaterPik® filled with the same solution is used to clean the head.

3. A soft toothbrush and cotton swabs are used to loosen dried oil around the head and eye area.

4. When the water becomes dirty, the bird is moved to a second pan. The washing process is repeated as often as necessary.

5. The bird is considered clean when the tub of water is clear and free of oil.

6. The bird is moved to another pan of clean warm water for rinsing.

7. A WaterPik filled with the warm water is used to clean the head.

8. When the water becomes soapy, the bird is moved to a second pan. The rinsing process is repeated as often as necessary to remove the remaining soap.

9. The bird is considered rinsed when no soap is visible in a fresh pan of water.

10. After wash and rinse, the cleaned bird is placed in a protective net-bottomed pen. As it rests, the bird will begin to preen its own feathers back into place. The complete realignment of feathers in a tight overlapping pattern creates a waterproof seal.

11. The bird is fed a nutritious food mixture to assure proper nourishment, plenty of fluids, as well as vitamins and medications, and is allowed free access to food.

The bird is released when it is stable, healthy, and completed preening. The bird shall be taken to a local veterinary clinic for examination prior to release.

Appendix E
North Ranch Surface Waste Management Facility
Inspection and Maintenance Plan

Inspection and Maintenance Plan

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 2019
Project No. 35187378

PREPARED FOR:

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1.0 INTRODUCTION

This Inspection and Maintenance Plan presents a site-specific inspection and maintenance schedule for the NGL Waste Services, LLC (NGL) North Ranch Surface Waste Management Facility (Facility) that complies with the requirements contained in Subsection L of New Mexico Administrative Code (NMAC) **19.15.36.13**. It should be used in conjunction with the **Operating Plan**, found in **Appendix D** of the permit application (PA).

Records of inspections and documentation of any maintenance resulting from the inspections will be recorded on Inspection Forms, such as the ones included in **ATTACHMENT A** of this document. The inspection forms may be modified as needed. A proposed minimum inspection and maintenance schedule is included in **TABLE 1** below. Inspection records and documentation will be placed in the Facility Permanent Operating Record System (POR).

Table 1. Facility Inspection Schedule

Site Component	Inspection Frequency	Form
Landfill/Operations Disposal operations and location Litter, odor, waste cover, free liquids	Daily	Facility Inspection – DAILY
Fueling Station	Daily	Facility Inspection – DAILY
Leachate Evaporation Pond Water-Basic Wind speed and direction, pond level & color, H_2S air concentration[1]	Daily	Facility Inspection – DAILY
Leachate Evaporation Pond Water-Complete Wind speed, direction, pond level & sheen, dissolved H2S, temperature, H2S air concentration	Monthly	Facility Inspection - MONTHLY
Earth Moving Equipment	Daily	Facility Inspection - DAILY
Leachate Collection System Including Leachate Pond Structures	Monthly -or- after a significant rain event	Facility Inspection – MONTHLY -or- Facility Inspection – RAIN EVENT
Leak Detection Sumps Landfill Leachate Evaporation Pond Wet Waste Drying Pad Truck Wash Pad	Monthly	Facility Inspection - MONTHLY

Stormwater Structures Run-on/run-off Ditches Erosion control structures Culverts Pumps Stormwater ponds	Monthly or after a significant rain event	Facility Inspection – MONTHLY -or- Facility Inspection – RAIN EVENT
Facility Security/Access Fencing/gates Access roads	Monthly	Facility Inspection – MONTHLY
Landfill Bottom Liner system Intermediate Cover System Final Cover System	Monthly	Facility Inspection – MONTHLY
Facility Survey Control Monuments	Monthly	Facility Inspection – MONTHLY
Emergency Response Equipment	Monthly/As needed	See Table 4 in Appendix F-Contingency Plan
Fire Extinguishers	Monthly Inspection/ Annual Test	See Table 4 in Appendix F-Contingency Plan

[1] H_2S monitors will be calibrated based on the monitor's manufacturer recommended frequency at a minimum.

2.0 FACILITY DESCRIPTION

The NGL Waste Services, LLC (NGL) North Ranch Surface Waste Management Facility (Facility) consists of approximately 303 total acres and is designed for the disposal of approved oil field wastes. The Facility includes designated areas for leachate disposal, waste handling, truck washing, administrative building, a leachate evaporation pond and three independent stormwater ponds. **Figure 7** in the Permit Narrative provides the facility layout.

2.1 Earth Moving Equipment

Earth moving equipment will be inspected daily and repaired as needed. If earth-moving equipment will be disabled for an extended period of time for repairs, additional equipment will be leased or borrowed as necessary to support the Landfill. Operators will use the Facility Inspection – DAILY form provided in **Attachment A**.

2.2 Fences and Gates

The integrity of Facility fencing shall be inspected monthly and repaired as necessary. The entrance gate to the Facility shall be inspected monthly to assure the locking mechanism is properly functional. Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A**.

2.3 Facility Roads

Temporary and permanent access roads shall be inspected daily and maintained as needed to provide access, and to control dust and mud accumulations. The Landfill access roads shall be graded and additional gravel or other surface course applied as necessary to minimize rutting, washboarding, mudding, and dust accumulation. Operators will use the Facility Inspection – DAILY form provided in **Attachment A**.

2.4 Leachate Collection System

The leachate pumping system will be inspected monthly to ensure proper operation. The leachate level in the collection sumps will be monitored monthly to verify compliance with regulatory head requirements (12 inches maximum). The leak detection sumps will be inspected monthly. If fluids are present in the leak detection sump, then sampling will be conducted with the analyses of fluid samples submitted to the OCD as per NMAC **19.15.36.17.C.2,** which states that the operator shall monitor leak detection systems pursuant to the approved surface waste management facility permit conditions, maintain monitoring records in a form readily accessible for Division inspection and report discovery of liquids in the leak detection system to the Division within 24 hours. Inspection dates, maintenance records, name of the inspector, and leak detection system status will be included in documentation. Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A**.

2.5 Stormwater and Surface Water System

Stormwater features including all ditches, temporary and permanent erosion control structures, ponds and culverts shall be inspected monthly or after each significant rainfall event, whichever is more frequent. Stormwater features shall be cleaned, repaired, or replaced as necessary.

It is very important that the stormwater management system at the Landfill be maintained so that it functions properly during a storm event. The following maintenance is recommended:

- Keep all ditches and swales unobstructed;
- Remove sediment from ditches, swales, sediment basins, and sediment barriers routinely; Sediment controls are most effective when sediment is removed regularly;
- Inspect and clean check dams and outlet control structures of sediment and other materials that may restrict flow;
- Periodically inspect the stormwater system (including pumps) for damage and repair immediately.
- Inspect and clean the stormwater system following a major storm event.

Operators will use the Facility Inspection – MONTHLY or the Facility Inspection – RAIN EVENT forms as appropriate, both provided in **Attachment A**.

2.6 Stormwater Ponds

The Facility includes three independent stormwater ponds, designated the north, east, and west stormwater ponds in the corners of the site. They have surface areas of approximately 3.5, 3.4, and 5.6 acres respectively and are 10 feet deep (including 2-3 feet of freeboard). Berms and the outside walls of pond levees will be inspected quarterly and after major rainfall or windstorms. Berms will be maintained in such a manner as to prevent erosion. Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A**.

2.7 Leachate Evaporation Pond

The leachate evaporation pond, located in the northeast portion of the site, has a surface area of approximately 2.2 acres, a minimum depth of 3 feet at its lowest point, and a maximum depth of 11 feet at its deepest. The berm surrounding the leachate evaporation pond has a height of 2 feet at its lowest point and 3 feet at its highest point. The pond is lined with two layers of 60-mil HDPE, a geocomposite leak detection drainage layer, and a leak detection sump. Berms and pond levees are to be inspected monthly and after major rainfall or windstorms. Berms will be maintained in such a manner as to prevent erosion.

Per **NMAC 19.15.36.13.L**, leak detection sumps will be inspected monthly. If fluids are present, then sampling will be conducted with the analyses of fluid samples submitted to the OCD. Also, **NMAC 19.15.36.17.C.2** States that the operator shall monitor leak detection systems pursuant to the approved surface waste management facility permit conditions, maintain monitoring records in a form readily accessible for Division inspection and report discovery of liquids in the leak detection system to the Division within 24 hours.

A basic check of the leachate pond will be performed daily, to include wind speed and direction, pond level & sheen (if sheen present, dispose of fluids via vacuum truck to offsite SWD facility), H2S air concentration (< 1 ppm allowable), and general condition of the pond facility. The results will be recorded on the Facility Inspection – DAILY form in **Attachment A**.

A complete check of the leachate evaporation pond will be performed monthly. The pH (2.0 < pH < 12.0 allowable) and dissolved H2S (< 1 ppm allowable) in the leachate evaporation pond will be monitored when liquids are present. If H_2S concentrations are detected above one (1) part per million (ppm), then the **Hydrogen Sulfide Contingency Plan** in **Attachment A** of **Appendix F** should be referred to for emergency response and notification procedures. Inspections will include a check for the presence of an oil sheen on the liquid surface (if present, dispose of fluids via vacuum truck to offsite SWD facility), wind speed, direction and H2S air concentrations (also < 1 ppm allowable). The results will be recorded on the Facility Inspection – MONTHLY form in **Attachment A**.

2.8 Drying pads & truck wash

Leak detection sumps are installed at each of the three (3) drying pads and at the truck wash. Per **NMAC 19.15.36.13.L**, each of these leak detection sumps will be inspected monthly. If fluids are present, then sampling will be conducted with the analyses of fluid samples submitted to the OCD. Also, **NMAC 19.15.36.17.C.2** States that the operator shall monitor leak detection systems pursuant to the approved surface waste management facility permit conditions, maintain monitoring records in a form readily accessible for Division inspection and report discovery of liquids in the leak detection system to the Division within 24 hours.
Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A**

2.9 Emergency Response Equipment

Communication equipment, the list of emergency phone numbers, and all first aid kits will be checked monthly or immediately after use. All equipment will be inspected, decontaminated, cleaned and replaced if necessary, immediately after use. If lost or damaged, equipment will be replaced immediately. The emergency coordinator will verify that equipment has been maintained after an emergency and will be readied for reuse if another emergency or incident occurs.

Fire extinguishers will be tested annually, and condition checked once per month. **Table 1** and **Table 2** in the **Contingency Plan**, found in **Appendix F** of the PA, contain the lists of emergency phone numbers. **Table 4** in the Contingency Plan (**Appendix F**) contains a list of the primary equipment used for emergency response.
Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A**.

2.10 Bottom Liner, Intermediate Cover, and Final Cover System

The intermediate and final cover system shall be inspected monthly for evidence of erosion, cracking or surface depressions. Where severe erosion has taken place, soil cover should be re-applied and seeded, given the appropriate seeding conditions. Temporary or permanent erosion control measures shall be used if significant erosion occurs. Various types of erosion control methods are discussed in **Section 4.4** of the **Operating Plan**, located in **Appendix D** of the PA. Areas of liquids seepage will be promptly repaired.
Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A**.

2.11 Survey Control Monuments

The survey control monuments will be inspected monthly. In the event benchmarks are damaged, the monuments shall be re- established immediately.
Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A.**

2.12 Landfill Grid Marker System

The waste grid markers will be inspected monthly. Repairs or replacements will be re-established as necessary.
Operators will use the Facility Inspection – MONTHLY form provided in **Attachment A.**

2.13 Perimeter Environmental Monitoring Systems

The Facility will not have groundwater monitoring wells as fresh groundwater was not encountered within 115-feet below the lowest point of the proposed landfill bottom during site subsurface investigations (see **Appendix I** of the Permit Application Document. Further, due to the arid environment and non-putrescible nature of the wastes disposed minimal landfill gas generation is anticipated, thus the Facility will also not have perimeter landfill gas monitoring probes. However, as detailed in **Attachment B,** the facility will be equipped with a vadose zone monitoring network. The vadose zone monitoring wells can also be used as needed to measure landfill gas. If perimeter landfill gas monitoring probes are installed they will be inspected monthly (Facility Inspection Checklist Form in **Attachment A).** Vadose zone and/or groundwater monitoring wells will be inspected monthly (Facility Inspection Checklist Form in **Attachment A).**

3.0 Recordkeeping

The NGL North Ranch Surface Waste Management Facility has in place a Permanent Operating Record System (POR) as outlined in **NMAC 19.15.36.13.G**, **19.15.36.13.L**, **19.15.36.13.P**, **19.15.36.14.C.8**, **19.15.36.14.G**, **19.15.36.17.C.2**, and **19.15.36.17.D.2.** All information contained in the Facility POR is available for inspection and is provided to the NMOCD upon request. The Facility will maintain these records for a minimum period of 5-years following the completion of the post-closure care monitoring period.

3.1 Inspection Log

Inspections and maintenance of the overall site, facilities, and operations are performed routinely by the landfill manager or facility personnel. Inspections should be performed often enough to identify problems in time to correct them before they harm human health or the environment. Inspections also prevent malfunction, deterioration, and operator error from affecting the performance of the facilities and operations.

The frequency of inspections is noted on the inspection checklist in **Table 1** (Operations Inspection Forms are located in **Attachment A** of this document). Inspections are also carried out after any major storm event or natural disaster. The inspection records will be kept in the POR and will be made available to the NMOCD on request.

3.2 Landfill Permanent Operating Record Requirements

The Facility Permanent Operating Record (POR) system includes the following information:

- Permit Application Document, Permit Conditions, regulations, and operator licenses;
- Location restriction demonstrations;
- Groundwater/vadose zone monitoring and gas monitoring data and records;
- Leachate analytical data and disposal documentation;
- Operational plans and programs;
- Inspection records, training procedures and records, and notification procedures;
- Design demonstrations;
- Geotechnical and hydrogeological information;
- Any reports and testing data related to final closure of areas;
- Financial assurance documentation; and
- Quality assurance/quality control documentation, certification, and test results relating to the construction of the Landfill and Evaporation Pond liner, leachate collection system, groundwater/vadose zone monitoring system, and final cover system.

Refer to **Section 9** of the **Operating Plan**, for more information on the Permanent Operating Records System for the NGL North Ranch SWMF.

ATTACHMENT A
Facility Inspection Forms

Facility Inspection-DAILY

Date and Time:	Inspected By:

General Facility

Yes	No	N/A	Item	Comments
			Litter Control	
			Odor	
			Waste Cover	
			Standing Water	
			Fueling Station	
			Earth Moving Equipment	
			Roads & Work Areas	

Leachate Evaporation Pond

	Item	Comments
	Precipitation last 24 hrs (in)	
	H2S-Air (<1 ppm OK)	
	Pond level (ft)	
	Pond color, sheen	
	Vegetation	
	Animal activity	
	Bird control measures	

Facility Inspection-MONTHLY

Date and Time:	Inspected By:

General Facility

Yes	No	N/A	Item	Comments
☐	☐	☐	Emergency Response Equipment	
☐	☐	☐	Security Fence & Access Gates	
☐	☐	☐	Survey control monuments & grid markers	

Cover Inspection

Yes	No	N/A	Item	Comments
☐	☐	☐	Erosion on protective cover?	
☐	☐	☐	Vegetation present on protective cover?	
☐	☐	☐	Anchor Trench runout exposed?	
☐	☐	☐	Geosynthetics damage?	
☐	☐	☐	Exposed geosynthetics?	
☐	☐	☐	Ponded water on slopes?	
☐	☐	☐	Erosion rills or gullies?	
☐	☐	☐	Settlement or animal holes or damage?	
☐	☐	☐	Slope instability, cracks or slides?	
☐	☐	☐	Soil washout around edge of crown?	
☐	☐	☐	Erosion on swales, terraces, down spouts?	
☐	☐	☐	Woody plants or saplings on slope?	
☐	☐	☐	Vegetation coverage problem >100 sq ft?	
☐	☐	☐	Botanical disease or weather stress?	
☐	☐	☐	Vegetation coverage in surrounding ditches?	

Leachate Collection System

Yes	No	N/A	Item	Comments
☐	☐	☐	Flow meters in working condition?	
☐	☐	☐	Leachate pipes in working condition?	
☐	☐	☐	Fluid in Cell 1 leachate sump? If so how much?	Verify < 12 inches.
☐	☐	☐	Fluid in Cell 1 leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Fluid in Cell 2 leachate sump? If so how much?	Verify < 12 inches.
☐	☐	☐	Fluid in Cell 2 leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Fluid in Cell 3 leachate sump? If so how much?	Verify < 12 inches.
☐	☐	☐	Fluid in Cell 3 leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Fluid in Drying Pad 1 leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Fluid in Drying Pad 2 leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Fluid in Drying Pad 3 leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Fluid in Truck Wash leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Fluid in Leachate Pond leak detection sump? If so how much?	If any fluid, take sample & notify.
☐	☐	☐	Indications of piping leaks?	
☐	☐	☐	Valves in working condition?	
☐	☐	☐	Flanges leaking?	
☐	☐	☐	Pumps in working condition?	
☐	☐	☐	Secondary containment clean?	
☐	☐	☐	Liquid level gauges in working condition?	

Stormwater Conveyance Systems

Yes	No	N/A	Item	Comments
			Buildup of silt deposits?	
			Washouts/obstructions in culverts?	
			Erosion/obstructions in drainage structures?	
			Excess sediment in drainage structures?	
			Damage to drainage terraces?	
			Damage to letdown structures?	
			Damage to perimeter channels?	
			Access road integrity sufficient?	
			Damage to surrounding vegetation?	
			Contaminants in stormwater pond?	
			Water flowing outside of drainage ditch?	

Vadose Zone Monitoring

Yes	No	N/A	Item	Comments
			Monitor well #1 condition	Attach Vadose Zone Monitoring Record
			Monitor well #2 condition	Attach Vadose Zone Monitoring Record
			Monitor well #3 condition	Attach Vadose Zone Monitoring Record
			Monitor well #4 condition	Attach Vadose Zone Monitoring Record
			Monitor well #5 condition	Attach Vadose Zone Monitoring Record

Leachate Evaporation Pond

	Item	Comments
	Wind speed (mph)	
	Wind direction	
	Precipitation last 24 hrs (in)	
	H2S-Air (<1 ppm OK)	
	Pond level (ft)	
	Pond color, sheen	
	Water temperature (deg F)	
	pH	
	H2S-Dissolved (<1 ppm OK)	
	Vegetation	
	Animal activity	
	Bird control measures	

Facility Inspection-RAIN EVENT

Date and Time:	Inspected By:

Cover Inspection

Yes	No	N/A	Item	Comments
☐	☐	☐	Erosion on protective cover?	
☐	☐	☐	Vegetation present on protective cover?	
☐	☐	☐	Anchor Trench runout exposed?	
☐	☐	☐	Geosynthetics damage?	
☐	☐	☐	Exposed geosynthetics?	
☐	☐	☐	Ponded water on slopes?	
☐	☐	☐	Erosion rills or gullies?	
☐	☐	☐	Settlement holes or damage?	
☐	☐	☐	Slope instability, cracks or slides?	
☐	☐	☐	Soil washout around edge of crown?	
☐	☐	☐	Erosion on swales, terraces, down spouts?	

Leachate Collection System

Yes	No	N/A	Item	Comments
☐	☐	☐	Flow meters in working condition?	
☐	☐	☐	Leachate pipes in working condition?	
☐	☐	☐	Fluid in Cell 1 sump?	If over 12" take sample.
☐	☐	☐	Fluid in Cell 2 sump?	If over 12" take sample.
☐	☐	☐	Fluid in Cell 3 sump?	If over 12" take sample.
☐	☐	☐	Fluid in Drying Pad 1 sump?	If any fluid, take sample.
☐	☐	☐	Fluid in Drying Pad 2 sump?	If any fluid, take sample.
☐	☐	☐	Fluid in Drying Pad 3 Sump?	If any fluid, take sample.
☐	☐	☐	Fluid in Truck Wash Sump?	If any fluid, take sample.
☐	☐	☐	Fluid in Leachate Pond Sump?	If any fluid, take sample.
☐	☐	☐	Indications of piping leaks?	
☐	☐	☐	Valves in working condition?	
☐	☐	☐	Flanges leaking?	
☐	☐	☐	Pumps in working condition?	
☐	☐	☐	Secondary containment clean?	
☐	☐	☐	Liquid level gauges in working condition?	

Stormwater Conveyance Systems

Yes	No	N/A	Item	Comments
☐	☐	☐	Buildup of silt deposits?	
☐	☐	☐	Washouts/obstructions in culverts?	
☐	☐	☐	Erosion/obstructions in drainage structures?	
☐	☐	☐	Excess sediment in drainage structures?	
☐	☐	☐	Damage to drainage terraces?	
☐	☐	☐	Damage to letdown structures?	
☐	☐	☐	Damage to perimeter channels?	
☐	☐	☐	Access road integrity sufficient?	
☐	☐	☐	Damage to surrounding vegetation?	
☐	☐	☐	Contaminants in stormwater pond?	
☐	☐	☐	Water flowing outside of drainage ditch?	

ATTACHMENT B
Vadose Zone Monitoring Plan

Vadose Zone Monitoring Plan

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 8, 2019
Project No. 35187378

Prepared for:
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EXHIBITS

1.0 INTRODUCTION

This Vadose Zone Monitoring Plan (VZMP) presents the details of the vadose zone monitoring program proposed for the North Ranch Surface Waste Management Facility (SWMF) and is submitted to satisfy the requirements of the NMOCD provisions set forth in *NMAC 19.15.36*. This VZMP will serve as a guidance document for personnel performing site monitoring during the active life of the facility and during closure and post-closure periods.

The Facility is located in Lea County in the State of New Mexico and is operated by the applicant - NGL Waste Services, LLC. The proposed facility includes an Oil Field Waste Landfill, a leachate evaporation pond, and associated infrastructure. The site for the proposed North Ranch SWMF (previously known as McCloy Ranch) is located 16 miles west of Jal, New Mexico and is approximately 303 acres in size. More specifically, the North Ranch SWMF site is located within Section 9 and 10 of T25S, R34E. **Figure 1** shows the approximate location of the SWMF on a site location map showing the locations of USGS monitored groundwater wells.

19.15.36.13.A(1) and **(5)** stipulate that no landfill shall be located where groundwater is less than 100 feet below the lowest elevation of the design depth at which oil field waste will be placed, and no other surface waste management facility shall be located where groundwater is less than 50 feet below the placement of oil field waste. **19.15.36.14.B** requires that a groundwater monitoring program be established if fresh groundwater exists at a site unless otherwise approved by the Division.

As indicated in **Appendix I** Hydrogeological Report, seven borings were advanced in the landfill footprint area to a depth of 165 feet below existing grade. Groundwater was not encountered in any of the borings beneath the landfill site. The uppermost aquifer beneath the landfill area exceeds 165 feet below existing grades and is more than 100 feet below the proposed maximum landfill depth. Depth to water-bearing zones in the Santa Rosa Sandstone is expected to occur at a depth of greater than 500 feet everywhere beneath the land surface in the landfill footprint area**.** **Figure 2** illustrates the existing SWMF site, the locations of the seven geotechnical borings and the proposed locations of the five (5) vadose zone monitoring wells to be included in this VZMP.

Water-bearing zones within the Santa Rosa Sandstone are indicated as vertically separated from proposed waste cells at the facility by at least 500 feet of Chinle Formation deposits. The Triassic Chinle Formation is described as a red to green claystone with minor fine-grained sandstone and siltstones. The Chinle is present in all of the eastern part of southern Lea County but thins westward and is absent in extreme western portions. Thickness of the Chinle varies from 0 to 1,270 feet. Geotechnical borings advanced at the SWMF characterized the upper Chinle Formation as primarily fine-grained sandstone. However, regional borings within the Chinle Formation confirm the presence of shale and other low permeability strata within the interval overlying the Santa Rosa Sandstone. Therefore, the Chinle Formation is expected to provide an aquitard relative to downward migration of near surface groundwater into the Santa Rosa Sandstone regional aquifer.

The Santa Rosa Sandstone is described as a primarily red, fine-to-coarse grained sandstone, is exposed only in minor outcrops, and the thickness ranges from 140 to 300 feet. Approximate depths from the lowest point of the proposed landfill to formational contacts and the top of the water-bearing zone below the facility are summarized in Table 1 below.

TABLE 1
LANDFILL SUBSURFACE CHARACTERISTICS

Site Hydrogeologic Features	Approximate Depth Below Ground Surface at Lowest Waste Placement Location (ft)	Approximate Depth Below Landfill Lowest Sump Placement (Cell E-3) Elev. (ft)
Top of Chinle Formation	54	1
Top of Santa Rosa Sandstone	601	548
Approximate Potentiometric Surface Elevation – Uppermost Aquifer	171	118

The proposed SWMF landfill incorporates a double HDPE geomembrane composite liner system with a leak detection layer and associated leachate collection and removal system infrastructure. For the purpose of vadose zone monitoring, in the unlikely event that leakage through the bottom liner occurs, it is assumed that some down-dip (generally east-southeast) lateral migration will be caused along the contact between overlying Quaternary age unconsolidated sands and the sandstone and claystone beds of the underlying Triassic Chinle Formation.

Vadose zone monitoring at the Chinle Formation/Unconsolidated sands contact is proposed for the site. It is anticipated that properly located and completed vadose zone monitoring wells would detect leakage from the facility long before groundwater monitoring wells completed in the uppermost aquifer or Santa Rosa Sandstone. Early detection through vadose zone monitoring wells would provide a greater level of protection to groundwater resources below the landfill and evaporation pond. The sections below discuss the stratigraphic setting in the SWMF area and the proposed design for vadose zone monitoring at the site.

2.0 SITE GEOLOGY/HYDROGEOLOGY

The proposed North Ranch SWMF is located near the boundary between the South Plain and Eunice Plain of Southern Lea County. Eunice Plain is underlain by a hard caliche surface and is almost entirely covered by reddish-brown dune sand. The South Plain has no generally accepted local name and has irregular topography without integrated drainage. Several well developed gullies originate in the Eunice Plain area but do not completely traverse the South Plain. The South Plain area is almost completely covered by a thick layer of sand (Nicholson and Clebsch, 1961).

The Great Plains Physiographic Province near surface profile in the vicinity of the North Ranch SWMF consists of generally dipping (southeast) Triassic sedimentary bedrock units (Chinle Formation "red beds" and Santa Rosa Sandstone) covered by varying thickness unconsolidated to semi-consolidated sand, silt, gravel and caliche deposits of the Ogallala Formation and Quaternary eolian and piedmont deposits. For the purposes of this VZMP, any potential Ogallala Formation alluvial and eolian deposits and Quaternary alluvial, piedmont or eolian deposits are not differentiated. It is assumed that the Ogallala has been largely removed locally by erosion and a veneer (approximately 50 feet) of Quaternary age unconsolidated Ogallala detritus and eolian sands cover the sandstone and claystone beds of the Triassic Chinle.

3.0 SITE GROUNDWATER CONDITIONS

Water-bearing units in the vicinity of the SWMF include local shallow Quaternary alluvial aquifers and the Santa Rosa Sandstone, which is in the lower portion of the Triassic Dockum Group. The Santa Rosa Sandstone, underlying the Chinle Formation, is present at depth throughout much of southern Lea County and locally produces modest quantities of groundwater. **Figure 3** provides approximate top of Chinle Formation contours, based on the local geotechnical borings advanced at the site and **Figure 4** illustrates top of Santa Rosa Sandstone general contours based on reviewed data.

The USGS Water Information System includes historic depth to groundwater measurements for groundwater wells in Lea County. ChevronTexaco mapped the depth to uppermost groundwater contours for Lea County based on the USGS monitoring points. Three local groundwater wells in the vicinity of the SWMF have been completed in the Ogallala Formation/Unconsolidated Sands and Chinle Formation to depths of from about 175 to 300 feet below ground surface (see **Figure 1**). **Figure 5** illustrates the local potentiometric surface elevations based on the USGS measurements and adapted from the ChevronTexaco depth to groundwater map.

The potentiometric surface is projected at an elevation of around 3166 feet above NGVD29 beneath the lowest point of waste placement in the SWMF landfill. Three USGS monitored groundwater wells - USGS 320738103270501, USGS 320934103253901 and USGS 321025103263601 (New Mexico Office of the State Engineer, New Mexico Water Rights

Reporting System wells C-02314, C-02401 and C-04310 respectively) are located in the vicinity of the SWMF as shown on **Figure 1**. Well USGS 320738103270501 is located approximately 0.7 miles southeast of the landfill footprint in S15, T25S, R34E.

Boring data obtained during the proposed vadose zone monitoring wells installations will be added to the site characterization data for the North Ranch SWMF. Locations of site characterization borings and wells in the vicinity of the SWMF are shown on **Figure 1** and **Figure 2**. The approximate cross-sectional relationship between the existing groundline, top of the landfill bottom liner system, the underlying geologic units and the groundwater potentiometric surface are illustrated in **Figure 6**.

4.0 PROPOSED VADOSE ZONE MONITORING WELL NETWORK

Due to the anticipated significant depth to the shallowest water-bearing units in the vicinity of the SWMF, vadose zone monitoring is proposed for the site. The proposed vadose zone monitoring wells would be positioned along the eastern boundary of the disposal cells and leachate evaporation pond and screened across the Unconsolidated Sand/Alluvium and Chinle Formation contact, where fluid from a potential leak from the facility would likely be detected before approaching water-bearing zones in uppermost aquifer and the Santa Rosa Sandstone regional aquifer, more than 500 feet below.

4.1 Proposed Monitoring Well Locations

Locations of the proposed vadose zone monitoring wells for the facility are shown on **Figure 2.** Five wells are proposed along the eastern boundaries of facility disposal cells and the leachate evaporation pond, including one directly downgradient from the leachate collecting sump for Cell E-3, which is the lowest point in the landfill liner system. Based upon the general structural dip of the Chinle Formation, there is a high probability that proposed vadose zone monitoring wells positioned directly downdip from the proposed waste disposal cells and pond areas will provide the best available opportunity for early detection of escaping liquids in the unlikely event of a release.

4.2 Proposed Well Drilling and Completion

Prior to drilling, each proposed well location will be staked, and the elevation of existing ground determined so that formational elevations can be approximated during drilling. Found top of Chinle elevations will be compared to the conceptual structural top of Chinle model. The site geologist or engineer will determine the elevation of the top of the Chinle during drilling observation.

Proposed vadose zone monitoring wells would be installed using hollow-stem auger drilling methods; i.e., no fluids would be introduced into the borings during drilling. Drilling equipment would be equipped to switch to air rotary should auger refusal be reached before adequate depth is reached for each well. Undisturbed, depth-referenced samples would be collected on five-foot intervals using split spoon sampling equipment. Standard Penetration Test blow counts will be determined during split spoon sampling and used to verify the location of the upper indurated Chinle (redbeds) surface in each well boring. A competent geologist or engineer will be present during drilling and will log descriptions of the lithology, texture, sorting, rounding, color, plasticity, degree of lithification, and moisture content of each sample and stratigraphic unit that is penetrated.

Each boring would be advanced into the hardened Triassic Chinle Formation to a penetration depth of at least 20 feet, or 10 feet lower than the sump elevation of the adjacent waste cells, whichever is lower in elevation. Each well boring will be evaluated for the presence of water. Upon reaching total depth, the drilling rig would be placed on standby for at least two hours, during which time soundings will be made inside the augers to check for accumulating fluid.

Vadose zone monitoring wells will be completed in accordance with the Typical Vadose Zone Monitoring Well detail shown in **Figure 7**. Each well will be completed using 2-inch schedule 40 flush joint PVC casing. Each well will be completed with a 30-foot length of 0.010-inch slotted PVC well screen, positioned with the lowermost end extending 20 feet into the upper Chinle Formation surface and the upper screened interval extending ten feet above the Chinle Formation surface. Each well annulus will be backfilled with a 10/20 CSSI sand pack extending two feet above the top of the screened interval, a two foot pelletized bentonite seal and an annular seal consisting of bentonite grout or equivalent extending to 3 feet below land surface. The remainder of the annulus to land surface will be filled with concrete integral to the well pad. Each well would be equipped with a sloped concrete well pad with locking steel protective steel security cover extending at least three (3) feet above grade. The security cover will be positioned a minimum of four inches from the top of the PVC well casing to allow for easy access for removal of the PVC vented cap.

A 4ft x 4ft x 6in concrete pad will be poured around the steel protective covers. The pads will be sloped away from the wells to promote stormwater drainage away from the wells; and will be protected on each corner by steel bollards.

The tops of each PVC well casing, and points set in the tops of the of concrete pads of the new monitoring wells, will be surveyed in State Plane coordinates with elevations relative to the site survey grid and control points. Well completion data, NMOSE drilling permits and well records and survey location information will be submitted to NMOCD in a Well Completion Report.

5.0 VADOSE ZONE MONITORING PROGRAM

The proposed vadose zone monitoring program will include initial monthly inspections of each well for the presence of fluid, alongside the inspections of the landfill and leachate pond leak detection sumps, in accordance with provisions set forth in **19.15.36.13.L**. Results of fluid detection measurements would be submitted with related leachate monitoring results in normal facility operations reporting to the NMOCD. If fluids are noted in any of the monitoring wells, the fluid will be sampled and tested quarterly in accordance with **19.15.30.9** and **20.6.2.7** NMAC and a report of findings will be transmitted to the division in accordance with requirements for groundwater monitoring and reporting set forth in **19.15.36.14.B**.

Evidence of fluids in the vadose zone monitoring wells will not necessarily mean that the wells have been impacted by landfill or leachate pond fluids, requiring that the fluid's origin be ascertained by sampling and analysis. For example, geometric re-configuration of stormwater run-off may alter subsurface water recharge and liquids may potentially accumulate in a monitoring well from condensate within the well casing. The following sections describe the planned monitoring plan for the SWMF vadose zone monitoring network.

5.1 Monitoring Schedule

The proposed vadose zone monitoring program will initially include inspection of each well for the presence of fluid in advance of the applicable disposal area construction. After the initial inspection, each well will be monitored for the presence of free liquids on a monthly basis for a period of 12 months. If the monthly monitoring results continually indicate the absence of fluid, a petition will be made to the NMOCD to transition the vadose zone monitoring wells to quarterly monitoring. A continued lack of fluids in the wells during the quarterly monitoring will initialize additional requests to the NMOCD for a reduced monitoring frequency (i.e., semi-annual or annual).

5.2 Monitoring Assessment

Monitoring for the presence of liquid will be performed by tape down measurement with a water level indicator that emits an audible signal when a water surface is encountered. Total well depth measurements will also be recorded with the same electronic tape. **Exhibit A** to this Monitoring Plan is an example field information form that may be used for routine vadose zone monitoring purposes.

If the water level indicator detects free liquids in the well casing, an attempt will be made to extract the liquid to investigate its origin by lowering a two-inch PVC or Teflon bailer to remove the liquid from the well for sampling/testing purposes. If a liquid sample cannot be retrieved, then the quantity of liquid in the well will be considered de minimis and likely the result of condensation. The same procedures will be used to check for liquid and evacuate samples for each subsequent monitoring event.

If a sufficient quantity of liquid is available to allow sample collection, the liquid will be field-screened for specific conductance, pH, and temperature (i.e., field parameters). In addition, initial sampling will include independent qualified commercial laboratory analysis for the parameters identified in **Table 2**. Initial data will be collected prior to construction of adjacent landfill cells or the leachate pond and will be considered "background values." The initial field and laboratory data collected post-construction will be evaluated to determine if the water encountered is the result of surface water infiltration or potential impacts from the landfill or pond.

If the initial analyses indicate that no impact from the SWMF is evident, then routine monitoring of field parameters will continue on either a monthly or quarterly basis, as applicable, for wells with a measurable water column. If subsequent monitoring indicates elevated measurements of the field parameters relative to the background measurements (i.e., greater than five times background values), additional samples will be collected for laboratory analyses, and the data will be evaluated in accordance with the following Section to determine if a release from the landfill or leachate pond is evident.

5.3 Monitoring Data Evaluation

If the field parameter measurements indicate that a well shows evidence of contaminant influenced water, the NMOCD will be notified within 48 hours and verification re-sampling for the parameters listed in **Table 2** will be conducted within two weeks. If the secondary sampling analytical results indicate that a statistically significant increase and potential SWMF release may have occurred, within 90 days of the finding, leachate samples from each active Landfill sump will collected and analyzed for the parameters listed in **Table 2** for comparative evaluation with the re-sampling results. This data comparison is important for determining whether the potential source of an identified significant change is from the SWMF, another on-site or off-site source, natural variability, an error in the sampling and analysis process, etc. The SWMF will work with NMOCD to devise an appropriate scope of work for assessing water quality changes.

If the evaluation indicates that the well may contain SWMF derived liquids, the SWMF will submit an Action Plan detailing the course of action to investigate further the potential release and/or complete any mitigation measures as appropriate, to the NMOCD within 30 days. If the comparative evaluation indicates that no SWMF derived impacts have occurred, the monitoring data will be maintained as part of the Permanent Operating Record and submitted with annual vadose zone monitoring data for the facility.

TABLE 2 VADOSE ZONE MONITORING PARAMETERS	
Field Parameters	Specific Conductance pH Temperature Depth to Water Total Depth of Well
Major Cations	Calcium Iron Magnesium Potassium Sodium
Major Anions	Fluoride Chloride Nitrate as N Phosphorous Sulfate
RCRA Metals	Arsenic Lead Barium Mercury Cadmium Selenium Chromium Silver
Organic Compounds	Benzene Ethylbenzene Toluene Xylenes
Additional Parameters	Total Dissolved Solids (TDS) Total Petroleum Hydrocarbons (TPH)

During each vadose zone monitoring event, H2S monitoring will be performed in each vadose zone monitoring well using a portable gas analyzer, or equivalent instrument. Soil vapor samples will be purged from each vadose zone monitoring well and screened for concentrations of H2S. Hydrogen sulfide concentrations will be expressed as percent volume in air and will be recorded on the form provided in **Exhibit A**. In the event that hydrogen sulfide concentrations approach the OSHA Permissible Exposure Limit (PEL) for construction workers, the SWMF will work with NMOCD to devise an appropriate scope of work for assessing the H2S monitoring results.

6.0 REFERENCES

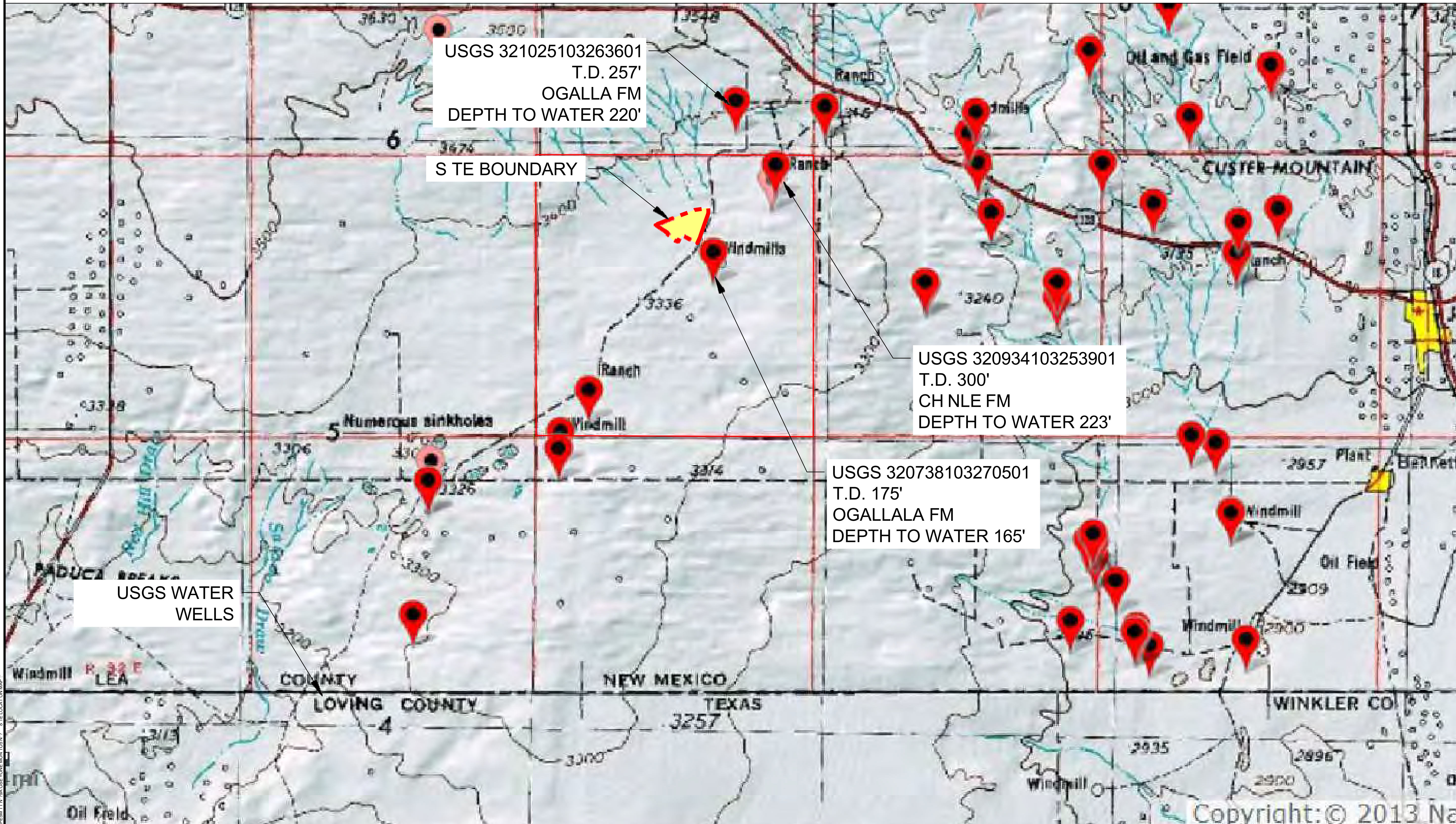
Gordon Environmental, Inc. and Golder Associates, Inc., 2016, Vadose Zone Monitoring Plan for the Proposed OWL Landfill Services, LLC Surface Waste Management Facility, Lea County, New Mexico, via NMOCD.

Nicholson, A., and Clebsch, A., 1961, Geology and Ground - Water Conditions in Southern Lea County, New Mexico, New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico, Groundwater Report 6.

ChevronTexaco, 2005, Lea Co. Depth to Ground Water.

Office of the New Mexico State Engineer, 2013, Electronic image well log files for Lea County, http://www.ose.state.nm.us/water_info_rights_dist2_LeaCountyWellLogs.html.

Figures



REV	DATE	BY	DESCRIPTION

NGL

S TE LOCAT ON MAP
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
LEA COUNTY
NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

F GURE 1

DESIGNED BY:	FOC
DRAWN BY:	JBM
APPVD. BY:	FOC
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	372-002
SHEET NO.:	1 OF 7

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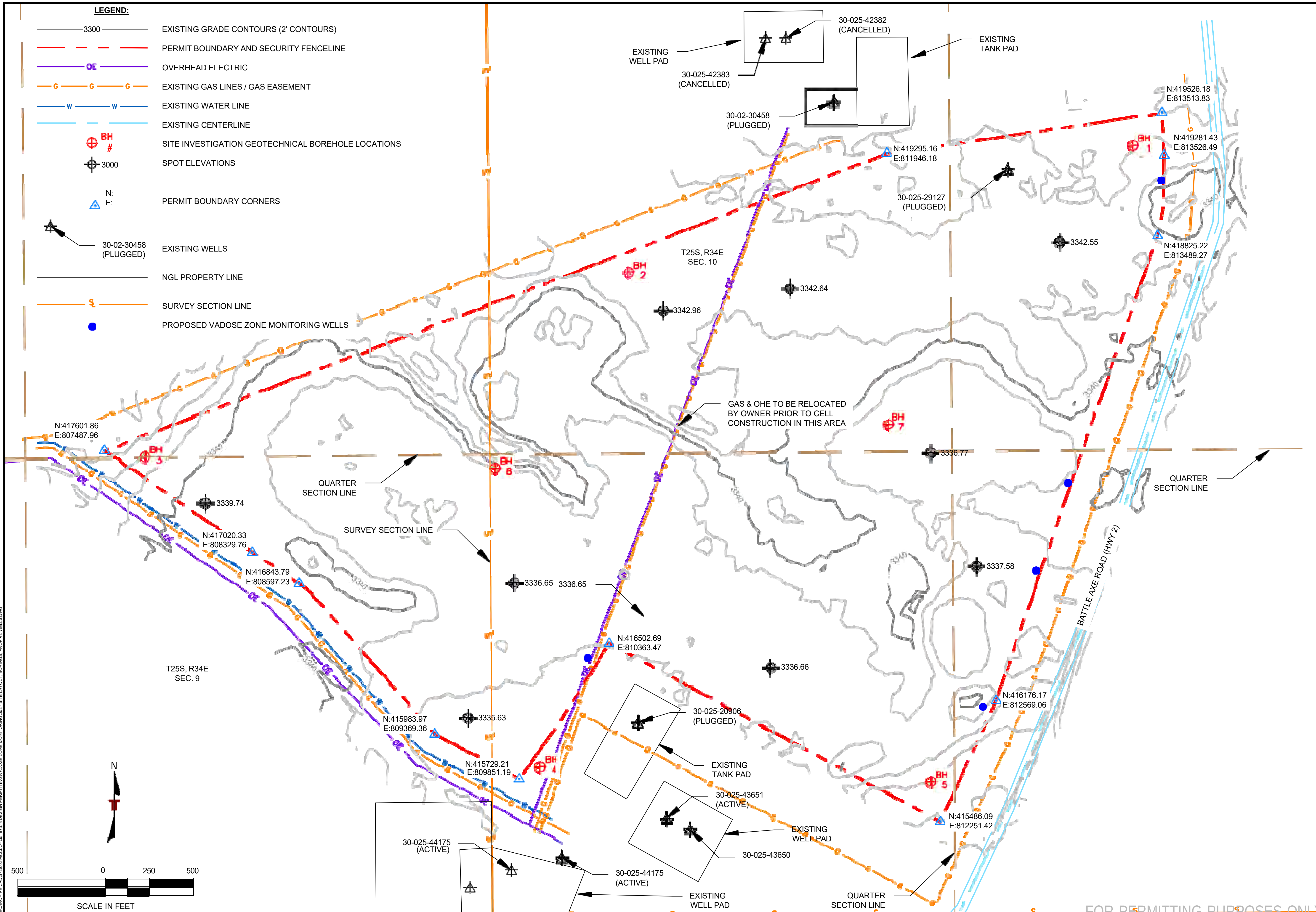

SITE LAYOUT WITH VADOSE ZONE WELL LOCATIONS

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

LEA COUNTY NEW MEXICO

Terracon
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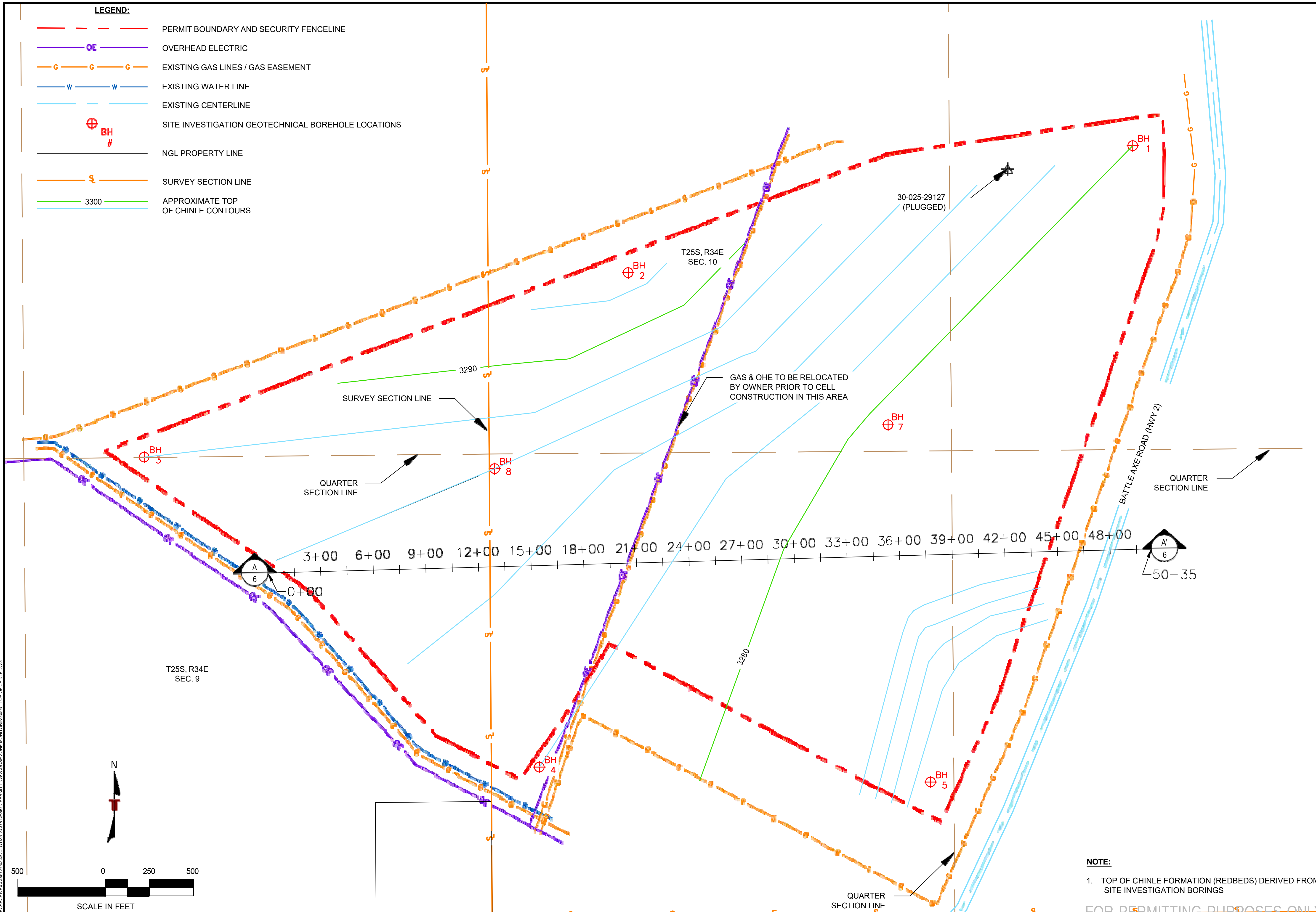
FIGURE 2

DESIGNED BY:	FOC
DRAWN BY:	JBM
APPVD. BY:	FOC
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	2 OF 7



NOTE:

1. TOP OF CHINLE FORMATION (REDBEDS) DERIVED FROM SITE INVESTIGATION BORINGS

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION

APPROXIMATE TOP OF CHINLE FORMATION

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
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FIGURE 3

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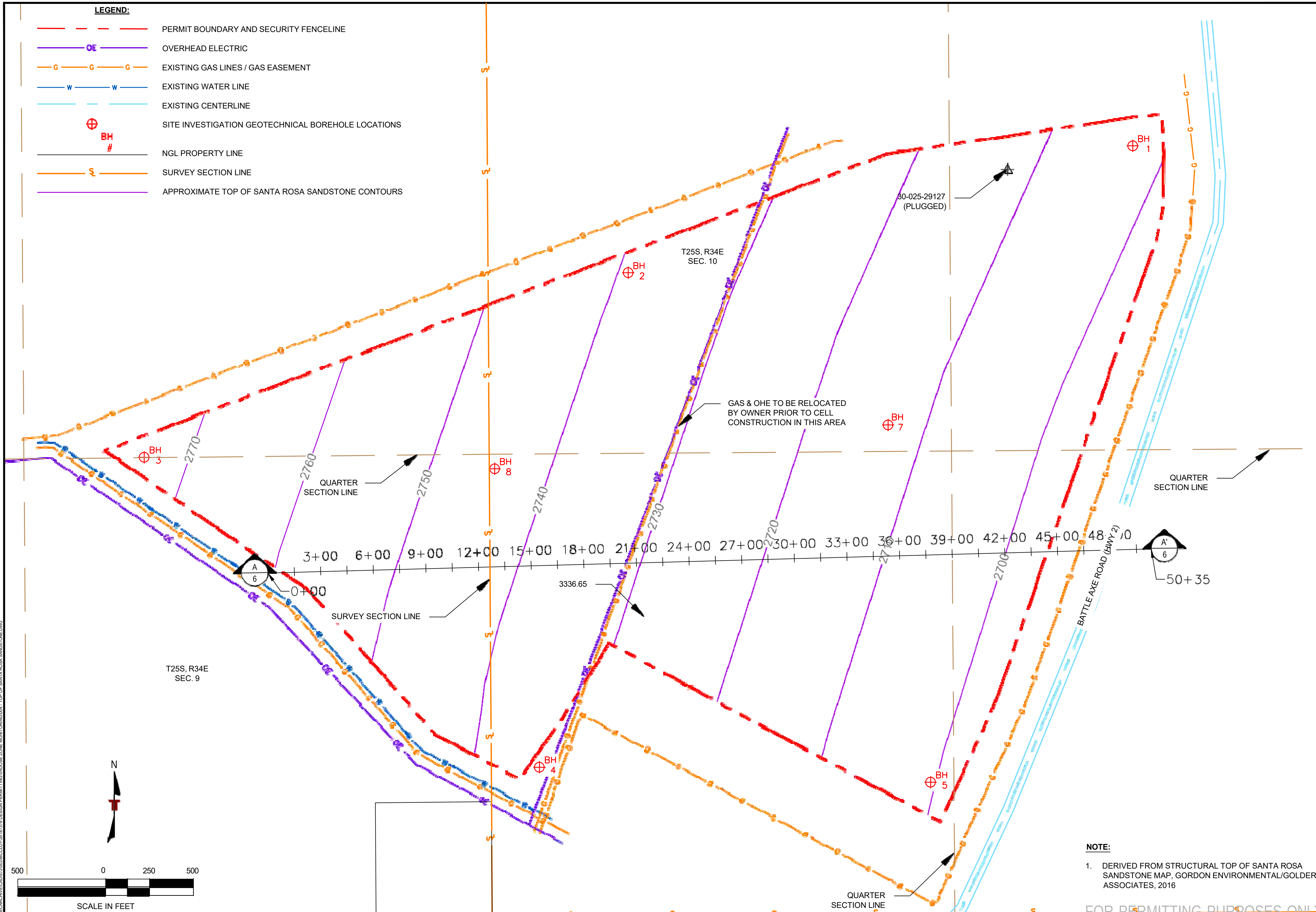
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	3 OF 7



REV.	DATE	BY	DESCRIPTION

APPROXIMATE TOP OF SANTA ROSA SANDSTONE

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
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FIGURE 4

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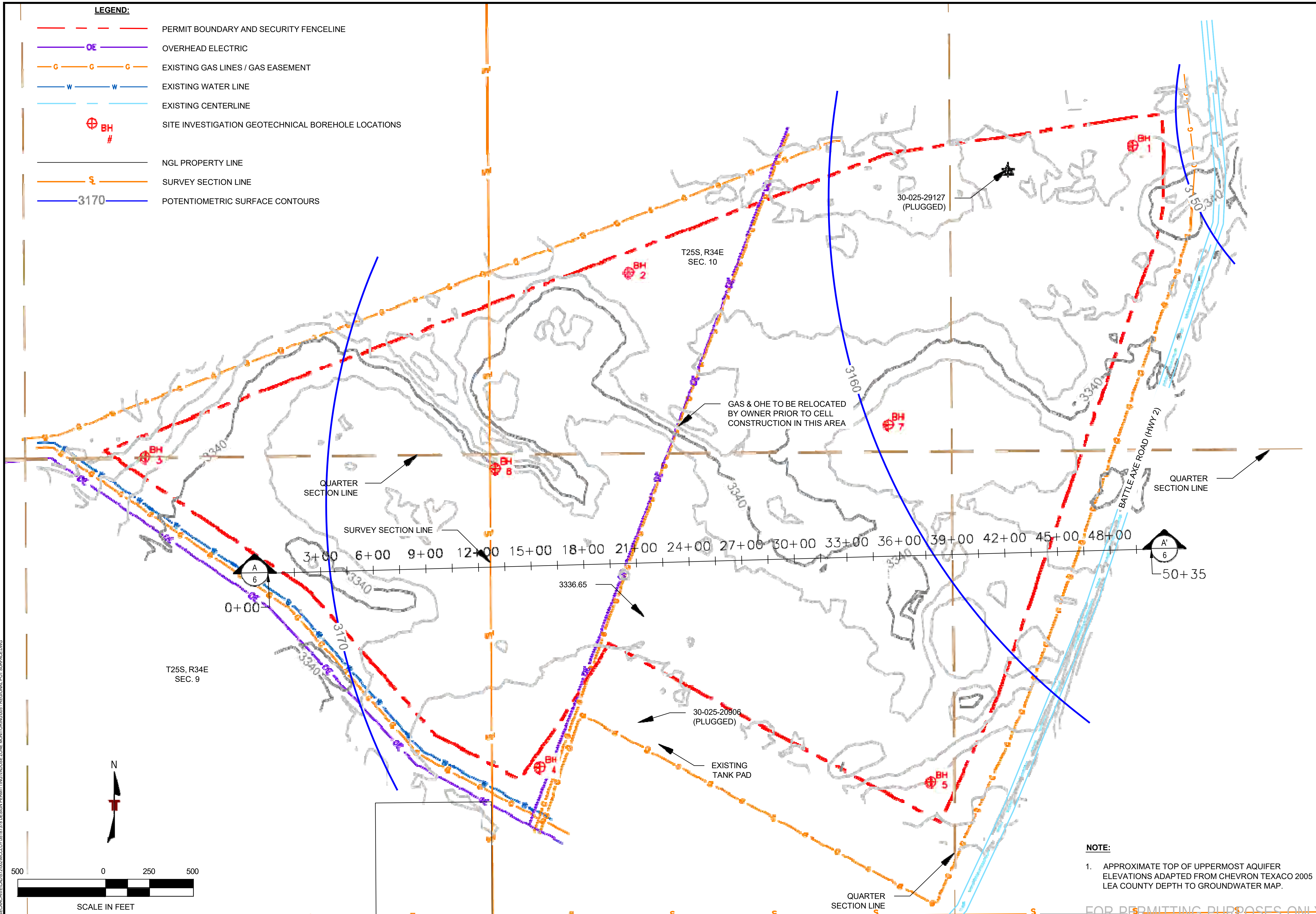
APPVD. BY:	FOC
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	4 OF 7



APPROXIMATE REGIONAL POTENTIOMETRIC SURFACE

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
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FIGURE 5

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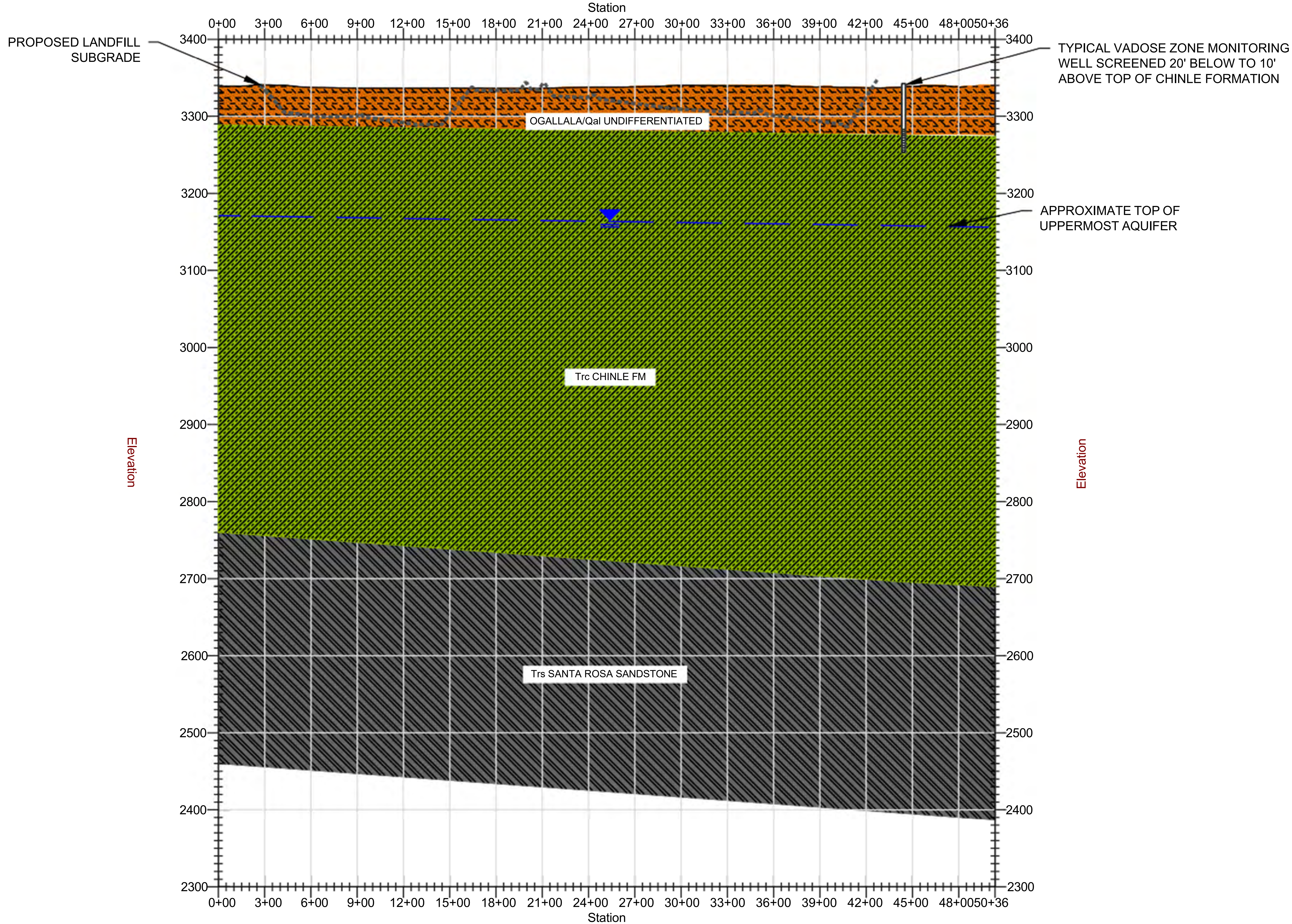
DRAWN BY:	JBM
APPVD. BY:	FOC
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	5 OF 7

REV.	DATE	BY	DESCRIPTION



FOR PERMITTING PURPOSES ONLY

REV | DATE | BY | DESCRIPTION

VADOSE ZONE CROSS SECTION

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists

25809 I-30 SOUTH BRYANT, AR 72022
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FIGURE 6

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APPVD. BY:	FOC
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	6 OF 7

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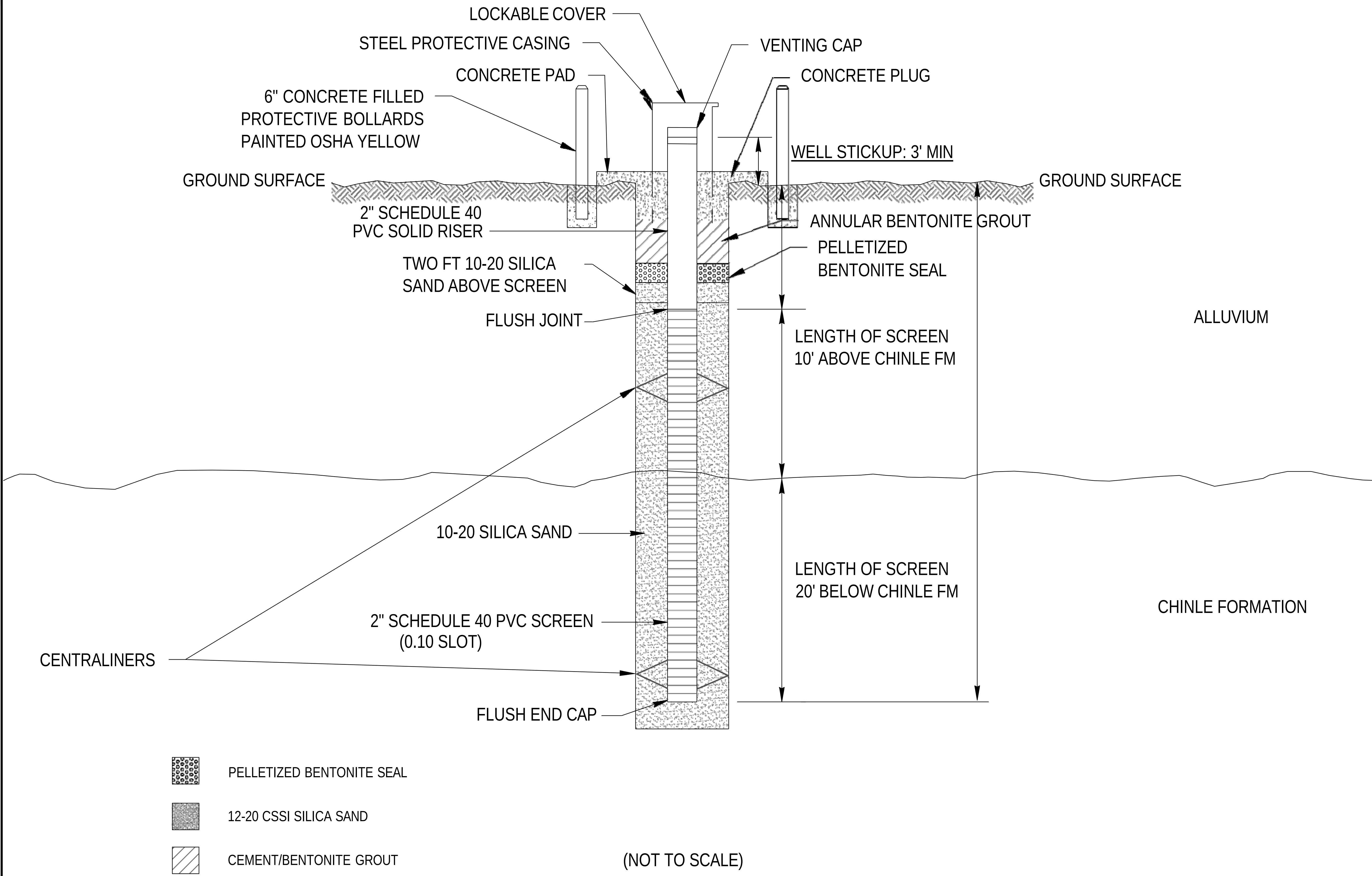

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION

TYPICAL VADOSE ZONE MONITORING WELL

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists

25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 7

DESIGNED BY:	FOC
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APPVD. BY:	FOC
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	372-002
SHEET NO.:	7 OF 7

Exhibit A
Example Vadose Zone Monitoring Record

VADOSE ZONE MONITORING RECORD

Terracon

WELL ID:			
SAMPLING LOCATION:			
WEATHER CONDITIONS:			
WIND SPEED/DIRECTION:			
BAROMETRIC PRESSURE:			
MONITORING WELL CONDITION:			
WELL LOCKED?		**WELL NUMBER LABELED?**	
CASING CONDITION:			
DATUM FOR WATER/CASING DEPTH (TOC EL.):			
GENERAL WELL EXTERIOR/INTERIOR CONDITIONS:			
DECON FIELD EQUIPMENT:			
WATER DEPTH (WD):		**TOTAL DEPTH OF WELL (TD):**	
VOLUME OF WATER IN WELL:			
V = 0.0408 x [TD-WD(feet)] x [Well Diameter (inches)]^2 =		**Gallons**	
WATER CONDITION BEFORE SAMPLING IF KNOWN:			
APPEARANCE:		**ODOR:**	
WELL SAMPLING DATE:		**SAMPLING METHOD:**	
TIME OF SAMPLING:			
VOLUME EXTRACTED:			
APPEARANCE:		**ODOR:**	
WELL DRY?			

FIELD MEASUREMENTS:

TIME	TEMP (DEG °C)	H_2S GAS (%)	pH (SU)	SPEC COND (mS/cm)	Water Level

FIELD SAMPLE PRESERVATION:	
CONTAINER HANDLING:	
COMMENTS:	

Appendix F
North Ranch Disposal Facility
Contingency Plan

Contingency Plan

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 2019
Project No. 35187378

Modified by:

NGL Waste Services, LLC
1008 Southview Circle
Center, TX 75935
(936) 598-8587

TABLE OF CONTENTS

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LIST OF FIGURES

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1.0 INTRODUCTION

The following document comprises the Contingency Plan for the NGL Waste Services, LLC (NGL) North Ranch Surface Waste Management Facility (Facility) located near Jal, Lea County, New Mexico. New Mexico Administrative Code (NMAC) **19.15.36.13.N** requires that owners and operators of surface waste management facilities maintain a written Contingency Plan that also complies with New Mexico Statues Annotated (NMSA) 12-12-1 through 12-12-30 (the Emergency Management Act). This Contingency Plan contains procedures to be followed in the event of fire, explosion, unplanned sudden or non-sudden release of contaminants or oil field wastes to air, soil, surface water, or groundwater.

The objective of this plan is to minimize hazards and ensure the safety of site personnel, emergency responders, public health, fresh water, and the environment. It is intended to complement existing law, regulations, rules, standards, policies, and procedures pertaining to safety standards, fire prevention, and pollution prevention rules.

1.1 General Facility Information

The North Ranch Surface Waste Management Facility is an Oil Field Waste Landfill and is located west of Jal, New Mexico in Township 25 South, Range 34 East, Sections 9 and 10. More specifically, the site can be accessed by traveling approximately 14 miles west of Jal on New Mexico State Road 128 West, then turning southwest onto Battle Axe Rd. The landfill entrance is located approximately 5 miles down Battle Axe Rd, traveling southwest. The site consists of approximately 303 acres with a Landfill footprint of approximately 205 acres. The property includes designated areas for leachate disposal, waste handling, scale house, equipment maintenance facilities, and truck washing.

2.0 RELEVANT TELEPHONE NUMBERS

TABLE 1 lists the designated site primary emergency contacts who will act as the contingency plan emergency coordinators. If no emergency contact can be reached, the employee who identified the situation shall follow the necessary steps until an emergency contact is available. **TABLE 2** lists local, state, and federal emergency contacts not included in Table 1**.** A list of these phone numbers shall be posted and updated regularly.

Table 1. Emergency Contacts

Position	Name	Office Phone	Address
North Ranch SWMF - Facility Manager (Primary Emergency Contact)	Darren Warren	575-263-6959	476 Battle Axe Rd Jal, NM 88252 darrenw@r360es.com
North Ranch Landfill – Facility Operator (Alternate Emergency Contact)	Eric Duran	575-361-8037	476 Battle Axe Rd Jal, NM 88252 Eric.duran@wasteconnections.com
Lea Regional Medical Center		911 or 575-492-5000	

In the event an individual needs to be taken to the hospital, an ambulance can be called, or the person may be taken to the following location:

Lea Regional Medical Center - Medical Center
5419 N Lovington Hwy
Hobbs, NM 88240

A map depicting the location of the Hospital in relation to the site is shown on **FIGURE 1**. The Lea Regional Medical Center is located approximately 74 miles northeast of the Landfill Facility.

Table 2. Emergency Telephone Numbers

Organization	Phone Number
All Emergencies	911
Fire **Jal Fire Department**	911 or 575-395-2221
Police Jal Police Department	911 or 575-395-2501
Lea County Sheriff's Department Sheriff - Corey Helton	911 or 575- 396-3611
New Mexico State Police (Hobbs District Office)	911 or 575-392-5580
Medical Jal Clinic 805 W Kansas Ave Jal, NM 88252	911 or 575-395-3400
Lea Regional Medical Center 5419 N Lovington Hwy Hobbs, New Mexico 88240	911 or 575-492-5000
Lea County Health Department 302 N 5th Street Lovington, NM 88260	911 or 575-396-2853
Poison Control Center	800-222-1222
Oil Conservation Division (OCD) Emergency Contacts Oil Conservation Division – District 1 1625 N. French Drive Hobbs, NM 88240	575-629-6116 (office) 575-626-0830 (cell)
New Mexico Oil Conservation Division – Main Office 1220 S. St. Francis Drive Santa Fe, NM 87505	505-476-3441 (office)
State of New Mexico Contacts New Mexico Environmental Department 1190 St. Francis Drive Santa Fe, NM 87502 Hazardous Waste Bureau	505-827-2855 (office)
New Mexico Environmental Emergencies	505-827-9329 (24 hrs)
Local Emergency Response Contacts Lea County Emergency Management Director – Lorenzo Velasquez	575-391-2983 (office) 575-605-6561 (cell)

Federal Emergency Contacts	
National Response Center (NRC)	800-424-8802
US EPA Region 6 Hotline	800-887-6063 214-665-2760
Additional Local Contacts	
Lea County Electrical Coop.	575-396-3631
Hobbs Animal Shelter – contact Emergency Management	575-397-9323

3.0 EMERGENCY PROCEDURES

The Contingency Plan here within shall be carried out immediately whenever there is a fire, explosion or release of contaminants or oil field waste constituents that could threaten fresh water, public health or the environment. A copy of the Contingency Plan shall be kept at the scale house of the Facility. Other types of emergencies include: storm damage, spills, and any other events requiring the prompt intervention of the landfill facility officials, police and fire departments, or other public health and safety officials. Accidents must be reported **PROMPTLY** to the employee's immediate supervisor for evaluation and/or investigation. Immediate reporting is mandatory not only to comply with applicable laws and regulations, but also to ensure that steps are taken to correct the conditions that contributed to the accident. Since every accident includes a sequence of contributing factors, it is possible to avoid a repeat of the first event by recognizing and eliminating these factors. The removal of just a single factor could prevent a recurrence.

3.1 Assessment and Notification in an Emergency

In the event of an emergency, **TABLE 3** shall be followed to assess the scene and provide notification quickly and effectively. However, the emergency coordinator may deviate from the plan as necessary in an emergency situation if any of the actions could create a safety hazard. Initial efforts will focus on the safety and protection of the facility personnel and the persons using the facility. No persons shall attempt to contain or control fires, explosions, spills, or leaks beyond their corresponding scope of safety, training, and available equipment. Refer to **Section 3.4** for fire/explosion response procedures **and Sections 3.5 - 3.8** for spill/release response procedures.

Table 3. Assessment and Notification Procedures for Emergencies

1. Notify Emergency Contact

The employee who identifies the emergency will immediately notify the designated primary emergency contact via 2-way radio, thereby broadcasting the emergency to all facility personnel. If the primary emergency contact is not available, the alternate emergency contact or the onsite manager will be notified via 2-way radio. The responding emergency contact will assume the role of emergency coordinator over the situation.

---

2. Assess the Scene

The emergency coordinator will assess the scene by direct observation, review of surface waste management facility records or manifests, and if necessary, by chemical analysis. The emergency coordinator will assess:

A. Release identification
   a. Type and quantity of released material
   b. Location of release
   c. Nature of the hazard (eg, fire, release to air, release to water, regulated NORM)

B. Vulnerability Analysis (ie., what is susceptible to damage?)
   a. Extent of the vulnerable zone (eg. Size of release, wind direction, wind speed, proximity to water)
   b. Persons in the vulnerable zone (eg, facility personnel, nearby working crews)
   c. Environmental impact (eg, endangered species, surface water, natural areas)

C. Risk Analysis (ie, probability of damage)
   a. Environmental conditions (eg, risk of spread due to high winds or rainstorm)
   b. Facility personnel skillset (ie, within capabilities of personnel to contain and control)
   c. Equipment availability (ie, is the facility equipment sufficient to deal with the emergency)
   d. Type and severity of harm to people, property & environment

---

3. Containment and Control

Containment and/or control procedures will only be implemented if deemed safe to do so. If deemed safe by the emergency coordinator, personnel will perform actions within the scope of their training to contain the incident and prevent the spread/dispersion of the release. Depending on the type of emergency, the appropriate equipment will be used (absorbents for spills, fire extinguishers, and/or earthmoving equipment).

A. For fire/explosion response procedures see **Section 3.4.**

B. For spill/release to soil response procedures see **Section 3.5**.

C. For spill/release to surface water response procedures see **Section 3.6**.

D. For spill/release to groundwater response procedures see **Section 3.7**.

E. For release to air response procedures see **Section 3.8**.

F. For H2S specific response procedures see **Attachment D, Hydrogen Sulfide Contingency Plan.**

---

4. Notify Emergency Authorities

Appropriate state and local emergency authorities and the OCD will be notified depending on the emergency if their assistance is needed.

■ OCD District 1 – office	(575) 629-6116
■ OCD District 1 – mobile phone	(575) 626-0830
■ OCD Santa Fe main office	(505) 476-3441
■ New Mexico State Police (Hobbs District Office)	911 or (575) 392-5580
■ Lea County Sheriff Department	911 or (575) 396-3611
■ Lea County Emergency Management	911 or (575) 391-2983

Section 3.10 shall be followed in the event of a major or minor spill/release (as defined in **Section 3.9**).

---

5. Divert Traffic and Evacuate

Facility personnel and vehicular traffic not actively assisting in emergency response activities will be diverted from the scene of the emergency until the area is determined safe and the situation is abated.

3.2 Emergency Response Team Coordination

Facility officials will coordinate with local agencies regarding notification, emergency response procedures, and evacuation. Jal Police Department, Lea County Sheriff's Department, the local fire department and hospital, contractors, and emergency response teams will be provided copies of the Contingency Plan so that the organizations can be prepared to coordinate with the Facility in the event of an emergency. The Environmental Bureau of the Oil Conservation Division (OCD) shall also be provided a copy of the Contingency Plan and will be promptly notified of changes in emergency coordinator personnel or in the emergency coordinators' contact information. A copy of this contingency plan will be provided and documented to local police, fire, hospitals and local emergency response.

3.3 Emergency Response Equipment

Table 4 contains a list of the primary equipment used for emergency response, the operator will keep this list current. The OCD will be notified within 5 days of any changes to the list provided in Table 4. Immediately after use, all equipment will be inspected, decontaminated, cleaned and made ready to be used again. If lost or damaged, equipment will be replaced immediately. The emergency coordinator will verify that equipment has been maintained after an emergency and will be readied for reuse if another emergency or incident occurs. Also See **Figure 2** for visual representation of locations of some of the items listed below.

Table 4. Emergency Response Equipment List

Equipment Description	Location	Quantity	Capability
10-lb ABC rated fire extinguisher	Administration building	2	2 minute duration, extinguish fires involving combustibles, flammable liquids, or electrical equipment
10-lb ABC rated fire extinguisher	Trucks	2	2 minute duration, extinguish fires involving combustibles, flammable liquids, or electrical equipment
10-lb ABC rated fire extinguisher	Heavy equipment	1	2 minute duration, extinguish fires involving combustibles, flammable liquids, or electrical equipment
20-lb ABC rated fire extinguisher	Diesel storage tank	1	4 minute duration, extinguish fires involving combustibles, flammable liquids, or electrical equipment
Windsocks	Administration building, drying pad, working face, facility entrance	4	Indicate wind direction
Pair leather gloves	Assigned to employee	1 per employee	Protect hands from cuts and abrasions
Pair safety glasses	Assigned to employee	1 per employee	Eye protection as per ANSI Z87.1
Personal H2S monitor	Assigned to employee	1 per employee	Alarm if H2S concentration >10ppm
Electronic 4 gas monitor	Administration building	1	Identify H2S, CO, O2, and LEL concentrations

pH check strips	Administration building	1 container	Identify corrosivity of materials, pH 0-14
Radiation survey meter	Administration building	1	Measure radioactivity up to 50 mR/hr min
First aid kit	Administration building	1	First aid supplies, support 10 persons minimum
First aid kit	Facility vehicles	1 per vehicle and moving equipment	First aid supplies, support 10 persons minimum
Eye wash station	Administration building	1	First aid, eye wash 1 incident
Portable 2-way radios	Assigned to employee	1 per employee	2 mile transmitting range
Office phone	Administration building	1	Communication with outside regulatory or emergency organizations
Absorbent Oil Booms	Administration building	4	32 gallon liquid capacity each
Round point shovels	Administration building	2	Earthmoving, ~1/4 cu. ft. per shovel
Water Truck	Facility	1	2000 gallons water
Loader	Facility	1	Earthmoving, 2 cu. yd. per load
Excavator	Facility	1	Earthmoving, 2 cu. ft. per load

3.4 Fire/Explosion Response

As required by **19.15.36.14A(3)**, the Facility shall be operated in a manner that does not pose a fire hazard to personnel or property. Personnel will receive training on fire safety and prevention before beginning work at the facility and on an annual basis thereafter. Incoming loads of waste and vehicles entering the site will be regularly inspected. Waste inspections will be pursuant to the Facility's Hazardous and Unauthorized Waste Exclusion Plan provided in

Attachment A of Appendix F of the Permit Application. **Table 4** includes a list of emergency response equipment at the Facility that is available in the event of an incident or emergency, including a physical description of each item and a brief outline of its capability.

In the event that a fire does occur, stockpiles of soil are readily accessible on the north side and near the working face of the Landfill. Portable fire extinguishers are kept in the landfill office, on the landfill operating equipment and one by the diesel storage tank. Personnel shall be trained in the use of these extinguishers and shall become familiar with their locations. The extinguishers shall be inspected annually and maintained in a ready condition. In the event a fire cannot be contained by onsite personnel, Emergency numbers are posted on the Landfill sign at the Facility entrance, and the Fire Department shall be contacted immediately.

After notifying the local Fire Department or the Lea County Emergency Management, the following procedures shall be followed as applicable:

- If any facility personnel responding to or witnessing a fire/explosion assesses the situation and deems it necessary to evacuate the facility, that person will immediately announce an evacuation via 2-way radio. The **Evacuation Plan in Section 3.12** will be followed. Evacuation will take place if at any time the fire is out of control (A fire shall be considered out of control any time it advances in size greater than 16 square feet or whenever the smoke concentration prevents visual inspection of the fire).
- The Emergency Coordinator will ensure that no oil field waste, which may be incompatible with the released material, is treated, stored or disposed of until cleanup procedures are complete by closing the facility gate to incoming disposal traffic and halting processing of materials on the drying pads.
- Cover the fire with soil;
- Use a fire extinguisher and/or water hose to combat fire; direct the discharge from the extinguisher at the base of the fire. Note: Never fight an electrical fire with water – use a Carbon Dioxide (CO_2) or dry chemical extinguisher;
- Employees will use the P.A.S.S. method for ABC-type fire extinguishers (Pull pin, Aim nozzle, Squeeze trigger, Sweep from side to side to extinguish).
- Secure all electrical power to the facility at the main breaker, and station a guard at the gate to keep the access road clear for emergency vehicles;
- Remain on guard over the affected area after the fire is extinguished until the fire fighters arrive. Monitor the site for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, and equipment;
- After fire has been extinguished, contact a third party contractor to remediate the fire area. If water was used to extinguish the fire, the area will be contained using absorbent booms or soil berms as necessary to stop the spread of the liquid and allow for spill/release assessment and remediation by the Emergency Coordinator and third party contractor.
- Any disposal of hazardous or unauthorized waste must take place in accordance with the procedures as designated
- The Emergency Coordinator will meet with personnel and any agencies involved to assess the cause of the incident and determine steps to take to prevent it from occurring again. Facility personnel will be informed of these resultant actions and, if needed, the Contingency Plan will be updated.
- The Emergency Coordinator will document the incident on an Incident Report Form

(**Attachment B**) and maintain a copy in the Facility Permanent Operating Record.

- Notifications to OCD will be made as per **Section 3.10**.

3.5 Spill/Release to Soil Response

The Facility shall be operated in a manner that does not pose a hazard to personnel, property or the environment. Personnel will receive training on spill & release prevention before beginning work at the facility and on an annual basis thereafter. Incoming loads of waste and vehicles entering the site will be inspected pursuant to the Facility's Hazardous and Unauthorized Waste Exclusion Plan provided in **Attachment A of Appendix F** of the Permit Application. Also, liquid by-products and contaminated water caused by precipitation percolating through the waste, or contaminated soil cover materials that run off during period of wet weather are potential release hazards. Table 4 includes a list of emergency response equipment at the Facility that is available in the event of an incident or emergency, including a physical description of each item and a brief outline of its capability. In the event that a spill/release to soil occurs, the following procedures will be followed as applicable:

- The spill/release will have been assessed as per **Table 3** above in regards to identification, corrosivity (pH), combustibility (LEL), regulated NORM & potential H2S.
- If any facility personnel responding to or witnessing a release assesses the situation and deems it necessary to evacuate the facility, that person will immediately announce an evacuation via 2-way radio. The **Evacuation Plan in Section 3.12** will be followed. Evacuation will take place if the spill/release covers an area greater than 16 sq. ft. and is identified as having high corrosivity (pH<2.0 or pH>12.5), high combustibility (LEL>10%), or high H2S (>10 ppm).
- The Emergency Coordinator will ensure that no oil field waste, which may be incompatible with the released material, is treated, stored or disposed of until cleanup procedures are complete by closing the facility gate to incoming disposal traffic and halting processing of materials on the drying pads.
- If it is safe to do so, the source of the release should be eliminated or stopped.
- Contact a third party contractor to remediate the spill. While waiting on third party contractor, and if safe to do so, place spill containment equipment such as absorbent oil booms or clean soil to stop the spread of the spill/release. Shovels and heavy equipment such as a loader or excavator can be used.
- Third party contractor will supply appropriate equipment and barriers to excavate the area of any liquids, sludge, and wet soils in such a way as to stop the spill from penetrating deeper into the soil or spreading to a further areal extent.
- If sampling is appropriate, third party contractor shall obtain samples and isolate contaminants in designated sealed glass jars.
- If the spill/release is a major or minor release, as defined in **Section 3.9**, the OCD will be notified by filling out Form C-141 (**Attachment B**) and following the steps described in

Section 3.10.

- A remediation plan will be developed by the Emergency Coordinator in consultation with management, the third party contractor, and with OCD if the spill/release is determined to be a major or minor release, taking into account the vulnerabilities and risks identified in **Table 3** above.
- Continue with the remediation plan and dispose of all liquids, contaminated soils and sludges as appropriate for the identified contaminant.
- Liquids and sludges will be mixed with dry soil until they pass a paint filter test prior to disposal.
- Ensure that any equipment is cleaned over the third party contractor supplied fluid impermeable containment and the cleaning fluids are mixed with dry soil so that it passes a paint filter test and is disposed of appropriately as well.
- The Emergency Coordinator will document the incident on an Incident Report Form (**Attachment C**) and maintain a copy in the Facility Permanent Operating Record.
- The Emergency Coordinator will meet with personnel and any agencies involved to assess the cause of the incident and determine steps to take to prevent it from occurring again. Facility personnel will be informed of these resultant actions and, if needed, the Contingency Plan will be updated.

3.6 Spill/Release to Surface Water Response

Note that there are no surface water features in the area of the Facility. The Facility shall be operated in a manner that does not pose a hazard to personnel, property or the environment. Personnel will receive training on spill & release prevention before beginning work at the facility and on an annual basis thereafter. Incoming loads of waste and vehicles entering the site will be inspected pursuant to the Facility's Hazardous and Unauthorized Waste Exclusion Plan provided in **Attachment A of Appendix F** of the Permit Application. Also, liquid by-products and contaminated water caused by precipitation percolating through the waste, or contaminated soil cover materials that run off during period of wet weather are potential release hazards. Table 4 includes a list of emergency response equipment at the Facility that is available in the event of an incident or emergency, including a physical description of each item and a brief outline of its capability. In the event that a spill/release to surface water occurs, the following procedures will be followed as applicable:

- The spill/release will have been assessed as per **Table 3** above in regards to identification, corrosivity (pH), combustibility (LEL), regulated NORM & potential H2S.
- If any facility personnel responding to or witnessing a release assesses the situation and deems it necessary to evacuate the facility, that person will immediately announce an evacuation via 2-way radio. The **Evacuation Plan in Section 3.12** will be followed. Evacuation will take place if the spill/release covers an area greater than 16 sq. ft. and is identified as having high corrosivity (pH<2.0 or pH>12.5), high combustibility (LEL>10%), or high H2S (>10 ppm).

- The Emergency Coordinator will ensure that no oil field waste, which may be incompatible with the released material, is treated, stored or disposed of until cleanup procedures are complete by closing the facility gate to incoming disposal traffic and halting processing of materials on the drying pads.

- If it is safe to do so, the source of the release should be eliminated or stopped.

- Contact a third party contractor to remediate the spill. While waiting on third party contractor, and if safe to do so, place spill containment equipment such as absorbent oil booms or clean soil to stop the spread of the spill/release. Shovels and heavy equipment such as a loader or excavator can be used.

- A spill/release to surface water is out of the scope of facility personnel to remediate. Contact a third-party contractor for emergency response.

- The third party contractor will obtain samples of the contaminant and isolate contaminants in designated sealed glass jars.
- If the spill/release is a major or minor release, as defined in **Section 3.9**, the OCD will be notified by filling out Form C-141 (**Attachment B**) and following the steps described in **Section 3.10**.
- A remediation plan will be developed by the Emergency Coordinator in consultation with management, the third party contractor, and with OCD if the spill/release is determined to be a major or minor release, taking into account the vulnerabilities and risks identified in **Table 3** above.
- Continue with the remediation plan and dispose of all liquids, contaminated soils and sludges as appropriate for the identified contaminant.
- Liquids and sludges will be mixed with dry soil until they pass a paint filter test prior to disposal.
- Ensure that any equipment is cleaned over the third party contractor supplier fluid impermeable containment and the cleaning fluids are mixed with dry soil so that it passes a paint filter test and is disposed of appropriately as well.
- The Emergency Coordinator will document the incident on an Incident Report Form (**Attachment C**) and maintain a copy in the Facility Permanent Operating Record.
- The Emergency Coordinator will meet with personnel and any agencies involved to assess the cause of the incident and determine steps to take to prevent it from occurring again. Facility personnel will be informed of these resultant actions and, if needed, the Contingency Plan will be updated.

3.7 Spill/Release to Groundwater Response

Refer to the Inspection and Maintenance Plan, Attachment B (Vadose Monitoring Plan). A spill/release to groundwater will be identified by the sampling and analysis procedures specified in the Vadose Monitoring Plan. In the event that a spill/release to groundwater occurs, the following procedures will be followed as applicable:

- The Emergency Coordinator will notify the NMOCD within 48 hours
- Verification re-sampling for the parameters listed in **Table 2** of the **Vadose Monitoring Plan** will be conducted within 2 weeks.
- If the secondary sampling analytical results indicate that a statistically significant increase and potential SWMF release may have occurred, within 90 days of the finding, leachate samples from each active Landfill sump will be collected and analyzed for the parameters listed in **Table 2** of the **Vadose Monitoring Plan** for comparative evaluation with the re-sampling results.
- The Emergency Coordinator will work with OCD to devise an appropriate scope of work for assessing water quality changes.
- If the evaluation indicates that the well may contain SWMF derived liquids, the SWMF will submit an Action Plan to OCD detailing the course of action to investigate further the potential release and/or complete any mitigation measures as appropriate, to the OCD within 30 days.
- If the comparative evaluation indicates that no SWMF derived impacts have occurred, the monitoring data will be maintained as part of the Permanent Operating Record and submitted with annual vadose zone monitoring data for the facility.

3.8 Release to Air Response

Refer to Attachment D, Hydrogen Sulfide Contingency Plan for H2S specific releases to air. In the event that a release to air of another gaseous contaminant occurs, the following procedures will be followed as applicable:

- If any facility personnel responding to or witnessing a release to air assesses the situation and deems it necessary to evacuate the facility, that person will immediately announce an evacuation via 2-way radio. The **Evacuation Plan in Section 3.12** will be followed. Evacuation will take place if the spill/release covers an area greater than 16 sq. ft. or is drifting due to wind, and is identified as **potentially** having high corrosivity (pH<2.0 or pH>12.5), high combustibility (LEL>10%), or high H2S (>10 ppm).
- The Emergency Coordinator will ensure that no oil field waste, which may be incompatible with the released material, is treated, stored or disposed of until cleanup

procedures are complete by closing the facility gate to incoming disposal traffic and halting processing of materials on the drying pads.

- Contact a third party contractor to assist with assessment of the spill/release as per **Table 3** above in regards to identification, corrosivity (pH), combustibility (LEL), regulated NORM, & potential H2S. Facility personnel will not approach the release, as operations with SCBA (Self-Contained-Breathing-Apparatus) are beyond the capabilities of the facility equipment and personnel.
- If it is safe to do so, the source of the release should be eliminated or stopped.
- If the release is unable to be stopped safely, do not reenter the area of the release, as additional operations are beyond the capabilities of the facility equipment and personnel. Facility personnel will cooperate with and assist the emergency authorities notified in **Table 3** above.
- If the spill/release is a major or minor release, as defined in **Section 3.9**, the OCD will be notified by filling out Form C-141 (**Attachment B**) and following the steps described in **Section 3.10**.
- A remediation plan will be developed by the Emergency Coordinator in consultation with management and the OCD if the spill/release is determined to be a major or minor release, taking into account the vulnerabilities and risks identified in **Table 3** above.
- The Emergency Coordinator will document the incident on an Incident Report Form (**Attachment C**) and maintain a copy in the Facility Permanent Operating Record.
- The Emergency Coordinator will meet with personnel and any agencies involved to assess the cause of the incident and determine steps to take to prevent it from occurring again. Facility personnel will be informed of these resultant actions and, if needed, the Contingency Plan will be updated.

3.9 Spill/Release Definitions

According to **NMAC 19.15.29.7**, a **major release** means:

(1) An unauthorized release of a volume, excluding gases, of 25 barrels or more;

(2) An unauthorized release of a volume that:
  (a) Results in a fire or is the result of a fire
  (b) May with reasonable probability reach a watercourse
  (c) May with reasonable probability endanger public health; or
  (d) Substantially damages property or the environment

(3) An unauthorized release of gases exceeding 500 MCF; or

(4) A release of a volume that may with reasonable probability be detrimental to fresh water or exceed the standards in **NMAC 19.15.30.9** subsections A, B, or C.

A **minor release** means an unauthorized release, which is not a major release and is a volume greater than five barrels but less than 25 barrels; or for gases, greater than 50 MCF but less than 500 MCF.

3.10 Spill/Release Notification Requirements

The emergency coordinator must notify the OCD of a major or minor release occurring during the drilling, producing, storing, disposing, injecting, transporting, servicing or processing of oil, gases, produced water, condensate or oil field waste including regulated NORM, or other oil field related chemicals, contaminants or mixture of the chemicals or contaminants, by filling out Form C-141 (see **Attachment B**), in accordance with the requirements of **19.15.29 NMAC**.

According to **19.15.29.10 NMAC**, for reporting a **major release**, the responsible party must notify the OCD's environmental bureau chief and the NMOCD District 1 office verbally or by email within 24 hours of discovery of the release. The notification must provide the information required on Form C-141, including the following:

- Provide the NMOCD with a description of the nature and cause of noncompliance;
- Inform the NMOCD of the period of noncompliance, including exact dates and times and/or the anticipated time when the Facility will return to compliance;
- Notify the NMOCD of steps taken or to be taken to reduce, eliminate, and prevent recurrences of the noncompliance; and
- Take the first three actions listed above within 24 hours in the case of any noncompliance that could constitute a threat to human health, welfare or the environment.

The NMOCD District 1 office must also be notified in writing within 15 days of discovering the release by completing and filing Form C-141. The written notification must verify the prior verbal or email notification and include any additions or corrections to the information contained in the prior verbal or email notification.

For reporting a **minor release**, the responsible party must notify the appropriate division district office in writing within 15 days of discovery of the release by completing and filing Form C-141.

3.11 Spill/Release Corrective Action

The Facility shall comply with any corrective action deemed necessary by the OCD for spills/ releases that endanger public health or the environment, remediate the spill/release in accordance with the approved remediation plan, and submit a final closure report to OCD within 90 days of discovery of the spill/release as required by **19.15.29.12 NMAC**. If the spill/release has caused water pollution in excess of the standards and requirements of **19.15.30 NMAC**, the facility will remediate the spill/release in accordance with the approved abatement as per **19.15.30.11 NMAC** and submit a final closure report to OCD within 90 days of discovery of the spill/release.

3.12 Evacuation Plan

When an incident or emergency constitutes an evacuation of the site, the following plan shall be followed:

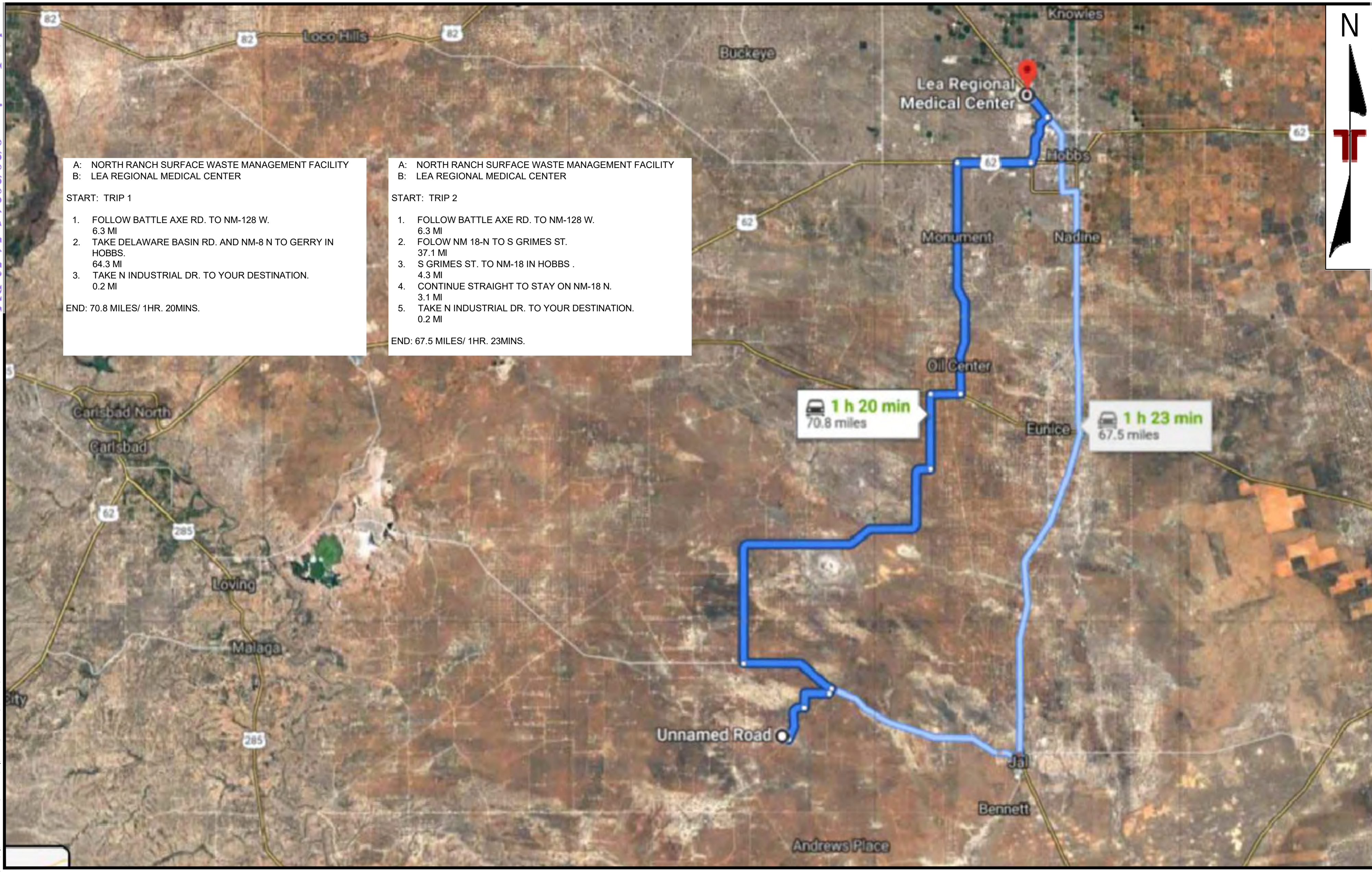
- The evacuation notice will immediately be communicated to all facility personnel by 2-way radios.
- The facility has two assembly areas in case of an evacuation, the main gate and the secondary emergency evacuation gate (see Figure 2). Facility personnel will check the windsocks for wind direction and assemble at the most upwind assembly area.
- Facility personnel will immediately communicate the evacuation notice to any non-facility visitors, drivers, or other persons in their work area.
- All traffic, incoming waste loads, and other vehicles will be diverted from the area where the emergency is taking place by facility personnel in their work area and directed towards the most upwind assembly area.
- The Emergency Coordinator will ensure that the facility gate is closed to incoming disposal traffic.
- The facility operator manning the front desk of the administrative building will keep the facility sign-in sheet and any in-process load manifests on their person and will be responsible for accounting for all persons on the site. A 2-way radio will be used to coordinate the headcount in the case that there are persons assembled at both of the assembly locations. Once assembled and accounted for, facility personnel will assist the emergency coordinator in securing the site or evacuate to a further distance away.
- Personnel may only return to the facility once the emergency coordinator has indicated via 2-way radio that it is safe to do so.

3.13 Hazardous and Unauthorized Waste

In accordance with **19.15.36.13.F** the North Ranch Landfill must implement a program to detect and prevent the disposal of regulated hazardous wastes, regulated NORM, and additional unauthorized wastes. The Facility has developed a site- specific Hazardous and Unauthorized Waste Exclusion Plan (HUWEP) for the Landfill in accordance with the requirements of the NMAC. A copy of the Facility HUWEP is included as **Attachment B** to this Contingency Plan.

3.14 Contingency Plan Amendments

The Contingency Plan will be amended within five (5) working days if the Facility permit is revised or modified, the plan fails in the event of an emergency, or the list of emergency equipment changes. Additionally, if the design, construction operation, maintenance, or other characteristics of the Facility changes in a way that increases the potential for fires, explosions, or releases of oilfield waste constituents that could pose a threat to safety, public health, fresh water, and the environment or alter the response necessary in an emergency, the Contingency Plan will be amended accordingly. The emergency coordinator can revise this plan as necessary to address an emergency. Any change in the emergency coordinators or their contact information will necessitate an update to the Contingency Plan immediately. The Facility will provide the OCD's environmental bureau and local emergency response agencies with a copy of any amendments to the Contingency Plan promptly.



A: NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
B: LEA REGIONAL MEDICAL CENTER

START: TRIP 1

1. FOLLOW BATTLE AXE RD. TO NM-128 W.
   6.3 MI
2. TAKE DELAWARE BASIN RD. AND NM-8 N TO GERRY IN HOBBS.
   64.3 MI
3. TAKE N INDUSTRIAL DR. TO YOUR DESTINATION.
   0.2 MI

END: 70.8 MILES/ 1HR. 20MINS.

A: NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
B: LEA REGIONAL MEDICAL CENTER

START: TRIP 2

1. FOLLOW BATTLE AXE RD. TO NM-128 W.
   6.3 MI
2. FOLOW NM 18-N TO S GRIMES ST.
   37.1 MI
3. S GRIMES ST. TO NM-18 IN HOBBS .
   4.3 MI
4. CONTINUE STRAIGHT TO STAY ON NM-18 N.
   3.1 MI
5. TAKE N INDUSTRIAL DR. TO YOUR DESTINATION.
   0.2 MI

END: 67.5 MILES/ 1HR. 23MINS.

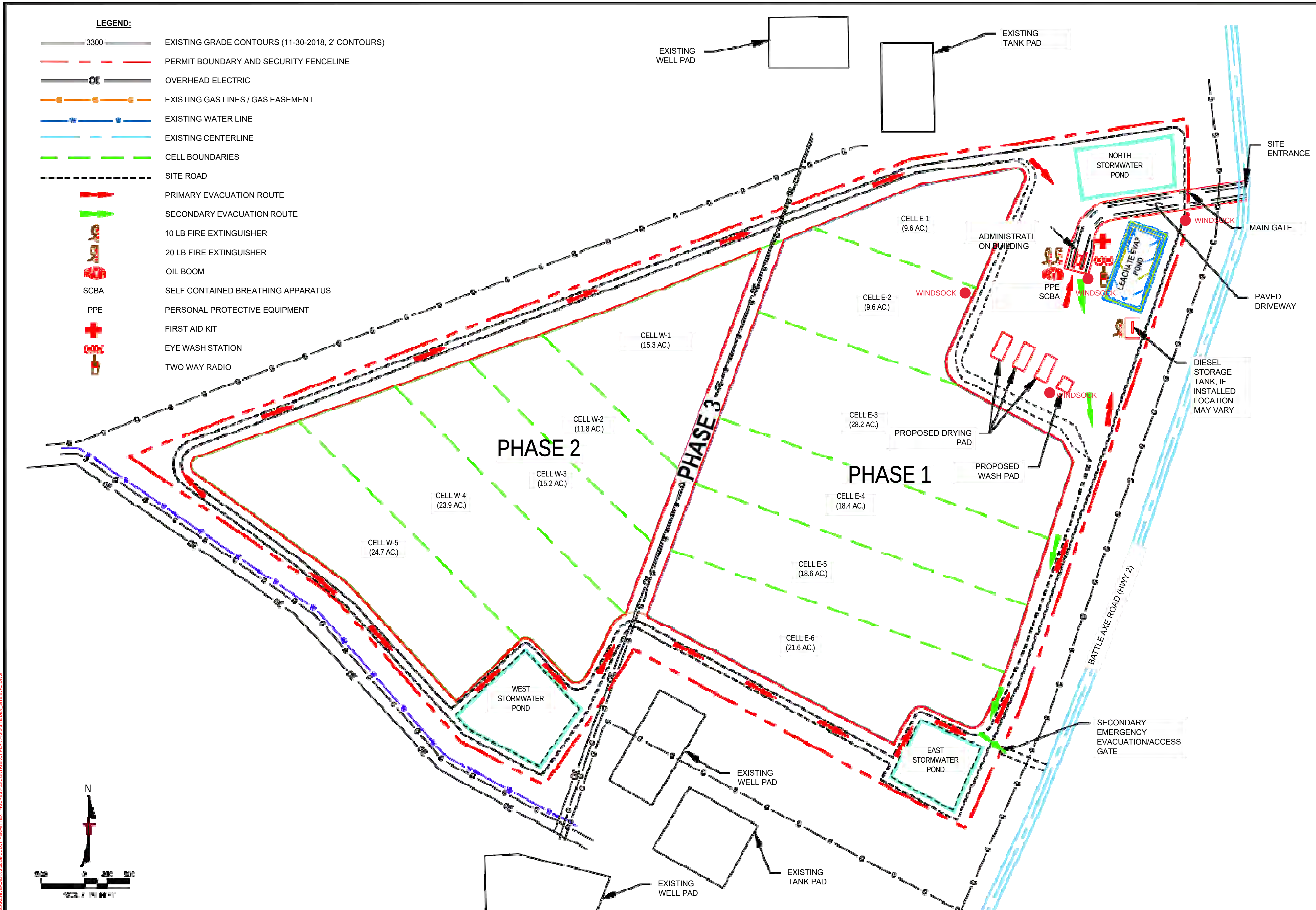
REV.	DATE	BY	DESCRIPTION

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

HOSPITAL LOCATION MAP
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. 1

DESIGNED BY:	DEW
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	AS SHOWN
DATE:	APRIL 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	1 OF 2



REV.	DATE	BY	DESCRIPTION

SITE EVACUATION PLAN

PERMIT APPLICATION FIGURE

SURFACE WASTE MANAGEMENT FACILITY

NORTH RANCH

LEA COUNTY — NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH — BRYANT, AR 72022
PH. (501) 847-9292 — FAX. (501) 847-9210

FIGURE 2

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	APRIL 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	1 OF 2

ATTACHMENT A

Copy of Hazardous and Unauthorized Waste Exclusion Plan (HUWEP)

Contingency Procedures

8.0 HUWEP CONTINGENCY PROCEDURES

This Contingency procedure is intended to protect the safety and welfare of the employees, Facility, and community in the event that a hazardous or unauthorized waste has been accepted for disposal in the landfill. This Contingency procedure is also intended to satisfy the requirements of **19.15.36** and describes the procedures for excluding the receipt of non-exempt hazardous waste and unauthorized waste. This Plan is developed to include, at a minimum, notification procedures and remedial actions to be taken when non-exempt hazardous waste and other unauthorized wastes are identified at the Facility. The Contingency procedure should be used by employees at the landfill as a guide for emergency and remedial procedures in the event a non-exempt hazardous or unauthorized waste has been accepted by the Facility. This plan is initiated by identification of hazardous or unauthorized waste, and includes the following:

- Internal notification process and notification to appropriate state and federal agencies;
- Assessment of the nature and extent of the incident;
- Control of the hazardous or unauthorized waste; and
- Reporting.

8.1 Internal Notification Process and Notification to Appropriate State and Federal Agencies

In the event of an incident involving hazardous or unauthorized wastes at the Facility, the employee first identifying the incident will contact the landfill manager regarding the incident. The landfill manager shall determine if it is necessary to halt operations at the Facility. The landfill manager shall then notify all landfill personnel of the incident and continue to follow the steps outline in this Contingency procedure.

The first priority of the landfill manager should be the safety of the employees at the Facility, and he/she therefore should begin mitigating the incident immediately. However, within 72 hours the manager shall contact the OCD of the acceptance of the hazardous or unauthorized waste. The landfill manager shall provide the OCD with all available information concerning the generator, type of waste, amount of waste, dates of disposal and reason for concern or reclassification of the waste. If the hazardous waste is determined to regulated NORM the manager shall also notify the NMED Radiation Control Bureau

8.2 Assessment of the Nature and Extent of the Incident

Once the applicable notifications have been made, the landfill manager will locate and determine the identity, exact source and amount of non-exempt hazardous or other unauthorized waste that was accepted into the landfill. The manager will then be able to determine if the acceptance of the hazardous or other unauthorized waste constitutes an emergency based on the gathered information. After the waste has been identified, the specific information on the associated hazards, appropriate PPE, decontamination, etc. will be obtained from the associated material safety data sheet (MSDS), the waste generator, or from appropriate reference materials. The assessment of the incident should include, at a minimum, the following:

- Exposure – The magnitude of actual or potential exposure to employees, the general public, and the environment. The duration and pathways of exposure should also be evaluated.
- Toxicity – The types of adverse health or environmental effects associated with exposure to the material.
- Reactivity – The degree to which the material is reactive with other materials.
- Uncertainties -Considerations for undeterminable or future exposures. Uncertain or unknown health effects, including future health effects.

8.3 Control of the Hazardous or Unauthorized Waste

After the applicable notifications have been made, and the landfill manager has assessed the nature and extent of the incident, the landfill manager should verify if the waste has been disposed of in the landfill. Different procedures should be followed depending on if the waste has been disposed of in the landfill, or if the waste has been accepted through the gate but not disposed. It should be noted that, if necessary, the Facility shall immediately suspend receipt of further shipment(s) of the non-authorized waste from the generator until the procedures of this section have been fulfilled.

If that waste has not been disposed of in the landfill, the waste should be stockpiled in a place that will reduce the potential for harm to employees, the general public, or the environment, preferably contained on the original hauler vehicle. As soon as practical, the waste shall be returned to the waste hauler or waste generator according to the materials safe handling procedures. Note that the hazardous waste must be hauled away by hauling company with an EPA transporter ID number and must comply with with EPA's Hazardous Waste Manifest System. The generator or hauler shall then take responsibility for the waste.

If the waste has been disposed of in the landfill, the landfill manager shall determine if the waste poses a risk to the health and safety of the employees or the general public. If the waste does not pose a potential risk, and with the approval of the OCD and EPA if hazardous waste and/or the NMED Radiation Control Bureau if regulated NORM, the waste shall remain in the landfill and records of the event will be maintained in the Facility operating record. Monitoring of constituents of concern, evaluation of potential receptors and pathways, and/or reclassification of the waste stream may result from this interactive process with the OCD. If the waste does pose a potential risk, the waste shall be removed from the landfill according to the following waste rejection and removal procedures.

The waste material will be removed by personnel specifically trained in projects of this nature. A Remedial Services Contractor (RSC) will perform the removal activities with assistance from properly trained Facility personnel. The Operator and RSC will work/consult with OCD, EPA, and in the event of regulated NORM, the NMED Radiaton Control Bureau to ensure that the approved hazardous waste hauling company has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System. Every effort and control necessary to minimize or eliminate the escape of leachate or waste to the ground, surface waters or the atmosphere shall be utilized. The RSC will document the waste removal activities and prepare a project summary report for documentation of all stages of removal. The following outlines the RSC operational and technical approach which may be necessary to perform remedial activities associated with the removal of waste stream.

- Mobilization;
- Site Preparation;
- Excavation of Overburden;
- Excavation and Staging of Waste;
- Excavation and Loading of Unauthorized Waste Material;
- Transportation and Disposal of Unauthorized Waste Material;
- Stormwater Control;
- Site Restoration;
- Decontamination of Equipment; and
- Demobilization.

A project health and safety plan shall be prepared by the RSC which will establish health and safety protocols for the project in strict accordance with OSHA, USEPA, NMOCD and/or NMED regulatory requirements. The health and safety plan will, at a minimum, address the following items:

- Preliminary investigation of the site to identify proper health and safety issues;
- Explosive or hazardous gases and other landfill specific hazards assessment;
- Training program for RSC personnel presented prior to allowing these individuals to enter the project site;
- Establish work zones for the project site. Individual areas within the zones will be delineated based on project activities which may require different levels of personal protection;
- Levels of personal protection required based upon a determination regarding the applicability of OSHA Levels A, B, C, or D protection with specified personal protective equipment being provided; and
- Emergency response procedures will be established prior to initiation of any RSC on-site operations.

A review of Facility records will indicate the dates and amounts of the waste material to be removed and rejected. Prior to initiation of excavation activities, the RSC will erect marked temporary barriers around the designated work zones to exclude vehicular and pedestrian traffic from those zones to areas during and after work hours. The overburden, if necessary, will be removed from those areas targeted for removal utilizing an excavator. If required, additional equipment will be used which provide the excavation capabilities required by the project.

The overburden will be used as required to construct temporary staging areas adjacent to the proposed removal locations. The overburden material will be separated from waste material designated for removal during the excavation process. Once the disposal locations have been uncovered, and the material identified, the material will be excavated and loaded directly into transport vehicles for off-site disposal at an approved facility. Note that an approved hazardous waste hauling company that has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System must be used and that the waste must be delivered to an approved hazardous waste disposal facility. Loading of the material will be conducted such that decontamination of the transport vehicle will not be required prior to departure from the Facility. Polyethylene sheeting will be place adjacent to the trucks to contain potential spillage during the loading process. Waste material spilled during the loading process will be collected and placed into the trucks. All trucks will be loaded to ensure the Department of Transportation (DOT) weight requirements have been met and maximum payloads have been achieved for each vehicle and for manifesting purposes.

It is anticipated the excavation equipment to be utilized will allow for the removal of the waste material from locations outside the excavation area. As a result, only the backhoe bucket and portion of the boom will come into contact with the material to be removed. All excavation activities shall be completed in accordance with OSHA trenching requirements, 29 CFR Part 1926.

If cleaning is required during excavation operations, the cleaning will take place directly over a designated decontamination area with fluid handling accommodations such that all contaminated fluids will be captured. The fluid will then be mixed with dry material until it passes the paint filter test. The mixed dry unauthorized waste would then be loaded into trucks for transport to an approved facility. Note that an approved hazardous waste hauling company that has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System must be used and that the waste must be delivered to an approved hazardous waste disposal facility. Prior to trucks leaving the Facility, they will be visually inspected for potential contact with the excavated material outside the truck's box. Decontamination of any affected portions of the truck will be performed by dry methods (i.e. scrapping, brushing) and/or steam cleaning as necessary. Documentation shall be made of the visual inspections and decontamination process if applicable. These inspections will be included in the project summary report.

A weatherproof tarp shall be provided and secured over each shipment leaving the site. All shipments will comply with applicable regulatory and DOT requirements of the waste material removed. Vehicles used for the transportation of waste material removed from the Facility will be licensed, as required, and will be plainly marked and placarded as specified by the USEPA, NMED and DOT regulatory requirements. Note that an approved hazardous waste hauling company that has an EPA transporter ID number and complies with EPA's Hazardous Waste Manifest System must be used and that the waste must be delivered to an approved hazardous waste disposal facility.

The Generator of the rejected waste, or its designee, will be responsible for completing manifests for all shipments transported off-site. If the original generator cannot be located, the Operator will assume the responsibility of generator.

Once all waste removal activities have been completed and all required inspections performed, the excavation area will then be backfilled with refuse removed in the process as overburden. If necessary, additional waste accepted during normal Facility operations will be placed in the excavated area to achieve working grades up to permitted final grades. Intermediate cover material will be replaced, if previously present, and regraded according to the Facility permit requirements. Because unauthorized waste material in question will have been removed, there is no need for any maintenance procedures in addition to the Facility's existing landfill site maintenance.

8.4 Reporting

Every stage of the process, after identifying that a non-exempt hazardous or unauthorized waste was accepted at the landfill shall be documented and kept on-site in the Facility's operating record or electronic operating record.

If, after the non-exempt hazardous or unauthorized waste was disposed of in the landfill, each of the various stages of the rejection and removal process will be recorded for documentation purposes and placed into a project summary report. Documentation may include photographs, certified survey drawings/records, field reports of excavation procedures, Health and Safety Plan, manifests and waste disposal tickets. Once completed the project summary report will be placed in the Facility files for a permanent record of the waste rejection and removal activity. A copy will be provided to the waste material generator for their records and files.

At completion of the rejection and removal activities, as outlined above, the Facility will submit to the NMOCD a certification that the waste material has been removed in accordance with this Contingency procedure. If the waste material was disposed of in the landfill, the certification will be signed by the Facility Operator.

ATTACHMENT B

FORM C-141

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources Department

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-141
Revised August 24, 2018
Submit to appropriate OCD District office

Incident ID	
District RP	
Facility ID	
Application ID	

Release Notification

Responsible Party

Responsible Party	OGRID
Contact Name	Contact Telephone
Contact email	Incident # *(assigned by OCD)*
Contact mailing address	

Location of Release Source

Latitude ______________________ Longitude ______________________
(NAD 83 in decimal degrees to 5 decimal places)

Site Name	Site Type
Date Release Discovered	API# *(if applicable)*

Unit Letter	Section	Township	Range	County

Surface Owner: ☐ State ☐ Federal ☐ Tribal ☐ Private (*Name:* ______________________)

Nature and Volume of Release

Material(s) Released (Select all that apply and attach calculations or specific justification for the volumes provided below)

☐ Crude Oil	Volume Released (bbls)	Volume Recovered (bbls)
☐ Produced Water	Volume Released (bbls)	Volume Recovered (bbls)
	Is the concentration of dissolved chloride in the produced water >10,000 mg/l?	☐ Yes ☐ No
☐ Condensate	Volume Released (bbls)	Volume Recovered (bbls)
☐ Natural Gas	Volume Released (Mcf)	Volume Recovered (Mcf)
☐ Other (describe)	Volume/Weight Released (provide units)	Volume/Weight Recovered (provide units)
Cause of Release		

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Was this a major release as defined by 19.15.29.7(A) NMAC? ☐ Yes ☐ No	If YES, for what reason(s) does the responsible party consider this a major release?
If YES, was immediate notice given to the OCD? By whom? To whom? When and by what means (phone, email, etc)?	

Initial Response

The responsible party must undertake the following actions immediately unless they could create a safety hazard that would result in injury

☐ The source of the release has been stopped.

☐ The impacted area has been secured to protect human health and the environment.

☐ Released materials have been contained via the use of berms or dikes, absorbent pads, or other containment devices.

☐ All free liquids and recoverable materials have been removed and managed appropriately.

If all the actions described above have not been undertaken, explain why:

Per 19.15.29.8 B. (4) NMAC the responsible party may commence remediation immediately after discovery of a release. If remediation has begun, please attach a narrative of actions to date. If remedial efforts have been successfully completed or if the release occurred within a lined containment area (see 19.15.29.11(A)(5)(a) NMAC), please attach all information needed for closure evaluation.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ____ Title: ____

Signature: ____ Date: _____________

email: ____ Telephone: ______________________________

OCD Only

Received by: ____ Date: _______________

Form C-141
Page 3

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Site Assessment/Characterization

This information must be provided to the appropriate district office no later than 90 days after the release discovery date.

What is the shallowest depth to groundwater beneath the area affected by the release?	_________ (ft bgs)
Did this release impact groundwater or surface water?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a continuously flowing watercourse or any other significant watercourse?	☐ Yes ☐ No
Are the lateral extents of the release within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark)?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of an occupied permanent residence, school, hospital, institution, or church?	☐ Yes ☐ No
Are the lateral extents of the release within 500 horizontal feet of a spring or a private domestic fresh water well used by less than five households for domestic or stock watering purposes?	☐ Yes ☐ No
Are the lateral extents of the release within 1000 feet of any other fresh water well or spring?	☐ Yes ☐ No
Are the lateral extents of the release within incorporated municipal boundaries or within a defined municipal fresh water well field?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a wetland?	☐ Yes ☐ No
Are the lateral extents of the release overlying a subsurface mine?	☐ Yes ☐ No
Are the lateral extents of the release overlying an unstable area such as karst geology?	☐ Yes ☐ No
Are the lateral extents of the release within a 100-year floodplain?	☐ Yes ☐ No
Did the release impact areas **not** on an exploration, development, production, or storage site?	☐ Yes ☐ No

Attach a comprehensive report (electronic submittals in .pdf format are preferred) demonstrating the lateral and vertical extents of soil contamination associated with the release have been determined. Refer to 19.15.29.11 NMAC for specifics.

Characterization Report Checklist: ***Each of the following items must be included in the report.***

- ☐ Scaled site map showing impacted area, surface features, subsurface features, delineation points, and monitoring wells.
- ☐ Field data
- ☐ Data table of soil contaminant concentration data
- ☐ Depth to water determination
- ☐ Determination of water sources and significant watercourses within ½-mile of the lateral extents of the release
- ☐ Boring or excavation logs
- ☐ Photographs including date and GIS information
- ☐ Topographic/Aerial maps
- ☐ Laboratory data including chain of custody

If the site characterization report does not include completed efforts at remediation of the release, the report must include a proposed remediation plan. That plan must include the estimated volume of material to be remediated, the proposed remediation technique, proposed sampling plan and methods, anticipated timelines for beginning and completing the remediation. The closure criteria for a release are contained in Table 1 of 19.15.29.12 NMAC, however, use of the table is modified by site- and release-specific parameters.

Form C-141

Page 4

State of New Mexico
Oil Conservation Division

Incident ID	
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Facility ID	
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I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ______________________________ Title: ______________________________

Signature:______________________________ Date: ______________

email: ______________________________ Telephone: ______________________________

OCD Only

Received by: ______________________________ Date: ______________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Remediation Plan

Remediation Plan Checklist: ***Each of the following items must be included in the plan.***

☐ Detailed description of proposed remediation technique
☐ Scaled sitemap with GPS coordinates showing delineation points
☐ Estimated volume of material to be remediated
☐ Closure criteria is to Table 1 specifications subject to 19.15.29.12(C)(4) NMAC
☐ Proposed schedule for remediation (note if remediation plan timeline is more than 90 days OCD approval is required)

Deferral Requests Only: ***Each of the following items must be confirmed as part of any request for deferral of remediation.***

☐ Contamination must be in areas immediately under or around production equipment where remediation could cause a major facility deconstruction.

☐ Extents of contamination must be fully delineated.

☐ Contamination does not cause an imminent risk to human health, the environment, or groundwater.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ____ Title: ____

Signature: ____ Date: _____________

email: ____ Telephone: _________________________________

OCD Only

Received by: ____ Date: _________________

☐ Approved ☐ Approved with Attached Conditions of Approval ☐ Denied ☐ Deferral Approved

Signature: ____ Date: _______________________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Closure

The responsible party must attach information demonstrating they have complied with all applicable closure requirements and any conditions or directives of the OCD. This demonstration should be in the form of a comprehensive report (electronic submittals in .pdf format are preferred) including a scaled site map, sampling diagrams, relevant field notes, photographs of any excavation prior to backfilling, laboratory data including chain of custody documents of final sampling, and a narrative of the remedial activities. Refer to 19.15.29.12 NMAC.

Closure Report Attachment Checklist: ***Each of the following items must be included in the closure report.***

☐ A scaled site and sampling diagram as described in 19.15.29.11 NMAC

☐ Photographs of the remediated site prior to backfill or photos of the liner integrity if applicable (Note: appropriate OCD District office must be notified 2 days prior to liner inspection)

☐ Laboratory analyses of final sampling (Note: appropriate ODC District office must be notified 2 days prior to final sampling)

☐ Description of remediation activities

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations. The responsible party acknowledges they must substantially restore, reclaim, and re-vegetate the impacted surface area to the conditions that existed prior to the release or their final land use in accordance with 19.15.29.13 NMAC including notification to the OCD when reclamation and re-vegetation are complete.

Printed Name: ______________________________ Title: ______________________________

Signature: ______________________________ Date: ________________

email: ___________________________ Telephone: ______________________

OCD Only

Received by: ______________________________ Date: ____________

Closure approval by the OCD does not relieve the responsible party of liability should their operations have failed to adequately investigate and remediate contamination that poses a threat to groundwater, surface water, human health, or the environment nor does not relieve the responsible party of compliance with any other federal, state, or local laws and/or regulations.

Closure Approved by: ______________________________ Date: ____________

Printed Name: ______________________________ Title: ______________________________

ATTACHMENT C

INCIDENT REPORT FORM

North Ranch Surface Waste Management Facility
Incident Report Form

Type of Incident and General Information			
[ ]	Work Related Injury/Illness	[ ]	Unsafe Act/Near Miss
[ ]	Property Damage	[ ]	Vandalism/Criminal Activity
[ ]	Vehicular Accident	[ ]	Other ____________________ (i.e. spill, release, fire, explosion, hot load, etc.)

Employee Name: ______________________Job Title: ______________________

Phone No.: __________________Date of Incident: __________Time of Incident: ______AM/PM

Location of Incident: ____________________________________Weather: __________________

Date and Time Reported to Management: Date: __________________Time: _________AM/PM

Reported to: ___________________Title: _____________Reported by: ____________________

Injury Category of Incident when first reported?	
[ ]	N/A Employee was not injured
[ ]	Notice of injury only, medical treatment declined at this time
[ ]	First aid performed onsite, medical treatment declined at this time
[ ]	Medical Treatment - transported by ____________________to ____________________
[ ]	Employee Fatality

(Section below to be filled out by employee)

Employee's Description of Incident		
Were you injured?	[ ] yes	[ ] no
Type of injury?		
Area of body?		
In your own words, explain the incident:		

Employee Signature: ____Date: _______________

ATTACHMENT D

HYDROGEN SULFIDE CONTINGENCY PLAN

Hydrogen Sulfide Prevention and Contingency Plan

North Ranch Surface Waste Management Facility
Lea County, New Mexico
September 2019
Project No. 35187378

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

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1.0 INTRODUCTION

New Mexico Administrative Code (NMAC) **19.15.36.8.C(8)** requires that owners and operators of surface waste management facilities maintain a written Hydrogen Sulfide (H_2S Prevention and Contingency Plan that complies with **19.15.11 NMAC**. This Facility will not be accepting, treating, or managing process water, thus major health and safety concerns regarding H_2S are not anticipated. As discussed herein, the Facility will be routinely monitoring for H_sS of incoming wastes and at various locations throughout the Facility for concentrations exceeding 1 part per million. Regardless, the Facility will maintain this document, which comprises the Hydrogen Sulfide Prevention and Contingency Plan for the proposed NGL North Ranch Surface Waste Management Facility. It is intended to provide a systematic approach to emergency response in the event of a release or detection of hydrogen sulfide (H_2S) and is designed to complement existing laws, regulations, rules, standards, policies, and procedures pertaining to safety standards, fire prevention, and pollution prevention rules.

1.1 General Facility Information

The proposed facility is an Oil Exploration and Production Waste Landfill and is located west of Jal, New Mexico. The site can be accessed by traveling approximately 14 miles on New Mexico State Road 128 West, then turning southwest onto Battle Axe Rd. The landfill entrance is located approximately 5 miles down Battle Axe Rd, traveling southwest. More specifically, the site is in Township 25 South, Range 34 East, Sections 9 and 10. The site consists of approximately 303-acres with a Landfill footprint of approximately 205-acres. See site location map provided as **Figure 1.**

1.2 Hydrogen Sulfide Characteristics

Hydrogen sulfide (H_2S) is a colorless, extremely toxic, flammable gas that can be encountered in the production of crude oil and associated gas and waters. It is slightly heavier than air and can collect in low places. Sometimes a rotten-egg odor can indicate the presence of H_2S; however, smell cannot be relied upon to detect dangerous concentrations of the gas because exposure to high concentrations of the gas paralyzes the olfactory nerve and the sense of smell. Therefore, odor cannot be expected to alert persons to the presence of dangerously high concentrations of H_2S. Exposure to the gas can poison the respiratory system and cause death. See exposure symptoms & effects in table below (from OSHA.gov):

Concentration (ppm)	Symptoms/Effects
0.00011-0.00033	Typical background concentrations
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor described as sweet or sickeningly sweet.
2-5	Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep. Airway problems (bronchial constriction) in some asthma patients.
20	Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness.
50-100	Slight conjunctivitis ("gas eye") and respiratory tract irritation after 1 hour. May cause digestive upset and loss of appetite.
100	Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death

Note that when burned, H2S and Oxygen combine to form sulfur dioxide (SO2) a colorless gas with a characteristic, irritating, pungent odor. Exposure to sulfur dioxide may cause irritation to the eyes, nose, and throat. Symptoms include: nasal mucus, choking, cough, and bronchial constriction. In the event that H_2S must be flared off, personnel must stay upwind and out of the area to avoid injury.

The following sections describe measures that will be taken at the facility to ensure the safety of employees, visitors, nearby landowners, and the public. The facility will implement a H_2S monitoring program. Facility employees will participate in H_2S training on an annual basis or if any changes are made to the plan. Also, new employees will be trained in H_2S safety before beginning work at the facility. An Immediate Action Plan is included that contains instructions to be followed in the event a potentially hazardous concentration of H_2S is detected. Facility officials will coordinate with local agencies regarding notification, emergency response procedures and evacuation. See **Figure 3 for an evacuation routing map.**

2.0 RELEVANT TELEPHONE NUMBERS

A list of important phone numbers shall be posted and updated regularly. **TABLE 1** lists the designated site primary emergency contacts and other important contacts. **TABLE 2** lists local, state, and federal emergency contacts not included on **TABLE 1.**

Table 1. Emergency Contacts

Position	Name	Office Phone	Address
North Ranch SWMF - Facility Manager (Primary Emergency Contact)	Darren Warren	575-263-6959	476 Battle Axe Rd Jal, NM 88252 darrenw@r360es.com
North Ranch Landfill – Facility Operator (Alternate Emergency Contact)	Eric Duran	575-361-8037	476 Battle Axe Rd Jal, NM 88252 Eric.duran@wasteconnections.com
Lea Regional Medical Center		911 or 575-492-5000	

In the event an individual need to be taken to the hospital, an ambulance can be called, or the person may be taken to the following location:

Lea Regional Medical Center
5419 N Lovington Hwy
Hobbs, New Mexico 88240

A map depicting the location of the Hospital in relation to the site is shown on **FIGURE 2**. The Lea Regional Medical Center is located approximately 74 miles northeast of the Landfill Facility.

Table 2. Emergency Telephone Numbers

Organization	Phone Number
All Emergencies	911
Fire **Jal Fire Department**	911 or 575-395-2221
Police Jal Police Department	911 or 575-395-2501
Lea County Sheriff's Department Sheriff - Corey Helton	911 or 575- 396-3611
New Mexico State Police (Hobbs District Office)	911 or 575-392-5580
Medical Jal Clinic 805 W Kansas Ave Jal, NM 88252	911 or 575-395-3400
Lea Regional Medical Center 5419 N Lovington Hwy Hobbs, New Mexico 88240	911 or 575-492-5000
Lea County Health Department 302 N 5th Street Lovington, NM 88260	911 or 575-396-2853
Poison Control Center	800-222-1222
Oil Conservation Division (OCD) Emergency Contacts Oil Conservation Division – District 1 1625 N. French Drive Hobbs, NM 88240	575-629-6116 (office) 575-626-0830(cell)
New Mexico Oil Conservation Division – Main Office 1220 S. St. Francis Drive Santa Fe, NM 87505	505-476-3441 (office)
State of New Mexico Contacts New Mexico Environmental Department 1190 St. Francis Drive Santa Fe, NM 87502 Hazardous Waste Bureau	505-827-2855 (office)
New Mexico Environmental Emergencies	505-827-9329 (24 hrs)
Local Emergency Response Contacts Lea County Emergency Management Director – Lorenzo Velasquez	575-391-2983 (office) 575-605-6561 (cell)

Federal Emergency Contacts National Response Center (NRC)	800-424-8802
US EPA Region 6 Hotline	800-887-6063 214-665-2760
Additional Local Contacts	
Lea County Electrical Coop.	575-396-3631
Hobbs Animal Shelter – contact Emergency Management	575-397-9323

3.0 Immediate Action Plan

This Immediate Action Plan contains procedures for alerting and protecting facility and contractor personnel and the public. Per the requirements of **19.15.36.8.C(8) NMAC** and **19.15.11.9 B(1) NMAC**, as it applies to surface waste management facilities, the Immediate Action Plan follows the guidelines laid out in the American Petroleum Institution "Recommended Practice for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide (API RP-55). See **Exhibit C** for a complete copy of ARI RP-55.

In the event of an emergency, these Immediate Action Plan procedures shall be followed to assess the scene and provide notification quickly and effectively. However, the emergency coordinator may deviate from the plan as necessary in an emergency situation if any of the actions could create a safety hazard. Initial efforts will focus on the safety and protection of the facility personnel and the persons using the facility. No persons shall attempt to contain or control any H_2S release beyond their corresponding scope of safety, training, and available equipment.

If H2S is detected at 10-ppm or greater, the Facility will immediately be evacuated.

- Any facility employee that witnesses the 10 ppm or greater H_2S alarm will immediately communicate the evacuation notice to all facility personnel by 2-way radios.
- The employee who identifies the emergency will then specifically notify the designated primary emergency contact via 2-way radio, If the primary emergency contact is not available, the alternate emergency contact or the onsite manager will be notified via 2-way radio. The responding emergency contact will assume the role of emergency coordinator over the situation.
- The facility has two assembly areas in case of an evacuation, the main gate and the secondary emergency evacuation gate (see Figure 3). Facility personnel will check the windsocks for wind direction and assemble at the most upwind assembly area.

- Facility personnel will immediately communicate the evacuation notice to any non-facility visitors, drivers, or other persons in their work area.

- All traffic, incoming waste loads, and other vehicles will be diverted from the area where the emergency is taking place by facility personnel in their work area and directed towards the most upwind assembly area.

- The Emergency Coordinator will ensure that the facility gate is closed to incoming disposal traffic.

- The facility operator manning the front desk of the administrative building will keep the facility sign-in sheet and any in-process load manifests on their person and will be responsible for accounting for all persons on the site. A 2-way radio will be used to coordinate the headcount in the case that there are persons assembled at both of the assembly locations.

- Once assembled and all employees, visitors and other persons are accounted for, facility personnel will assist the emergency coordinator in securing the site or evacuate to a further distance away.

- When the site is secure the Emergency Coordinator will notify the New Mexico State Police, Lea County Sheriff, Lea County Emergency Management. NMOCD will be notified by phone within 4 hrs of the plan activation by phone as per **NMAC 19.15.11.16.** Lea County Emergency Management will notify the public if necessary.

- The emergency coordinator will assess the scene by direct observation, review of the H2S monitoring system, surface waste management facility records or manifests, and if necessary, by chemical analysis. The emergency coordinator will assess:

   A. Release identification
      a. Type and quantity of released material containing H2S
      b. Location of release
      c. Nature of the hazard (eg, H2S)
   B. Vulnerability Analysis (ie., what is susceptible to damage?)
      a. Extent of the vulnerable zone (eg. Size of release, wind direction, wind speed)
      b. Persons in the vulnerable zone (eg, facility personnel, nearby working crews. Note that there are no public areas or residences nearby the landfill. Lea County Road 1 is the only public road in the area. See **Figure 3**)
      c. Environmental impact (eg, endangered species, surface water, natural areas)
   C. Risk Analysis (ie, probability of damage)
      a. Environmental conditions (eg, risk of spread due to high winds)

b. Facility personnel skillset (ie, within capabilities of personnel to contain and control)
c. Equipment availability (ie, is the facility equipment sufficient to deal with the emergency)
d. Type and severity of harm to people, property & environment

- Containment and/or control procedures will only be implemented if deemed safe to do so. If deemed safe by the emergency coordinator, personnel will perform actions within the scope of their training to contain the incident and prevent the spread/dispersion of the release. Use of SCBA (self-contained breathing apparatus) is beyond the capabilities of facility personnel and equipment. Facility personnel will not approach the area of the release. A third party contractor will be contacted to supply appropriate equipment and personnel to respond to the emergency.

- The Emergency Coordinator will ensure that no oil field waste, which may be incompatible with the released material, is treated, stored or disposed of until cleanup procedures are complete by keeping the facility gate closed to incoming disposal traffic and halting processing of materials on the drying pads.

- If it is safe to do so, the source of the release should be eliminated or stopped.

- If the release is unable to be stopped safely, do not reenter the area of the release, as additional operations are beyond the capabilities of the facility equipment and personnel. Facility personnel will cooperate with and assist the emergency authorities notified in **Table 2** above.

- Personnel may only return to the facility once the emergency coordinator has indicated via 2-way radio that it is safe to do so

- If the spill/release is a major or minor release, as defined in **Section 7.0**, the OCD will be notified by filling out Form C-141 (**Exhibit B**) and following the steps described in **Section 8.0**.

- A remediation plan will be developed by the Emergency Coordinator in consultation with management and the OCD if the spill/release is determined to be a major or minor release, taking into account the vulnerabilities and risks identified above.

- The Emergency Coordinator will document the incident on an Incident Report Form (**Exhibit A**) and maintain a copy in the Facility Permanent Operating Record.

- The Emergency Coordinator will meet with personnel and any agencies involved to assess the cause of the incident and determine steps to take to prevent it from occurring again. Facility personnel will be informed of these resultant actions and, if needed, the Hydrogen Sulfide Prevention and Contingency Plan will be updated.

4.0 Treatment Plan for Waste and Pond Water H2S at 1 ppm but less than 10 ppm

In the event of an H2S detection at 1 ppm or greater but less than 10 ppm, the following procedures will be implemented:

4.1 Presence in Waste Load

- Personnel will notify the Emergency Coordinator and notification of the presence of H2S in a waste load will be provided to both the driver (hauler) and the generator.
- The load will be rejected and directed to leave the Facility.
- The final H2S measurement will be recorded on the Shipping Manifest and "H2S at 1 ppm or greater" written as the reason for denial of acceptance of load. The Shipping Manifest with denial will be retained as part of the facility Permanent Operating Record.

4.2 Presence in the Leachate Evaporation Pond Water

- Concentration levels will be recorded in the inspection form provided in **Appendix E** of the Permit Narrative
- Personnel will notify the Emergency Coordinator and a third-party chemical provider will be contracted to treat the pond water.
- The third-party chemical representative will supply and wear the appropriate personal protective equipment and respirator, and shall treat the pond water with 35 oz of calcium hypochlorite (Ca(ClO)2) (1 coffee can).
- After approximately 20 minutes, the pond water will be re-tested for the presence of dissolved H2S. Treatment will continue until the H2S reading is below 1 ppm.
- Completion of treatment will be documented and maintained in the facility POR. **4.3**

Presence Around the Leachate Evaporation Pond

- Personnel will notify the Emergency Coordinator and take a second reading downwind of the leachate evaporation pond within one (1) hour and at the property boundary downwind of the pond if it is safe to do so.
- A sample from the pond will be tested for dissolved H2S, if safe to do so, and the pond water treated for H2S as per procedure if required.
- If the second reading is also at 1-ppm or greater the District 1 OCD office will immediately be notified, and hourly monitoring will continue for the next 24 hours.
- If necessary the pond water will be disposed of via vacuum truck in a permitted offsite SWD facility or treated as per the pond water treatment procedure above.

4.4 Presence Around the Drying Pad, Truck Wash or Working Face

- Personnel will notify the Emergency Coordinator and assess the waste in the working area using an electronic 4 gas monitor and segregate the waste so that it is contained on a waste drying pad.

- Personnel will notify the Emergency Coordinator and a third-party chemical provider will be contracted to treat the waste.

- The third-party chemical representative will supply and wear the appropriate personal protective equipment and respirator, and shall treat the waste with 35 oz of calcium hypochlorite ($Ca(ClO)_2$) (1 coffee can).

- A loader will be used to mix the waste thoroughly and the continuous stationary monitor will be checked for H2S concentration below 1 ppm. If the H2S concentration is not below 1 ppm the process will be repeated until the H2S concentration has decreased below 1 ppm, then the waste will be placed back in the active landfilling area.

5.0 Emergency Response Equipment

Table 4 contains a list of the primary equipment available for an H_2S emergency response, the operator will keep this list current. The OCD will be notified within 5 days of any changes to the list provided in Table 4. Immediately after use, all equipment will be inspected, decontaminated, cleaned and made ready to be used again. If lost or damaged, equipment will be replaced immediately. The emergency coordinator will verify that equipment has been maintained after an emergency and will be readied for reuse if another emergency or incident occurs. Also See **Figure 2** for visual representation of locations of some of the items listed below.

Table 4. Emergency Response Equipment List

Equipment Description	Location	Quantity	Capability
Windsocks	Administration building, drying pad, working face, facility entrance	4	Indicate wind direction
Pair leather gloves	Assigned to employee	1 per employee	Protect hands from cuts and abrasions
Pair safety glasses	Assigned to employee	1 per employee	Eye protection as per ANSI Z87.1

Personal H2S monitor (BW Clip)	Assigned to employee	1 per employee	Alarm if H2S concentration >10ppm. Spec sheet in Attachment D.
Electronic 4 gas monitor	Administration building	1	Identify H2S, CO, O2, and LEL concentrations
Continuous stationary H2S monitors (Otis OI-6900)	See Figure 4	10	Identify H2S concentration 0-100 ppm. Set to alarm at 1 ppm. Spec sheet in Attachment D.
Dissolved H2S sensor (Edaphic Scientific H2S Micro-Sensor)	Pond	1	Identify dissolved H2S concentration 0-10 ppm. Spec sheet in Attachment D.
pH strips	Administration building	1 box	Indicate pH between 0-14
First aid kit	Administration building	1	First aid supplies, support 10 persons minimum
First aid kit	Facility vehicles	1 per vehicle and moving equipment	First aid supplies, support 10 persons minimum
Eye wash station	Administration building	1	First aid, eye wash 1 incident
Portable 2-way radios	Assigned to employee	1 per employee	2 mile transmitting range
Office phone	Administration building	1	Communication with outside regulatory or emergency organizations
Cell Phone	Emergency Coordinators	2 minimum	Communication with outside regulatory or emergency organizations
Absorbent Oil Booms	Administration building	4	32 gallon liquid capacity each
Round point shovels	Administration building	2	Earthmoving, ~1/4 cu. ft. per shovel
Loader	Facility	1	Earthmoving, 2 cu. yd. per load
Excavator	Facility	1	Earthmoving, 2 cu. ft. per load

6.0 Spill/Release Definitions

According to **NMAC 19.15.29.7**, a **major release** means:

(5) An unauthorized release of a volume, excluding gases, of 25 barrels or more;

(6) An unauthorized release of a volume that:
- (a) Results in a fire or is the result of a fire
- (b) May with reasonable probability reach a watercourse
- (c) May with reasonable probability endanger public health; or
- (d) Substantially damages property or the environment

(7) An unauthorized release of gases exceeding 500 MCF; or

(8) A release of a volume that may with reasonable probability be detrimental to fresh water or exceed the standards in **NMAC 19.15.30.9** subsections A, B, or C.

A **minor release** means an unauthorized release, which is not a major release and is a volume greater than five barrels but less than 25 barrels; or for gases, greater than 50 MCF but less than 500 MCF.

7.0 Spill/Release Notification Requirements

The emergency coordinator must notify the OCD of a major or minor release occurring during the drilling, producing, storing, disposing, injecting, transporting, servicing or processing of oil, gases, produced water, condensate or oil field waste including regulated NORM, or other oil field related chemicals, contaminants or mixture of the chemicals or contaminants, by filling out Form C-141 (see **Exhibit B**), in accordance with the requirements of **19.15.29 NMAC**.

According to **19.15.29.10 NMAC**, for reporting a **major release**, the responsible party must notify the OCD's environmental bureau chief and the NMOCD District 1 office verbally or by email within 24 hours of discovery of the release. If an H2S release, NMOCD must be notified by phone within 4 hours of the H2S plan activation as per **NMAC 19.15.11.16**. The notification must provide the information required on Form C-141, including the following:

- Provide the NMOCD with a description of the nature and cause of noncompliance;
- Inform the NMOCD of the period of noncompliance, including exact dates and times and/or the anticipated time when the Facility will return to compliance;
- Notify the NMOCD of steps taken or to be taken to reduce, eliminate, and prevent recurrences of the noncompliance; and
- Take the first three actions listed above within 24 hours in the case of any noncompliance that could constitute a threat to human health, welfare or the environment.

The NMOCD District 1 office must also be notified in writing within 15 days of discovering the release by completing and filing Form C-141. The written notification must verify the prior verbal or email notification and include any additions or corrections to the information contained in the prior verbal or email notification.

For reporting a **minor release**, the responsible party must notify the appropriate division district office in writing within 15 days of discovery of the release by completing and filing Form C-141.

8.0 Spill/Release Corrective Action

The Facility shall comply with any corrective action deemed necessary by the OCD for spills/ releases that endanger public health or the environment, remediate the spill/release in accordance with the approved remediation plan, and submit a final closure report to OCD within 90 days of discovery of the spill/release as required by **19.15.29.12 NMAC**. If the spill/release has caused water pollution in excess of the standards and requirements of **19.15.30 NMAC**, the facility will remediate the spill/release in accordance with the approved abatement as per **19.15.30.11 NMAC** and submit a final closure report to OCD within 90 days of discovery of the spill/release.

9.0 H2S Monitoring

The Facility will monitor vehicles with incoming waste and the pond for H2S. Ten stationary continuous H_2S monitors will be placed throughout the site, located as per **Figure 4** to include the administrative building, drying pads, truck wash and cell working face. A dissolved H2S sensor will be placed in the pond. Facility personnel will be equipped with BW Clip individual H2S monitors to be worn outside of clothing, sensor facing out, between the beltline and neck. Individual H2S monitors will alarm personnel at 10 ppm H2S or greater.

9.1 Monitoring Waste Loads

Oilfield waste loads will be monitored for H_2S upon arriving at the site using an Otis OI-6900 stationary continuous monitor at the administrative building. The Shipping Manifest will be utilized for recording monitoring results. The documentation of the monitoring will be kept in the Facility Permanent Operating Record System (POR). Stationary continuous monitors will alarm staff at concentrations of 1-parts per million (ppm) H_2S or greater.

9.2 Monitoring Leachate Evaporation Pond, Drying Pads, and Truck Wash

The NGL North Ranch Facility has one leachate evaporation pond, located in the northeast portion of the site. Monitoring will be performed when there is liquid present in the pond. Stationary continuous Otis OI-6900 H_2S monitors will be placed around the leachate evaporation pond to continuously monitor for H_2S. Wind speed, direction and air H_2S concentrations will be recorded daily at the pond and documented on the Daily Air and Water Inspection Form (see **Attachment A** of the **Inspection and Maintenance Plan**, located in **Appendix E** of the permit application). Documentation of monitoring will be kept in the Facility Permanent Operating System (POR). In addition, a dissolved H2S sensor (Edaphic Scientific H2S Micro-Sensor) and pH sensor (Edaphic Scientific pH-ORP) will be placed in the leachate evaporation pond and monitored monthly.

Continuous monitoring via stationary Otis OI-6900 monitors will also occur around waste drying pads, the truck wash sump and the cell working face. See **Figure 4** for stationary monitor locations and a local wind rose. Stationary continuous monitors will alarm staff at concentrations of 1-parts per million (ppm) H2S or greater.

10.0 Radius of Exposure

The radius of exposure is calculated for hydrogen sulfide using the following formula assuming a continuous release of H_2S from a waste load during daytime hours:

$$ROE\ (ft) = Antilog[A * log(C_{H2S}) + B] \qquad \text{(OG 2010)}$$

Where:

A = Concentration Coefficient

B = Concentration Coefficient

C_{H2S}=H_2S Discharge rate in cubic feet per hour (CFH)

Assuming a 12 cubic yard waste load left is left open while waiting in line to dispose for a prolonged period of time at the scale house, and one-tenth of that volume is a continuous gas generation every minute. In this case, a continuous release rate of 1,944 CFH is assumed a H_2S concentration of 10 parts per million. At that concentration the coefficients are, A = 0.61 and B = 0.84 (OG 2010). These coefficients also assume stable air with a Stability Class PG F an average wind speed of 2.2 mph. Therefore, the radius of exposure is:

$$ROE\ (ft) = Antilog[0.61 * log(1{,}944\ CFH) + 0.84]$$

ROE = 692 ft,

Point sources at the administrative building, drying pads, leachate pond and working face, and their associated ROEs are represented in **Figure 3.**

11.0 Identification of roads, public areas and residences

Note that there are no public areas or residences near the landfill. Lea County Road 1 (Battle Axe Rd) is the only public road in the area. This public road and potential roadblock locations are also noted in **Figure 3**.

12.0 Training & Drills

All employees will receive H2S training at time of hire and annual refresher training thereafter through a third-party safety contractor. H2S Emergency Response drills will be performed quarterly to ensure employee familiarity with actions required by the Immediate Action Plan. Documentation of training & drills will be maintained in the employee training files and maintained as part of the Facility Permanent Operating Record. Training topics will include:

- H2S composition & sources

- Physical characteristics
- Exposure hazards
- Permissible exposure limits
- Occurrence of H2S
- H2S detection
- Personnel Protective Equipment (PPE)
- Safe work practices
- Engineering controls
- Contingency planning
- Emergency response
- FIT testing
- SCBA practical training

There are no nearby residents or persons in commercial buildings that would require H2S awareness training. Public authorities will be briefed on this contingency plan as per **Section 13.0** below.

13.0 Emergency Response Team Coordination

Facility officials will coordinate with local agencies regarding notification, emergency response procedures, and evacuation. Jal Police Department, Lea County Sheriff's Department, Jal Fire Department, New Mexico State Police, Lea County Emergency Management, the Oil Conservation Division (OCD) and hospital, contractors, and emergency response teams will be provided copies of the Hydrogen Sulfide Prevention and Contingency Plan so that the organizations can be prepared to coordinate with the Facility in the event of an emergency. Delivery of this plan to local authorities will be via email and follow up via phone to confirm receipt and allow for discussion of the plan. A copy of this email and documented receipt of the plan by the local authority will be retained in the facility Permanent Operating Record. The OCD and local authorities will be promptly notified via email of changes to the plan, in emergency coordinator personnel, or in the emergency coordinators' contact information, with follow up via phone to confirm receipt with local authorities. A copy of this revision notification email and documented receipt of the revised plan by the local authority will be retained in the facility Permanent Operating Record

14.0 Contingency Plan Amendments

The Contingency Plan will be amended within five (5) working days if the Facility permit is revised or modified, the plan fails in the event of an emergency, or the list of emergency equipment changes. Additionally, if the design, construction operation, maintenance, or other characteristics of the Facility changes in a way that increases the potential for fires, explosions, or releases of oilfield waste constituents that could pose a threat to safety, public health, fresh water, and the environment or alter the response necessary in an emergency, the Contingency Plan will be amended accordingly. The emergency coordinator can revise this plan as necessary to address an emergency. Any change in the emergency coordinators or their contact information will necessitate an update to the Contingency Plan immediately. The Facility will provide the OCD's environmental bureau and local emergency response agencies with a copy of any amendments to the Contingency Plan promptly.

15.0 References

Oil and Gas Petroleum Refineries, 2010 (OG 2010).
https://oilandgass.blogspot.com/2010/04/radius-of-exposure-roe-calculation.html

REV.	DATE	BY	DESCRIPTION

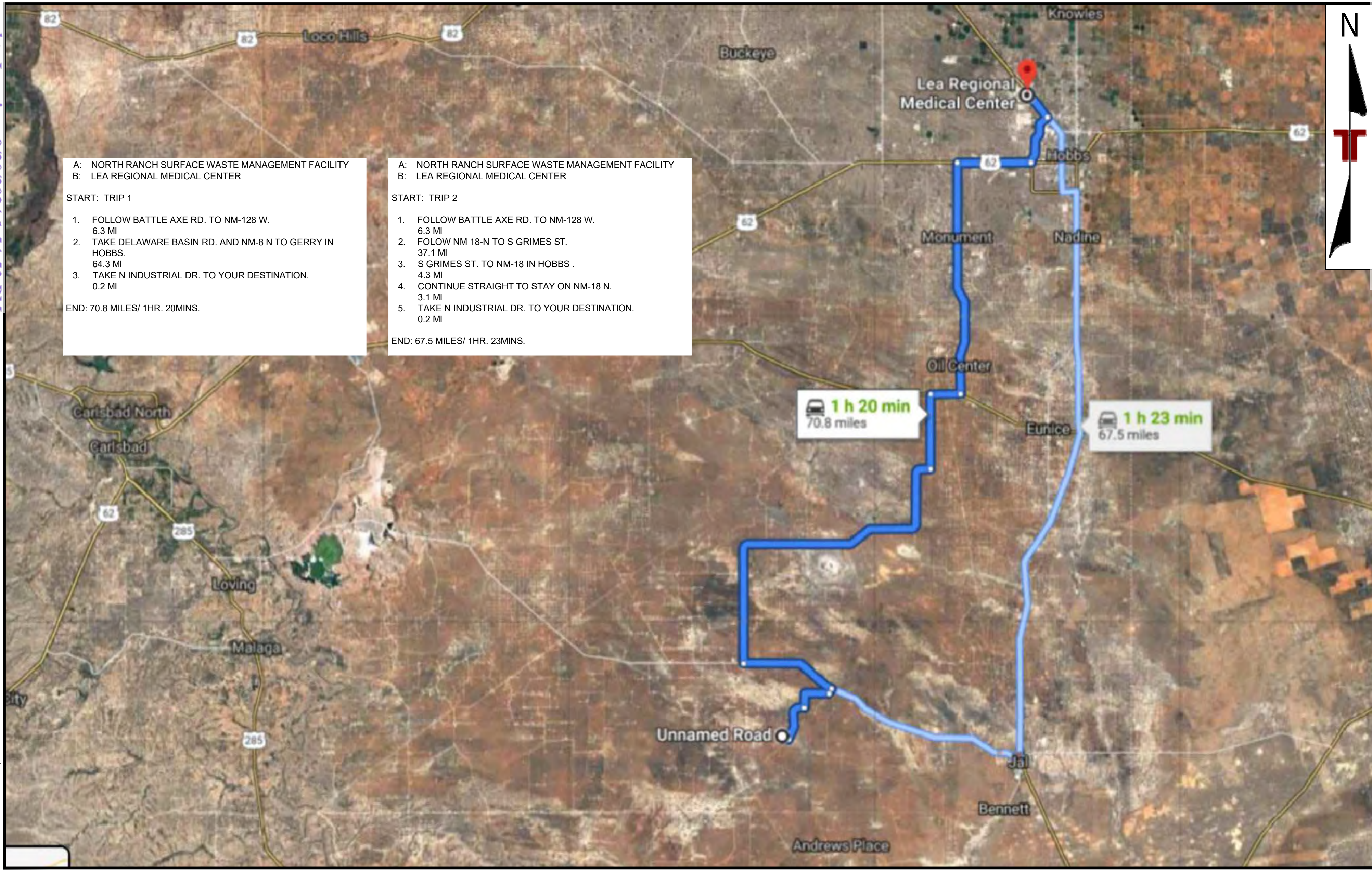
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

SITE LOCATION MAP
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. 1

DESIGNED BY:	-
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	1" = 100'
DATE:	SEPTEMBER 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	1 OF 1

N:\GECARCHIVE\CAD\572\002\MCCLOY\PERMIT TEXT FIGURES\PERMIT NARRATIVE\FIG 1 - SITE LOCATION MAP.DWG



A: NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
B: LEA REGIONAL MEDICAL CENTER

START: TRIP 1

1. FOLLOW BATTLE AXE RD. TO NM-128 W.
   6.3 MI
2. TAKE DELAWARE BASIN RD. AND NM-8 N TO GERRY IN HOBBS.
   64.3 MI
3. TAKE N INDUSTRIAL DR. TO YOUR DESTINATION.
   0.2 MI

END: 70.8 MILES/ 1HR. 20MINS.

A: NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
B: LEA REGIONAL MEDICAL CENTER

START: TRIP 2

1. FOLLOW BATTLE AXE RD. TO NM-128 W.
   6.3 MI
2. FOLOW NM 18-N TO S GRIMES ST.
   37.1 MI
3. S GRIMES ST. TO NM-18 IN HOBBS .
   4.3 MI
4. CONTINUE STRAIGHT TO STAY ON NM-18 N.
   3.1 MI
5. TAKE N INDUSTRIAL DR. TO YOUR DESTINATION.
   0.2 MI

END: 67.5 MILES/ 1HR. 23MINS.

REV.	DATE	BY	DESCRIPTION

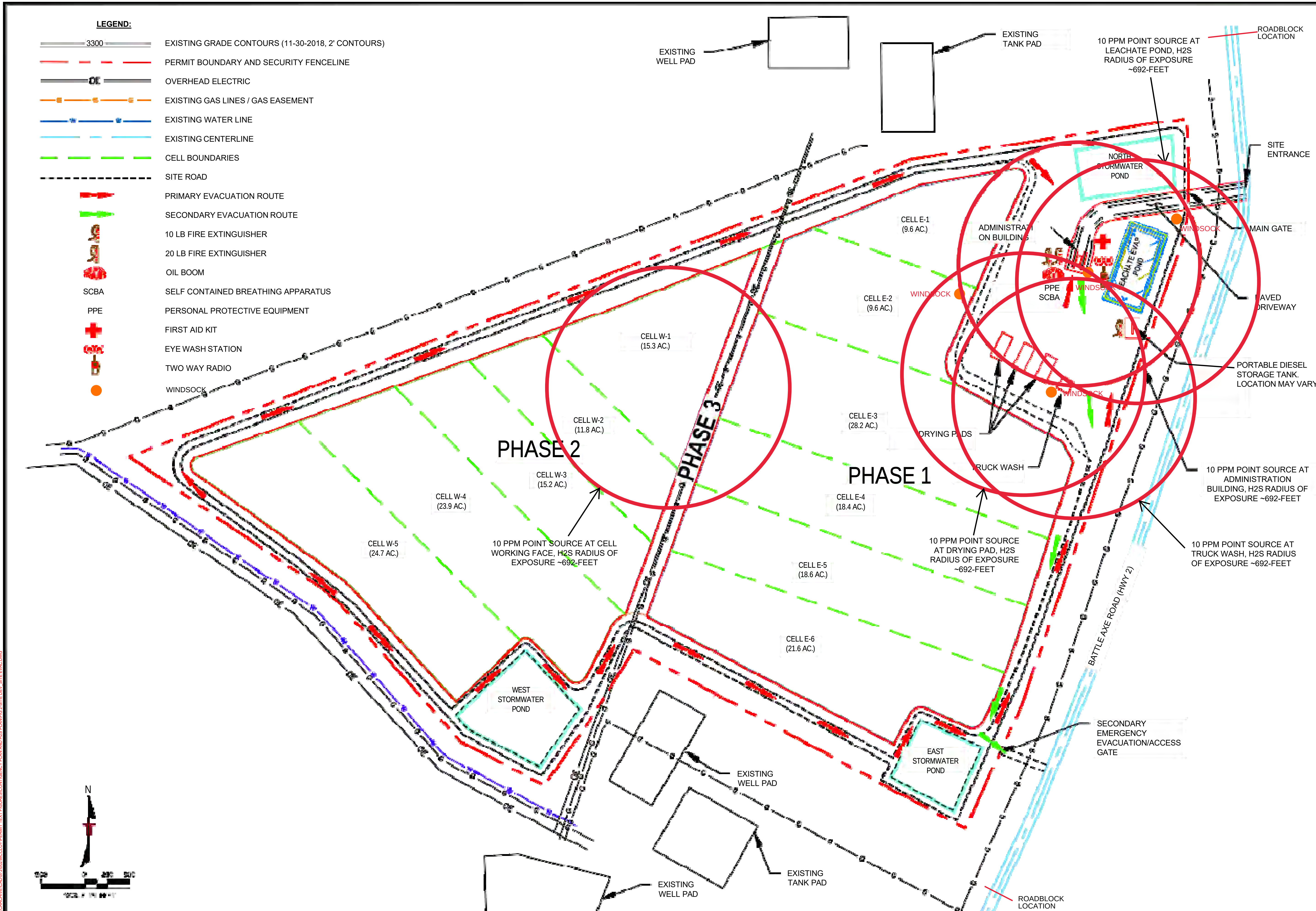
Terracon
Consulting Engineers and Scientists

25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

HOSPITAL LOCATION MAP
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. 2

DESIGNED BY:	DEW
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	AS SHOWN
DATE:	APRIL 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	1 OF 2



REV.	DATE	BY	DESCRIPTION

SITE EVACUATION PLAN

PERMIT APPLICATION FIGURE

SURFACE WASTE MANAGEMENT FACILITY

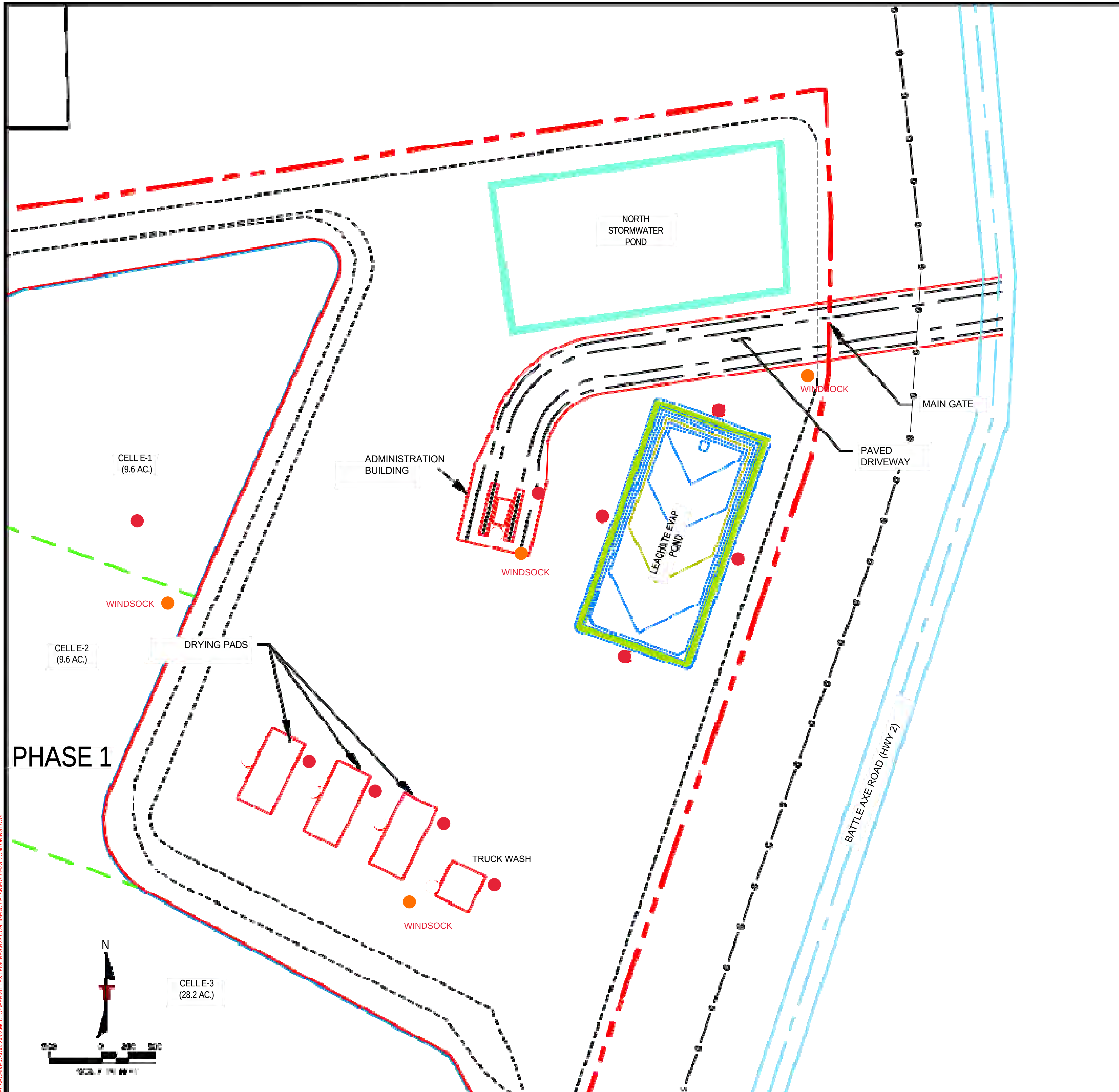
NORTH RANCH

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 3

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	APRIL 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	OF

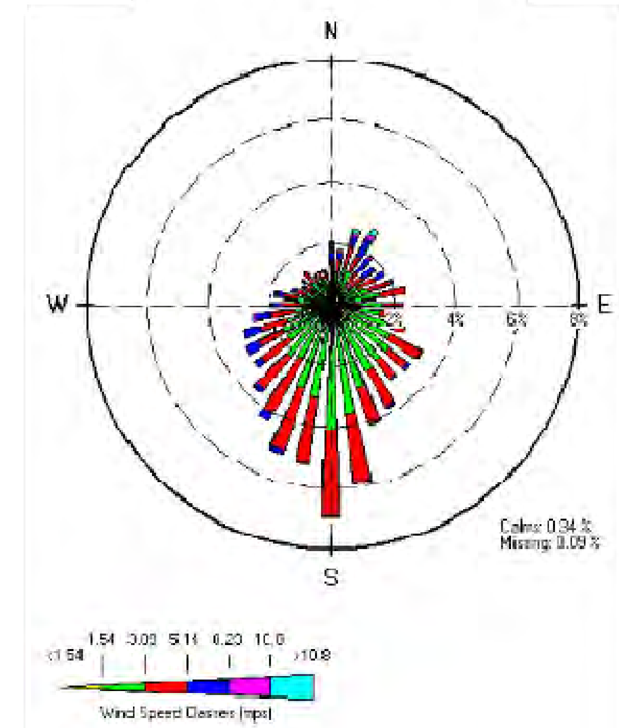


LEGEND:

- 3300 — EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
- PERMIT BOUNDARY AND SECURITY FENCELINE
- EXISTING GAS LINES / GAS EASEMENT
- EXISTING CENTERLINE
- CELL BOUNDARIES
- SITE ROAD
- STATIONARY H2S MONITORING LOCATION
- WINDSOCK

NEW MEXICO ENVIRONMENTAL DEPARTMENT - AIR QUALITY BUREAU

2015 WINDROSE DATA FOR HOBBS, NEW MEXICO (STATION 722676)



Note: Diagram of the frequency of occurrence of each wind direction.

Met File Type: AERMET SFC

REV.	DATE	BY	DESCRIPTION

STATIONARY H2S MONITORING

PERMIT APPLICATION FIGURE

SURFACE WASTE MANAGEMENT FACILITY

NORTH RANCH

LEA COUNTY NEW MEXICO

Terracon

Consulting Engineers and Scientists

25809 I-30 SOUTH BRYANT, AR 72022

PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 4

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	APRIL 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	OF

EXHIBIT A

INCIDENT REPORT FORM

North Ranch Surface Waste Management Facility
Incident Report Form

Type of Incident and General Information			
[ ]	Work Related Injury/Illness	[ ]	Unsafe Act/Near Miss
[ ]	Property Damage	[ ]	Vandalism/Criminal Activity
[ ]	Vehicular Accident	[ ]	Other ______________________________ (i.e. spill, release, fire, explosion, hot load, etc.)

Employee Name: ______________________Job Title: ____________________________________

Phone No.: __________________Date of Incident: __________Time of Incident: ______AM/PM

Location of Incident: ____________________________________Weather: __________________

Date and Time Reported to Management: Date: __________________Time: _________AM/PM

Reported to: ___________________Title: _____________Reported by: ____________________

Injury Category of Incident when first reported?	
[ ]	N/A Employee was not injured
[ ]	Notice of injury only, medical treatment declined at this time
[ ]	First aid performed onsite, medical treatment declined at this time
[ ]	Medical Treatment - transported by ____________________to ____________________
[ ]	Employee Fatality

(Section below to be filled out by employee)

Employee's Description of Incident		
Were you injured?	[ ] yes	[ ] no
Type of injury?		
Area of body?		
In your own words, explain the incident:		

Employee Signature: ____Date: _______________

EXHIBIT B

FORM C-141

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources Department

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-141
Revised August 24, 2018
Submit to appropriate OCD District office

Incident ID	
District RP	
Facility ID	
Application ID	

Release Notification

Responsible Party

Responsible Party	OGRID
Contact Name	Contact Telephone
Contact email	Incident # *(assigned by OCD)*
Contact mailing address	

Location of Release Source

Latitude ______________________________ Longitude ______________________________
(NAD 83 in decimal degrees to 5 decimal places)

Site Name	Site Type
Date Release Discovered	API# *(if applicable)*

Unit Letter	Section	Township	Range	County

Surface Owner: ☐ State ☐ Federal ☐ Tribal ☐ Private (*Name:* ______________________________)

Nature and Volume of Release

Material(s) Released (Select all that apply and attach calculations or specific justification for the volumes provided below)

☐ Crude Oil	Volume Released (bbls)	Volume Recovered (bbls)
☐ Produced Water	Volume Released (bbls)	Volume Recovered (bbls)
	Is the concentration of dissolved chloride in the produced water >10,000 mg/l?	☐ Yes ☐ No
☐ Condensate	Volume Released (bbls)	Volume Recovered (bbls)
☐ Natural Gas	Volume Released (Mcf)	Volume Recovered (Mcf)
☐ Other (describe)	Volume/Weight Released (provide units)	Volume/Weight Recovered (provide units)
Cause of Release		

Form C-141
Page 2

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Was this a major release as defined by 19.15.29.7(A) NMAC? ☐ Yes ☐ No	If YES, for what reason(s) does the responsible party consider this a major release?
If YES, was immediate notice given to the OCD? By whom? To whom? When and by what means (phone, email, etc)?	

Initial Response

The responsible party must undertake the following actions immediately unless they could create a safety hazard that would result in injury

☐ The source of the release has been stopped.

☐ The impacted area has been secured to protect human health and the environment.

☐ Released materials have been contained via the use of berms or dikes, absorbent pads, or other containment devices.

☐ All free liquids and recoverable materials have been removed and managed appropriately.

If all the actions described above have <u>not</u> been undertaken, explain why:

Per 19.15.29.8 B. (4) NMAC the responsible party may commence remediation immediately after discovery of a release. If remediation has begun, please attach a narrative of actions to date. If remedial efforts have been successfully completed or if the release occurred within a lined containment area (see 19.15.29.11(A)(5)(a) NMAC), please attach all information needed for closure evaluation.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ______________________________ Title: ______________________________

Signature: ______________________________ Date: __________

email: ______________________________ Telephone: ______________________

<u>OCD Only</u>

Received by: ______________________________ Date: __________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Site Assessment/Characterization

This information must be provided to the appropriate district office no later than 90 days after the release discovery date.

What is the shallowest depth to groundwater beneath the area affected by the release?	_________ (ft bgs)
Did this release impact groundwater or surface water?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a continuously flowing watercourse or any other significant watercourse?	☐ Yes ☐ No
Are the lateral extents of the release within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark)?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of an occupied permanent residence, school, hospital, institution, or church?	☐ Yes ☐ No
Are the lateral extents of the release within 500 horizontal feet of a spring or a private domestic fresh water well used by less than five households for domestic or stock watering purposes?	☐ Yes ☐ No
Are the lateral extents of the release within 1000 feet of any other fresh water well or spring?	☐ Yes ☐ No
Are the lateral extents of the release within incorporated municipal boundaries or within a defined municipal fresh water well field?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a wetland?	☐ Yes ☐ No
Are the lateral extents of the release overlying a subsurface mine?	☐ Yes ☐ No
Are the lateral extents of the release overlying an unstable area such as karst geology?	☐ Yes ☐ No
Are the lateral extents of the release within a 100-year floodplain?	☐ Yes ☐ No
Did the release impact areas **not** on an exploration, development, production, or storage site?	☐ Yes ☐ No

Attach a comprehensive report (electronic submittals in .pdf format are preferred) demonstrating the lateral and vertical extents of soil contamination associated with the release have been determined. Refer to 19.15.29.11 NMAC for specifics.

Characterization Report Checklist: ***Each of the following items must be included in the report.***

- ☐ Scaled site map showing impacted area, surface features, subsurface features, delineation points, and monitoring wells.
- ☐ Field data
- ☐ Data table of soil contaminant concentration data
- ☐ Depth to water determination
- ☐ Determination of water sources and significant watercourses within ½-mile of the lateral extents of the release
- ☐ Boring or excavation logs
- ☐ Photographs including date and GIS information
- ☐ Topographic/Aerial maps
- ☐ Laboratory data including chain of custody

If the site characterization report does not include completed efforts at remediation of the release, the report must include a proposed remediation plan. That plan must include the estimated volume of material to be remediated, the proposed remediation technique, proposed sampling plan and methods, anticipated timelines for beginning and completing the remediation. The closure criteria for a release are contained in Table 1 of 19.15.29.12 NMAC, however, use of the table is modified by site- and release-specific parameters.

Form C-141

Page 4

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ____ Title: ____

Signature:____ Date: ____________

email: _____________________________________ Telephone: ______________________________

OCD Only

Received by: ____ Date: _______________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Remediation Plan

Remediation Plan Checklist: ***Each of the following items must be included in the plan.***

☐ Detailed description of proposed remediation technique
☐ Scaled sitemap with GPS coordinates showing delineation points
☐ Estimated volume of material to be remediated
☐ Closure criteria is to Table 1 specifications subject to 19.15.29.12(C)(4) NMAC
☐ Proposed schedule for remediation (note if remediation plan timeline is more than 90 days OCD approval is required)

Deferral Requests Only: ***Each of the following items must be confirmed as part of any request for deferral of remediation.***

☐ Contamination must be in areas immediately under or around production equipment where remediation could cause a major facility deconstruction.

☐ Extents of contamination must be fully delineated.

☐ Contamination does not cause an imminent risk to human health, the environment, or groundwater.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ____ Title: ____

Signature: ____ Date: ____________

email: _____________________________________ Telephone: ______________________________

OCD Only

Received by: ____ Date: ________________

☐ Approved ☐ Approved with Attached Conditions of Approval ☐ Denied ☐ Deferral Approved

Signature: ______________________________________ Date: ______________________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Closure

The responsible party must attach information demonstrating they have complied with all applicable closure requirements and any conditions or directives of the OCD. This demonstration should be in the form of a comprehensive report (electronic submittals in .pdf format are preferred) including a scaled site map, sampling diagrams, relevant field notes, photographs of any excavation prior to backfilling, laboratory data including chain of custody documents of final sampling, and a narrative of the remedial activities. Refer to 19.15.29.12 NMAC.

Closure Report Attachment Checklist: ***Each of the following items must be included in the closure report.***

☐ A scaled site and sampling diagram as described in 19.15.29.11 NMAC

☐ Photographs of the remediated site prior to backfill or photos of the liner integrity if applicable (Note: appropriate OCD District office must be notified 2 days prior to liner inspection)

☐ Laboratory analyses of final sampling (Note: appropriate ODC District office must be notified 2 days prior to final sampling)

☐ Description of remediation activities

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations. The responsible party acknowledges they must substantially restore, reclaim, and re-vegetate the impacted surface area to the conditions that existed prior to the release or their final land use in accordance with 19.15.29.13 NMAC including notification to the OCD when reclamation and re-vegetation are complete.

Printed Name: ____________________________ Title: ______________________________

Signature: ______________________________ Date: ________________

email: ___________________________ Telephone: ______________________

OCD Only

Received by: ______________________________ Date: ____________

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EXHIBIT C

API RP – 55

Recommended Practice for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

Recommended Practice for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

API RECOMMENDED PRACTICE 55
SECOND EDITION, FEBRUARY 15, 1995
REAFFIRMED, MARCH 2007

Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

Exploration and Production Department

API RECOMMENDED PRACTICE 55
SECOND EDITION, FEBRUARY 15, 1995

American
Petroleum
Institute

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FOREWORD

These recommended practices were prepared by the API Subcommittee on Production Operations Involving Hydrogen Sulfide. This standard is under the administration of the American Petroleum Institute Exploration & Production Department's Executive Committee on Drilling & Production Practices.

It is intended that these voluntary recommended practices serve as a guide to promote and maintain integrity of oil and/or gas producing and gas processing facilities in the interests of public safety, personnel safety, and protection of the environment. Users of this publication are reminded that constantly developing technology, specific company requirements and policy, and specialized or limited operations do not permit coverage of all possible operations, practices, or alternatives. This standard is not so comprehensive as to present *all* of the recommended practices for oil and gas well producing operations and gas processing plant operations involving hydrogen sulfide. Alternative operating procedures and/or equipment are available and routinely used to meet or exceed recommended practices or performance levels set forth herein. Recommendations presented in this publication are based on industry experience and expertise involving a wide range of operating locations and conditions. Recommendations presented in this publication are not intended to inhibit developing technology and equipment improvements or improved operating procedures. This publication, or portions thereof, cannot be substituted for qualified technical/operations analysis and judgment to fit a specific situation.

There may be federal, state, or local statutes, rules, or regulations requiring oil and gas producing and gas processing operations to be conducted in a safe or environmentally sound manner. Organizations and individuals using this standard are cautioned that requirements of federal, state, or local laws and regulations are constantly evolving. These requirements should be reviewed to determine whether the practices recommended herein and the operations being planned or conducted are consistent with current laws and regulations.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet (MSDS).

Provisions of these voluntary recommended practices include use of the verbs "shall" and "should': whichever is deemed most applicable for the specific situation. For purposes of this publication, the following definitions are applicable.

Shall: Indicates the "recommended practice(s)" has universal applicability to that specific activity.

Should: Denotes a "recommended practice(s)" 1) where a safe comparable alternative practice(s) is available; 2) that may be impractical under certain circumstances; or 3) that may be unnecessary under certain circumstances.

Suggested revisions to these recommended practices are invited and should be submitted in writing to: Director, Exploration & Production Department, American Petroleum Institute, 700 North Pearl Street, Suite 1840, Dallas, Texas 75201-2845.

Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

O Introduction

The petroleum industry, through many years of research and operating experience, has developed guidelines for safe operations under conditions involving hydrogen sulfide. Continuing industry efforts, which inc1ude planning, prudent selection and layout of equipment, prudent selection of materials, operating and emergency procedures, specialized safety equipment, and appropriate personnel training are all necessary to ensure successful and safe operations. Effective response to emergencies requires prior planning. *Good engineering practice (engineering and administrative controls) dictates that producing and gas processing systems be designed to minimize exposure of personnel and the public to hydrogen sulfide and sulfur dioxide.*

1 Scope

Recommendations set forth in this publication apply to oil and gas producing and gas processing plant operations conducted with hydrogen sulfide present in the fluids being handled. The presence of hydrogen sulfide in these operations also presents the possibility of exposure to sulfur dioxide from the combustion of hydrogen sulfide. *Refer to Section 4 for applicability of this standard.*

2 References

2.1 STANDARDS

The following standards contain prov1S1ons which, through reference in this text, constitute provisions of this standard. All standards are subject to revision, and users are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ACGilJI

I. *Threshold Limit Values and Biological Exposure Indices (1993-94).*

ANSI2

2. B31.3 *Chemical Plant and Petroleum Refining Piping.*
3. B31.4 *Liquid Petroleum Transportation Piping Systems.*
4. B31.8 *Gas Transmission and Distribution Piping Systems.*
5. CGAG-7.l *Breathing Air, Grade D.*
6. ISEA 102 *Standard for Gas Detector Tube Units-Short Term Type for Toxic Gases and Vapors in Working Environments.*
7. 288.2 *Practices for Respiratory Protection.*

APP

8. BUL El *Bulletin on the Generic Hazardous Chemical Category List and inventory for the Oil and Gas Exploration & Production Industry.*
9. BUL E2 *Bulletin on Management of Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Production.*
JO. BUL E3 *Well Abandonment and Inactive Well Practices for U.S. Exploration and Production Operations.*
ll. BUL E4 *Release Reporting for the Oil and Gas Exploration and Production Industry as Required by the CWA, CERCLA, and SARA Title IJI.*
12. RP12Rl *Recommended Practice for Setting, Maintenance, Inspection, Operation, and Repair of Tanks in Production Service.*
13. RPI 4C *Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms.*
14. RP49 *Recommended Practice for Drilling and Drill Stem Testing Operations Involving Hydrogen Sulfide.*
15. RP500 · *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities.*
16. API 510 *Pressure Vessel Inspection Code: Maintenance Inspection, Rating, Repair, and Alteration.*
17. RP576 *Inspection of Pressure Relieving Devices.*
18. RP750 *Management of Process Hazards.*
19. STD 1104 *Welding of Pipelines and Related Facilities.*
20. PUBL 2217A *Guidelines for Work in Inert Confined Spaces in the Petroleum Industry.*

ASME4

21. *Boiler & Pressure Vessel Code.*

1American Conference of Governmental Industrial Hygienists, 1330 Kemper Drive, Cincinnati, OH 45240.
2American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.
3American Petroleum Institute, Publications & Distribution Section, 1220 L Street NW, Washington, D.C. 20005.
4American Society of Mechanical Engineers, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

EPA5

22. EPA/600/8-86/026A *Health Assessment Document for Hydrogen Sulfide.*

ISA6

23. S12.15, Part I *Performance Requirements for Hydrogen Sulfide Detection Instruments.*

24. RP12.15, Part II *Installation, Operation, and Maintenance of Hydrogen Sulfide Detection . Instruments.*

NACE7

25. MR0175-94 *Standard Material Requirements Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment.*

National Response Team8

26. NRT-1 *Hazardous Materials Emergency Planning Guide.*

27. *Technical Guidance for Hazards Analysis, Emergency Planning for Extremely HazardousSubstances.*

NFPA9

28. NFPA 70 *National Electrical Code.*

29. NFPA496 *Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (Classified) Locations.*

NIOSH10

30. NIOSH 74-111 *Criteria for a Recommended Standard for Occupational Exposure to Sulfur Dioxide (GPO No. 017-033-00029).*

31. NIOSH 77-158 *Criteria for a Recommended Standard for Occupational Exposure to Hydrogen Sulfide (GPO No. 0/7-033-00217-7).*

32. DHHS 85-114 *NIOSH Pocket Guide to Chemical Hazards.*

[5]Environmental Protection Agency, available from U.S. Government Printing Office, Washington, D.C. 20402.
[6]Instrument Society of America, Box 12277, Research Triangle Park, NC 27700.
[7]National Association of Corrosion Engineers, NACE International, Box 218340, Houston, Texas 77218-8340.
[8]National Response Team, National Oil and Hazardous Substances Contingency Plan GWDR/12, 2100 Second Street SW, Washington, D.C. 20593.
[9]National Fire Protection Association, 60 Batterymarch Park, Quincy, MA 02269.
[10]National Institute for Occupational Safety and Health (U.S. Department of Health, Education, and Welfare), available from U.S. Government Printing Office, Washington, D.C. 20402.

PACE11

33. Report 85-5 *Review of Ambient Hydrogen Sulfide Standards in Canada.*

2.2 REGULATIONS

The following regulations are referenced in this standard. All regulations are subject to revision, and users should detennine the latest version to ensure compliance. .

Bureau of Mines (DOI)12

34. 30 *CFR* Chapter 1, Subchapter B, Part II, Subpart H *Respiratory Protection Devices.*

Coast Guard (DOT)13

35. 33 *CFR* Parts 140, 143, and 146 *Emergency Evacuation Plans for Manned OCS Facilities.*

36. 54 *FR* 21566, May 18, 1989 *Emergency Evacuation Plans for Manned OCS Facilities.*

DOT14

37. 49 *CFR* Part 178, SubpartC *Shipping Container Specifications.*

EPA5

38. 40 *CFR* Part 264, SubpartD *Contingency Plans and Emergency Procedures.*

39. 40 *CFR* Part 302 *Designation, Reportable Quantities, and Notification.*

40. 40 *CFR* Part 355 *Emergency Planning and Notification.*

41. 40 *CFR* Part 370 *Hazardous Chemical Reporting: Community Right-to-Know.*

MMS (DOI)15

42. 30 *CFR* Parts 250 &256 *Oil,Gas, and Sulphur Operations in the Outer Continental Shelf.*

43. 53 *FR* 10596-10777, April 1, 1988 *Oil, Gas, and Sulphur Operations in the Outer Continental Shelf.*

44. **MMS-OCS-1** *Safety Requirements for Drilling Operations in a Hydrogen Sulfide Environment, Outer Continental Shelf. (February 1976).*

[11]Petroleum Association for Conservation of the Canadian Environment, 12002-275 Slater Street, Ottawa, Ontario, Canada LIP-5H9.
[12]Bureau of Mines, U.S. Department of Interior, available from U.S. Government Printing Office, Washington, D.C. 20402.
[13]Coast Guard, U.S. Department of Transportation, available from U.S. Government Printing Office, Washington, D.C. 20402.
[14]U.S. Department of Transportation, available from U.S. Government Printing Office, Washington, D.C. 20402.
[15]Minerals Management Service, U.S. Department of Interior, 381 Elden Street, Herndon, VA 22070-4817. Available from U.S. Government Printing Office, Washington, D.C. 20402.

45.	47 *FR* 28888, July 1, 1982	*Safety Requirements for Drilling Operations in a Hydrogen Sulfide Environment, Outer Continental Shelf (July 1, 1982).*

OSHA[16]

46.	29 *CFRPart* 1910.38	*Employee Emergency Plan and Fire Prevention Plans.*
47.	29 *CFR* Part 1910.l 19	*Process Safety Management of Highly Hazardous Chemicals.*
48.	29 *CFR* Part 1910.120	*Hazardous Waste Operations and Emergency Response.*
49.	54 *FR* Part 9294, March 6, 1989	*Hazardous Waste Operations and Emergency Response.*
50.	29 *CFR* Part 1910.134	*Respiratory Protection Standard.*
51.	29 *CFR* Part 1910.146	*Permit-required Confined Spaces.*
52.	29 *CFR* Part 1910.1000	*Toxic and Hazardous Substances (Air Contaminants).*
53.	*54FR* 2332, January 19, 1989	*Air Contaminants.*
54.	58 *FR* 35338, June 30, 1993	*Air Contaminants.*
55.	29 *CFRPart* 1910.1200	*Hazard Communication Standard.*

2.3 OTHER REFERENCES

56. Poda, George A., "Hydrogen Sulfide Can Be Handled *Safely",Archives of Environmental Health*, Vol. 12, 795-800, June 1966.
57. Ronk, Richard and White, **M. K.,** "Hydrogen Sulfide and the Probabilities of Inhalation Through a Tympanic Membrane Defect", *Journal of Occupational Medicine*, Vol. 25, No. 5, 337-340, May 1985.
58. *Synopsis of Boiler & Pressure Vessel Laws, Rules, and Regulations by States, Cities, Counties, and Provinces (United States and Canada)*, available from Uniform Boiler and Pressure Vessel Laws Society, P. 0. Box 1521, Oceanside, New York, NY I1572.
59. Pasquill, F., *Atmospheric Difusion*, Second Edition, John Wiley & Sons, New York, NY, 1947.
60. Slade, D. H., *Metrology and Atomic Energy* NTIS-TID 24190 (1968), National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.
61. Wilson, D. J., "Release and Dispersion of Gas from Pipeline Ruptures", Department of Mechanical Engineering, University of Alberta, Edmonton, Canada.
62. Jann, P. R., "Evaluation of Sheltering In Place•: *Journal of Loss Prevention in the Process lndustry*, Vol. 2, No. I, Jan. 1989, pp 33-38.
63. Macfarlane, D. R. and Ewing, T. F., "Acute Health Effects From Accidental Releases of High Toxic Hazard Chemicals", *Journal of Loss Prevention in the Process Industry*, Vol. 3, No. I, January 1990, pp 167-176.
64. Wilson, D. J., "Stay Indoors or Evacuate to Avoid Exposure to Toxic Gas?", *Emergency Preparedness Digest*, Ottawa, Canada, January-March 1987, pp 19-24.
65. Davies, P. C. and Purdy, G., "Toxic Gas Risk Assessments-The Effects of Being Indoors", North Western Branch Papers 1986 No. l, Institution of Chemical Engineers, Health and Safety Executive, Major Hazards Assessment Unit, St. Annes House, Stanly Precinct, Bootle, Merseyside, England.
66. Glickman, T.S. and Ujrhara, A. M., "Protective Action Decision Making in Toxic Vapor Cloud Emergencies", Center for Risk Management, Resources for the Future, Washington, D. C. 20036.
67. Wilson, D. J., "Variation of Indoor Shelter Effectiveness Caused by Air Leakage Variability of Houses in Canada and the USA", US EPNFEMA Conference on Effective Use of In-place Sheltering as a Potential Option to Evacuation During Chemical Release Emergencies, Emmitsburg, MD, November 30-December I, 1988.

16Qccupational Safety & Health Administration (U.S. Department of Labor), available from U.S. Government Printing Office, Washington, D.C. 20402.

2.4 BIBLIOGRAPHY

The following publications contain information related to this subject:

API RPI 4F *Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms.*

API RP54 *Recommended Practices for Occupational Safety for Oil and Gas Well Drilling and Servicing Operations.*

Recommended Standard for Occupational Exposure to Hydrogen Sulfide, National Institute for Occupational Safety and Health, 125 Baker Drive, Morgantown, WV.

Texas Railroad Commission Rule 36: *Oil, Gas, and Geothermal Resources Operations in Hydrogen Sulfide Areas*, Texas Railroad Commission, Austin, TX.

Public Health Service Publication 999-AP-26, *Workbook on Atmospheric Dispersion Estimates*, D. Bruce Tanner, available from U.S. Department of Health, Education, and Welfare, Cincinnati, OH.

GPA 2145-85 *Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas,* available from Gas Processors Association, 6526 E. 60th Street, Tulsa, OK 74145.

2.5 ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this publication:

ACC	Acceptable Ceiling Concentration
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CWA	*Clean Water Act*
DC	Direct Current
DOI	U.S. Department of Interior
DOL	U. S. Department of Labor
DOT	U. S. Department of Transportation
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
ERPG	*Emergency Response Planning Guide*
FR	*Federal Register*
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDLH	Immediately Dangerous to Life or Health
ISA	Instrument Society of America
LEL	Lower Explosive Limit
LEPC	Local Emergency Planning Committee
MMS	Minerals Management Service
MSDS	Material Safety Data Sheet
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NORM	Naturally Occurring Radioactive Material
NRTL	National Recognized Testing Laboratory
NTIS	National Technical Infonnation Service
OCS	Outer Continental Shelf
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PG	Pasquill-Gifford
RCRA	*Resource Conservation & Recovery Act*
REL	Recommended Exposure Level
RFI	Radio Frequency Interference
ROE	Radius of Exposure
RP	*Recommended Practice*
RQ	Reportable Quantity
SARA	*Superfund Amendments and Reauthorization Act*
SCF	Standard Cubic Foot
SSC	Sulfide Stress Cracking
STEL	Short Term Exposure Level
TLV	Threshold Limit Value
TPQ	Threshold Planning Quantity
WPS	Welding Procedure Specification

3 Definitions

For the purposes of this standard, the following definitions are applicable.

3.1 acceptable ceiling concentration: (ACC). The designated level of an air contaminant to which an employee may be exposed at any time during an 8-hour shift, except for a specified time period and up to a specified concentration not exceeding the "acceptable maximum peak concentration" above the acceptable ceiling concentration for an 8-hour shift. Refer to 29 *CFR* I910.l000 and Appendix A, Par. A.2.

3.2 breathing zone: A hemisphere forward of the shoulders with a radius of 6 to 9 inches. Refer to OSHA Instruction CPL 2-2.20A, March 30, 1984; amended by CPL 2-20A CH-1, October 29, 1984.

3.3 continuous hydrogen sulfide monitoring equipment: Equipment capable of continuously measuring and displaying the concentration of hydrogen sulfide in ambient air.

3.4 emergency response planning guide-level 2: (ERPG-2). The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual ;s ability to take protective actions. Refer to *Technical Guidance for Hazards Analysis; Emergency Planning for Extremely Hazardous Substances.*

3.5 enclosed facility: A three-dimensional space enclosed by more than two-thirds (^{2}/3) of the possible projected plane surface and of sufficient size to allow the entry of personnel. For a typical building, this would require that more than two-thirds of the walls, ceiling, and floor be present. Refer to *AP/ Recommended Practice 500.*

3.6 essential personnel: Those individuals required to provide proper and prudent safe operations activities and those required to effect control of the hazardous hydrogen sulfide or sulfur dioxide conditions.

3.7 gas detection instrument: An assembly of electrical, mechanical, and chemical components designed to sense and respond continuously to the presence of chemical gases in atmospheric mixtures.

3.8 hydrogen sulfide: Chemical formula is H_2S. A flammable, toxic gas that is heavier than air and sometimes found in fluids encountered in oil and gas producing and gas processing operations. *Inhalation at certain concentrations can lead to injury or death.* Refer to Appendix A.

3.9 immediately dangerous to life and health: (IDLH). An atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere. The National Institute for Occupational Safety & Health (NIOSH) considers 300 ppm and I00 ppm to be the IDLH concentrations for hydrogen sulfide and sulfur dioxide, respectively. *AP/ Publication 2217A* specifies an oxygen content of less than 19.5% as oxygen deficient and an oxygen content ofless than 16% is considered IDLH.

3.10 inadequately ventilated: Ventilation (natural or artificial) that is *not* sufficient to prevent the accumulation of significant quantities of hydrogen sulfide-air mixtures in excess of 10 ppm.

3.11 length-of-stain detector: A specially designed pump and colorimetric indicator tube detector (length-of-stain), with a supply of detector tubes, that operates by using the pump to pull a known volume of air or gas through a detector tube. The tubes contain chemical reagents that are designed to detect the presence and display the concentration of hydrogen sulfide or sulfur dioxide in the sample. The length of the resultant color band in the tube indicates an instantaneous quantitative concentration of the specific chemical in the sample.

3.12 permissible exposure limit: (PEL). The designated level of any airborne contaminant to which an employee may be exposed. The PEL may be expressed as an eight-hour time weighted average (TWA), a ceiling value, a short term exposure level (STEL), or a skin designation. PELs are subject to change and users should check the latest version of *29 Code of Federal Regulations* Part 1910.1000 for compliance.

3.13 shall: Indicates the "recommended practice(s)" has universal applicability to that specific activity.

3.14 shelter-in-place: The concept of providing the public additional protection by having residents stay indoors until emergency evacuators arrive or the emergency is over. Refer to references *62, 63, 64, 65, 66,* and *67*.

3.15 should: Denotes a "recommended practice(s)" 1) where a safe comparable alternative practice(s) is available;
2) that may be impractical under certain circumstances; or 3) that may be unnecessary under certain circumstances.

3.16 sulfur dioxide: Chemical formula is SO_2. A toxic product of _combustion of hydrogen sulfide. This gas is heavier than air. *Inhalation at certain concentrations can lead to injury or death.* Refer to Appendix B.

3.17 threshold limit value: (TLV). The maximum airborne concentration of a substance to which, it is believed that, nearly all workers may be repeatedly exposed day after day without adverse effects, as determined by the responsible committees of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *"Threshold Limit Values and Biological Indices.* "TLV" is a trademarked term of ACGIH. TLVs are subject to change and users should check the latest edition of the forestated reference.

4 Applicability

4.1 PERSONNEL AND EQUIPMENT PROTECTION

In oil and gas producing operations and gas processing plant operations, severity of the environment shall be assessed. As a minimum, the following measures shall be implemented:

a. Personnel protection should be provided if the work area concentration of hydrogen sulfide (refer to Par. 3.8) exceeds 10 ppm eight-hour time weighted average (TWA) or 15 ppm as a short term exposure level (STEL) averaged over 15 minutes (refer to Appendix A); or the work area concentration of sulfur dioxide (refer to Par. 3.16) exceeds 2 ppm as an eight-hour TWA or 5 ppm as a STEL averaged over 15 minutes (refer to Appendix B). Personnel safety provisions of this publication do not apply when:
1. the atmospheric concentration of hydrogen sulfide could not exceed 10 ppm (by volume), or
2. the atmospheric concentration of sulfur dioxide could not exceed 2 ppm (by volume).
b. Equipment and materials shall be selected on the basis of resistance to sulfide stress cracking and corrosion. Refer to Section 8, "Design and Construction Practices': Appendix D, and *NACE Standard MR0175* for recommendations for selection of equipment and materials. The equipment and materials provisions of this publication do not apply when the partial pressure of hydrogen sulfide in the gas could not exceed 0.05 psia or IO psia in the gas phase of sour crude systems (refer to Appendix D, Par. D.1.1.2).

Some conditions may require extensive personnel safety measures but only the use of conventional equipment and materials; other conditions may require the use of special equipment and materials but only minimal personnel safety measures; still other conditions may require both.

Throughout this publication, "trigger levels" for various actions are used to ensure safety of employees and the public. These trigger levels have been established considering threshold limit values (TLVs-refer to Par. 3.17). These TLVs are subject to change and users should check the latest edition of *Threshold Limit Values and Biological Exposure Indices* and the latest revision of *29 Code of Federal Regulations* Part 1910.1000, "Toxic and Hazardous Substances", for compliance.

In 1989, the U. S. Department of Labor, Occupational Safety and Health Administration (OSHA) issued updated pennissible exposure limits (PELs) for several hundred chemicals, including revised PELs for hydrogen sulfide {10 ppm as an eight-hour TWA or 15 ppm STEL averaged over 15 minutes) and sulfur dioxide [2 ppm as an eight-hour TWA or 5 ppm STEL averaged over 15 minutes (refer to 54 *Federal Register (FR)* 2333, January 19, 1989). A federal court set aside the OSHA 1989 rule (refer to 58 *Federal Register* 35338, June 30, 1993).

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a hydrogen sulfide TLV of 10 ppm (eight-hour TWA) and a STEL of 15 ppm averaged over 15 minutes and recommends 2 ppm as an eight-hour TWA TLV and 5 ppm as a STEL averaged over 15 minutes for sulfur dioxide (refer to *Threshold Limit Values for Chemical Substances and Biological Exposure Indices).* In the interest of safety and health, this standard recommends use of the ACGIH TLVs (refer to *Threshold Limit Values for Chemical Substances and Biological Exposure Indices 1993-94)* as trigger levels for employee safety (refer to Appendices A and B). Some states have adopted these levels as requirements for personal safety.

Individual employers may set their own trigger levels after review and due consideration of site specific conditions, various regulatory requirements, and material safety data sheet (MSDS) information. Users should check the current status of OSHA PELs, OSHA acceptable ceiling concentrations (ACCs), ACGIH TLVs, and applicable regulatory requirements concerning substances of interest.

4.2 LEGAL REQUIREMENTS

This publication presents recommended practices and precautions deemed pertinent to protect personnel and the public from exposure to potentially hazardous concentrations of hydrogen sulfide and sulfur dioxide. These recommended practices recognize that owners, operators, contractors, and their employees have separate responsibilities that may be contractual in nature. It is not the intent of these recommended practices to alter the contractual relationship(s) between the parties. Some of the practices recommended herein are mandatory by local, state, or federal laws, rules, and regulations. Because of the functional and geographical diversity of these requirements, no attempt has been made in these recommended practices to designate which are optional and which are required. Furthermore, even if all the practices recommended herein are followed, there still may be existing or future legally imposed laws or regulations which would not be *met. In the event of any omission or conflict between these recommended practices and legally required action(s) the requirements of laws and regulations must control.* Some of the federal regulations pertinent to safe production operations involving hydrogen sulfide are listed in Section 2, "References". Users of this publication shall review these regulations and other federal, state, and lo-. cal laws to assure appropriate compliance in their specific operations.

4.3 HAZARD COMMUNICATION (WORKER RIGHT-TO-KNOW)

This publication contains important information that is intended as a guide but may not comply in all respects with OSHA's Hazard Communication Standard. Appropriate counsel should be sought to assure compliance with hazard communication requirements for the specific operations. Refer to OSHA rules on hazard communication in 29 *Code of Federal Regulations* Part 1910.1200, "Hazard Communication Standard" (52 *Federal Register (FR)* 31877-31886, August 24, 1987).

4.4 *COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT* (CERCLA) AND *SUPERFUND AMENDMENTSANDREAUTHORIZAnON ACT* (SARA) TITLE III (EMERGENCY) PLANNING AND COMMUNITY RIGHT•TO-KNOW)

Environmental Protection Agency (EPA) regulations implementing Title III of the *Superfund Amendments and Reauthorization Act of 1986* (SARA Title III) set threshold levels (threshold planning quantities, i.e., TPQs) for emergency planning at a local level. Both SARA Title III and CERCLA set reportable quantities (RQs) for reporting releases to the environment. The TPQ for both hydrogen sulfide and sulfur dioxide is 500 pounds; RQs for release reporting *are* 100 pounds for hydrogen sulfide and 1 pound for sulfur dioxide. TPQs and RQs (trigger levels) and the regulations requiring response plans and release reports under both SARA Title III and CERCLA are *set* forth in 40 *Code of Federal Regulations* Part 302, and 40 *Code of Federal Regulations* Part 355. Refer to *AP/ Bulletin E-4* for guidance on release reporting requirements. "Trigger levels" for response plan and release reporting requirements are subject to change and users shall check the latest revisions for compliance. SARA Title III also requires submission of periodic and annual reports of infonnation to state and local officials on the presence of hazardous chemicals at production and gas processing facilities. Those regulations are set forth in 40 *Code of Federal Regulations* Part 370, and API has published suggested generic reporting fonns (refer to *AP/ Bulletin E-1)* that are acceptable to EPA. Appropriate guidance should be sought to assure compliance with these programs for the specific operations.

4.5 HAZARDOUS WASTE OPERATIONS AND AND EMERGENCY RESPONSE (HAZWOPER)

OSHA's standard, 29 *Code of Federal Regulations* Part 1910.120, sets requirements for safety and health protection of employees involved in cleanup operations at uncontrolled hazardous waste sites being perfonned under government mandate; certain hazardous waste treatment, storage, and disposal operations conducted under the *Resource Conservation and Recovery Act* **(RCRA);** and emergency response to incidents involving hazardous substances. Appropriate guidance should be sought to assure compliance with 29 *Code of Federal Regulations* Part 1910.120 requirements for the specific operations (refer to 54 *Federal Register* 9294-9336, March 6, 1989).

5 Personnel Training

5.1 INTRODUCTION

Operators of oil and gas producing and gas processing operations involving hydrogen sulfide shall alert personnel (including employees, service companies, and contractors) of the possibility of hydrogen sulfide atmospheric concentrations greater than IO ppm and sulfur dioxide atmospheric concentrations greater than 2 ppm that may be encountered in the performance of their work. All personnel working in an area where concentrations of hydrogen sulfide or sulfur dioxide may exceed the levels stipulated in Par. 4.1.a should be provided with training prior to beginning the work assignment. All employers, whether operator, contractor, or subcontractor, shall be responsible for training and instruction of their own employees. Personnel assigned to work in areas where they may be exposed to hydrogen sulfide or sulfur dioxide shall be trained by a hydrogen sulfide safety instructor, as defined in Par. 5.6.

5.2 MINIMUM TRAINING

The value of training and periodic drills in all oil and gas producing and gas processing plant operations cannot be over emphasized. The uniqueness or complexity of a specific facility or operation will detennine the extent of the training (e.g., SARA Title III and HAZWOPER; refer to Pars. 4.4 and 4.5) deemed necessary for the assigned personnel. However, the following elements are considered a minimum level of training for regularly assigned personnel:

a. The hazards, characteristics, and properties of hydrogen sulfide and sulfur dioxide (refer to Appendices A and B).
b. Sources of hydrogen sulfide and sulfur dioxide.
c. Proper use of hydrogen sulfide and sulfur dioxide detection methods used at the workplace.
d. Recognition of and proper response to the warning signals for hydrogen sulfide and sulfur dioxide detection systems used at the workplace.
e. Symptoms of hydrogen sulfide exposure (refer to Appendix A); symptoms of sulfur dioxide exposure (refer to Appendix B).
f. Rescue techniques and first aid to victims of hydrogen sulfide and sulfur dioxide exposure.
g. Proper use and maintenance of breathing equipment for working in a hydrogen sulfide and sulfur dioxide atmosphere (theory and hands-on practice, with demonstrated proficiency). **Refer** to 29 *Code of Federal Regulations* Part 1910.134.
h. Workplace practices and relevant maintenance procedures that have been established to protect personnel from the hazards of hydrogen sulfide and sulfur dioxide.
i. Wind direction awareness and routes of egress (refer to Par. 6.7).
j. Confined space and enclosed facility entry procedures (if applicable).
k. Emergency response procedures that have been established for the facility. Refer to Section 7, "'Contingency Planning Including Emergency Procedures".
I. Locations and use of safety equipment.
m. Locations of emergency assembly areas, if so designated.

5.3 ADDITIONAL TRAINING FOR ONSITE SUPERVISORY PERSONNEL

Those personnel assigned supervising responsibilities at the site shall have additional training in the following elements:

a. Supervisor responsibilities of the contingency plan (refer to Section 7).
b. Effects of hydrogen sulfide on components of the hydrogen sulfide handling system (i.e., corrosion, embrittlement, etc.).

5.4 REFRESHER TRAINING

A fonnal recurring training program shall be implemented to maintain proficiency in the elements listed in Pars. 5.2 and 5.3, as appropriate.

5.5 TRAINING VISITORS AND OTHER NON-REGULARLY ASSIGNED PERSONNEL

Prior to entering a potentially hazardous area, visitors and other non-regularly assigned personnel shall be briefed on route(s) of egress, emergency assembly area(s), applicable warning signals, and how to respond in the event of an emergency, including use of personal protective equipment, if required. These personnel may be allowed in potentially hazardous areas only in the presence of trained personnel, after being briefed on emergency action and evacuation procedures. In the event of an emergency, these personnel shall be immediately evacuated or immediately supplied with proper personal protective equipment.

5.6 HYDROGEN SULFIDE SAFETY INSTRUCTORS

Hydrogen sulfide safety instructors are persons who have successfully completed a course in hydrogen sulfide instructor training from an institution or organization offering such courses, or have received equivalent instruction from a company-designated hydrogen sulfide safety instructor/trainer, or have had equivalent instructor/trainer experience. A recurring training program shall be implemented to maintain proficiency of the hydrogen sulfide safety instructor.

5.7 SAFETY REVIEW

Before any persons unfamiliar with the job site enter the location, they shall, as a minimum, be briefed on emergency evacuation procedures.

5.8 SUPPLEMENTAL TRAINING

Training should be a continuing educational program for personnel (including personnel engaged in maintenance and repair work) whose work may involve exposure to hydrogen sulfide or sulfur dioxide. Effective ongoing training wi11 ensure that personnel have current knowledge of potential job hazards, procedures for dealing with confined space entry, procedures for enclosed facilities work, relevant maintenance procedures, and cleanup methods. Depending on the nature of the programs, certain appropriate training aids may be very usefuJ. These aids may include, but are not limited to, films, manuals, and industry publications or documents (refer to Section 2 "References"). Guest speakers, demonstrations, and consultants are also recommended.

5.9 RECORDS

Dates, instructors, attendees, and subjects for all personnel training sessions shall be documented and appropriate records should be retained for a minimum of one year.

5.10 OTHER PERSONNEL CONSIDERATIONS

5.10.1 Enclosed Facilities and Confined Space Entry

Refer to 29 *Code of Federal Regulations* Part 1910.146 for OSHA's confined space entry regulations. Refer to Section 12, "Operations Involving Enclosed Facilities", for some topics that may be used in training personnel for enclosed facilities work. Refer to Pars. 9.17 and 9.18 for further precautionary infonnation on entry into confined spaces (including vessels) and enclosed facilities.

5.10.2 Respiratory Problems

Personnel with known physiological or psychological conditions which impair nonnal respiration shall not be assigned to jobs involving potential exposure lo a hydrogen sulfide or sulfur dioxide environment if use of the breathing equipment or exposure will complicate their respiratory problems. Refer to OSHA's Respiratory Protection Standard (29 *Code of Federal Regulations* Part 1910.134).

Note: Personnel assigned job-related tasks requiring routine use of breathing equipment shall have a periodic review to determine their physiological and psychological adequacy for use of this equipment (refer to 29 *Code of Federal Regulations* Part I910.134 and *ANSI Z88.2.*

5.10.3 Perforated Eardrums

There are differences of opinion[17] in the medical community about whether a person with a perforated eardrum can become overexposed to a toxic substance via the ear even when wearing properly functioning breathing apparatus (refer to Par. 6.4). Refer to Appendix A.

6 Personnel Protective Equipment

6.1 INTRODUCTION

Section 6 discusses some personnel protective equipment that can be used in oil and gas well producing and gas processing plant operations where the work atmosphere concentration of hydrogen sulfide could exceed IO ppm or sulfur dioxide atmospheric conceptration could exceed 2 ppm (refer to Par. 4.1 and Appendices A and B). Having personnel protective equipment available is not enough; training personnel in the selection, use, inspection, and maintenance of the equipment is essential.

6.2 STATIONARY HYDROGEN SULFIDE MONITORING SYSTEMS

Stationary hydrogen sulfide atmospheric monitoring systems used in oil and gas producing and gas processing plant operations shall include visual or audible alarm(s), located where the alarm can be seen or heard throughout the work area. The batteries of direct current (DC) systems should be checked daily during operation unless an automatic low voltage alarm is provided. Instrument Society of America publications, *ISA-SJ 2.15,* Part I, and *ISA-RP12.J 5,* Part II, contain equipment performance requirements and

[17]Note: Compare Poda, George A., "Hydrogen Sulfide Can Be Handled *Safely*'"[55],*Archives of Environmental Health,* Vol. 112, 795-800, June 1966, and Ronk, Richard and White, M. K.• '"Hydrogen Sulfide and the Probabilities of Inhalation Through a Tympanic Membrane Defect"[56], *Journal of Occupational Medicine,* Vol. 25, No. *5,* 337-340, May 1985.

recommendations for installation, operation, and maintenance of hydrogen sulfide monitoring and detection instruments, respectively. Refer to Section 10 for additional details regarding evaluation and selection of hydrogen sulfide monitoring equipment.

6.3 PORTABLE DETECTION EQUIPMENT

If the atmospheric concentration of hydrogen sulfide could reach or exceed those levels stipulated in Par. 6.1, portable hydrogen sulfide detection instruments[18] shall be available. Refer to Section IO for details regarding evaluation, selection, maintenance, and use of hydrogen sulfide detection equipment. In those instances where the hydrogen sulfide atmospheric concentration may exceed the measurement range of the detection instruments in use, a pump and colorimetric indicator tube detector[19] (length-of-stain), with a supply of detector tubes, shall be available to take instantaneous ..grab" samples to determine hydrogen sulfide concentrations in enclosed facilities, storage tanks, vessels, etc.

If sulfur dioxide levels could reach or exceed those stipulated in Par. 6.1 (e.g., during flaring or other operations producing sulfur dioxide), either portable sulfur dioxide detection instruments or length-of-stain detectors, with a supply of detector tubes, shall be available for determining the sulfur dioxide concentration in the area and to monitor areas impacted by sulfur dioxide gas \\'.hen fluids containing hydrogen sulfide are burned. Personnel shall wear appropriate personal breathing equipment (refer to Par. 6.4) unless it is established that the work area atmosphere is safe.

6.4 BREATHING (RESPIRATORY PROTECTION) EQUIPMENT

Site specific contingency plans shall be prepared to specify the quantity and location of breathing equipment to be available. Respirators shall meet the requirements of OSHA's Respiratory Protection Standard (refer to 29 *Code of Federal Regulations* Part 1910.134) and be approved under procedures outlined in *ANSI Z88.2*. All breathing air cylinders shall meet U.S. Department of Transportation (DOT) or other appropriate regulatory requirements (refer to 30 *Code of Federal Regulations,* Part 1910.134, Chapter 1, Subchapter B, Part II, Subpart H, Par. 11.80 and 49 *Code of Federal Regulations* Part 178, Subpart C). The following types of breathing equipment with full face piece meet these requirements and should be used where the work area atmospheric concentration exceeds IO ppm for hydrogen sulfide or 2 ppm for sulfur dioxide:

a. Self-contained, positive-pressure/pressure-demand breathing equipment that provides respiratory protection in any atmospheric concentration of hydrogen sulfide or sulfur dioxide.

b. Positive-pressure/pressure-demand air-line breathing equipment coupled with a self-contained breathing apparatus equipped with a low pressure warning alarm and rated for fifteen minutes (minimum). This equipment permits the wearer to move from one work area to another.

c. Positive-pressure/pressure-demand, air-line breathing equipment, with an auxiliary self-contained air supply (rated for a minimum of 5 minutes). This type unit can be used for entry as long as the air line is connected to a source of breathing air. *The auxiliary self-contained air supply (rated for less than 15 minutes) is suitable only for escape or self-rescue use.*

Notes:
I. Personnel assigned job-related tasks requiring routine use of breathing equipment shall have a periodic review to determine their physiological and psychological adequacy for use of this equipment (refer to *ANSI* Z *88.2* and 29 *Code of Federal Regulations* Part 1910.134).
2. Positive-pressure/pressure-demand, air-line or self-contained breathing apparatus, as appropriate, with full face piece shall be worn by personnel e,i;-posed 10 atmospheres containing concentrations of hydrogen sulfide or sulfur dioxide above OSHA's ACCs and PELs for air contaminants (refer to 29 *Code of Federal Regulations* Part 1910.1000.

CAUTION: Gas mask canister type breathing and demand type (negative pressure) equipment shall not be used in oil and gas producing and gas processing plant operations when a hydrogen sulfide or sulfur dioxide environment could be encountered.

6.4.1 Storage and Maintenance

Personal breathing equipment shall be strategically located so that this equipment is quickly and easily available to essential personnel. Essential personnel are those required to provide proper and prudent safe operations activities and those required to effect control of the hazardous hydrogen sulfide or sulfur dioxide conditions (refer to Par. 7.5). Additional breathing equipment may be required by site specific contingency plans (refer to Section 7). Breathing equipment shall be maintained and stored in a convenient, clean, and sanitary location, in accordance with OSHA's Respiratory Protection Standard (refer to 29 *Code of Federal Regulations* Part 1910.134). All breathing equipment shall be checked before and after each use and inspected at least monthly to ensure that it is maintained in satisfactory condition. A record of the monthly inspections, including dates and findings, shall be retained [refer to 29 *Code of Federal Regulations* 1910.134({)]. These records should be retained for a minimum of twelve (12) months and longer if dictated by company policy. Equipment needing repair shall be appro-

[18] A gas detection instrument is an assembly of electric), mechanical, and chemical components designed to sense and respond continuously to the presence of chemical gases (hydrogen sulfide or sulfur dioxide) in atmospheric mixtures.

[19] A pump and colorimetric indicator tube detector (length-of-stain), with a supply of detector tubes, is an assembly of specially designed pump and detector tubes that operates by using the pump to pull a known volume of air or gas through a detector tube. The tubes contain chemical reagents that are designed to detect the presence and display the concentration of hydrogen sulfide or sulfur dioxide in the sample. The length of the resultant color band in the tube indicates an instantaneous quantitative concentration of the specific chemical in the sample.

priately tagged and removed from equipment stock until it is suitably repaired or replaced. Proper storage, maintenance, handling, and inspection is essential to the integrity of personal breathing equipment. Personnel with assigned breathing equipment should be instructed in proper maintenance of this equipment, or other steps shall be taken to ensure its integrity. NIOSH, OSHA, and manufacturer's recommendations shall be followed.

6.4.2 Face Piece Restrictions

Full face piece breathing equipment meeting requirements of Par. 6.4 should be used where the work area atmosphere concentration exceeds 10 ppm for hydrogen sulfide or 2 ppm for sulfur dioxide. Personnel shall not wear eyeglasses with temple bars that extend through the sealing edge of the face piece. Using approved adapters, corrective prescription lenses may be mounted inside the breathing apparatus face piece.

As of this writing, U. S. Department of Labor (OSHA) does not permit wearing contacts when using respirator breathing equipment [refer to 29 *Code of Federal Regulations* Part 1910.134(e)(5)(ii)]. OSHA has investigated the prohibition of contact lenses used under respirator breathing equipment and issued a field memorandum (February 8, 1989, Thomas Shepich, Director, Directorate of Compliance Programs) stating their intent to modify the rule and issuing an interim enforcement policy as follows:

a. Violations of the Respiratory Protection Standard (29 *Code of Federal Regulations* Part 1910.134) involving the use of gas penneable and soft contact lenses shall continue to be documented in the case file and recorded as de minimis; citations shall not be issued.

b. Evidence indicating any negative effect(s) associated with the use of contact lenses with respirator breathing equipment should be provided to U. S. Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), Directorate for Compliance Programs, Washington, D. C. 20210. Benefits associated with the use of contact lenses with respirator breathing equipment would be useful to OSHA. The issue of use of non-gas-penneable hard contact lenses will be resolved in OSHA's revision of 29 *Code of Federal Regulations* Part 1910.134.

Note: Companies should review available infonnation and provide employee guidance regarding the use of contact lenses under respirator breathing equipment.

Personnel shall not wear facial hair that may prevent proper sealing of the face mask. Personnel shall be satisfied that a face seal can be obtained with the assigned equipment or randomly selected unassigned equipment before they use the equipment. If a seal cannot be obtained, either satisfactory equipment must be provided or the individual shall be disqualified from working in areas where hazardous conditions are anticipated or existent.

6.4.3 Air Supply

Breathing air quality shall meet requirements set forth in OSHA's Respiratory Protection Standard, 29 *Code of Federal Regulations* Part 1910.134, and shall at least meet Grade D requirements as described in *ANSI CGA G-7.1*.

6.4.4 Compressors

All breathing air compressors used shall meet the requirements set forth in 29 *Code of Federal Regulations* Part 1910.134 of OSHA's Respiratory Protection Standard. The air intake for such compressors must be located in a contaminant-free area that is unclassified by *API RP500*, Section B. Inlet air for such compressors shall be monitored when conditions arise which pennit possible contamination of the inlet air by toxic, flammable, or combustible gases.

6.4.5 Breathing Equipment Use

Personnel shall use breathing equipment prior to entering an area where OSHA ACCs and PELs for hydrogen sulfide and sulfur dioxide, respectively, are exceeded (refer to Par. 4.1, Appendices A and B, and 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z.1) until either the area is made or tested safe or they return to a safe area. *Breathing equipment shall be put on in a safe area prior to either beginning a rescue operation or entering a hazardous environment.*

6.5 STANDBY RESCUE PERSONNEL

When personnel work in locations with hydrogen sulfide or sulfur dioxide concentrations considered immediately dangerous to life or health (IDLH) (refer to Appendices A and B) in the working breathing zone, a standby rescue person. trained in rescue techniques and with suitable rescue equipment, including appropriate breathing apparatus (refer to Par. 6.4), shall be provided.

6.6 RESCUE EQUIPMENT

At locations with hydrogen sulfide, sulfur dioxide, or oxygen concentration considered immediately dangerous to life or health (IDLH), suitable rescue equipment [for example, appropriate breathing equipment, lifeline(s), and harness(es)] shall be provided. Types of rescue equipment required will vary and will depend on the type of job and work being perfonned. Appropriate counsel with qualified health and safety professional personnel should be effected to detennine what rescue equipment should be available for site-specific job and work conditions.

6.7 WIND DIRECTION INDICATORS

Consideration should be given to locating windsocks, streamers, flags, or other suitable devices for indicating wind direction at the producing or gas processing site. These devices shall be readily visible to personnel on or approaching the work location.

Note: Regulatory requirements for wind direction indicators shall be observed.

6.8 WARNING SIGNS

Legible warning signs, such as "HYDROGEN SULFIDE OPERATIONS-ENTER ONLY WHEN MONITORING SHOWS THE AREA TO BE SAFE" or "RESPIRATORY PROTECTION EQUIPMENT MUST BE WORN BEYOND TIIIS POINT," should be prominently posted at appropriate locations (e.g., entrance points) for facilities where produced fluids containing hydrogen sulfide (refer to Par. 4.1 for applicability) are being processed or handled.

Note: Regulatory requirements for sign posting shall be observed.

7 Contingency Planning Including Emergency Procedures

7.1 INTRODUCTION

Operators shall evaluate existing and new operations involving hydrogen sulfide and sulfur dioxide to detennine if contingency plans, special emergency procedures, and/or training are required. The evaluation process shall identify potential emergencies and their impact on operating personnel and the general public. The contingency plan, if required, shall conform to all applicable local, state, and federal regulations regarding notifications, precautions, evacuations, and other requirements (refer to 40 *Code of Federal Regulations* Part 264, Subpart D; 29 *Code of Federal Regulations* Part 1910.120; and 29 *Code of Federal Regulations* Part 1910.38 for EPA and OSHA requirements, respectively, for contingency plans and emergency procedures).

7.2 SCOPE

The contingency plan should contain emergency response procedures that provide an organized immediate action plan for alerting and protecting operating personnel and the public. Contingency plans should be site specific for the facility operations and should consider the severity and extent of the anticipated atmospheric hydrogen sulfide and sulfur dioxide concentrations. Contingency plans should consider the dispersion characteristics of hydrogen sulfide and sulfur dioxide (refer to Appendix C or other recognized dispersion modelling techniques). Contingency plans should contain provisions for all applicable items listed in this section. (Refer to *Hazardous Materials Emergency Planning Guide, NRT-1*, and *Technical Guidance For Hazards Analysis.* In addition to the contingency plan, Sections 302 and 303 of the *Superfund Amendments and Reauthorization Act of 1986* **(SARA** Title III) can require a facility operator to name a facility emergency coordinator to work with a local emergency planning committee (LEPC) in the development of an emergency response plan (refer to 40 *Code of Federal Regulations* Part 355).

7.3 AVAILABILITY OF PLAN

The contingency plan shall be available to all personnel responsible for implementation, regardless of their normal location assignment.

7.4 PLAN INFORMATION

Contingency plans should contain, but not be limited to, infonnation on the following subjects, as appropriate:

a. Emergency Procedures:
   I. Responsibilities of personnel (refer to Par. 7.5).
   2. Immediate action plan (refer to Par. 7.6).
   3. Telephone numbers and communication methods (refer to Par. 7.7).
   4. Locations of nearby residences, businesses, parks, schools, churches, roads, medical facilities, etc.
   5. Evacuation routes and road block locations.
   6. Safety equipment and supplies available (e.g., number and location of breathing equipment).
b. Characteristics of Hydrogen Sulfide and Sulfur Dioxide:
   I. Refer to Appendix A for hydrogen sulfide characteristics.
   2. Refer to Appendix B for sulfur dioxide characteristics.
c. Facility Description, Maps, and Drawings:
   1. Plants.
   2. Water injection stations.
   3. Wells, tank batteries, gas conditioning facilities, flowlines.
   4. Compression facilities.
d. Training and Drills (refer to Par. 7.8):
   1. Responsibilities and duties of essential personnel.
   2. On-site or classroom (tabletop) drills.
   3. Informing nearby residents on protective measures in emergency situations, as appropriate.
   4. Training and attendance documentation.
   5. Briefing of public officials on issues such as evacuation or *shelter-in-place*[20] plans.

7.5 RESPONSIBILITIES OF PERSONNEL

The contingency plan shall outline responsibilities and duties of all essential personnel. Visitors and other non-essential personnel should be prohibited from remaining in or entering an area contaminated by hydrogen sulfide exceeding an atmospheric concentration of 1O ppm or a concentra-

20Shelter-in-place refers to the concept of providing the public additional protection by having residents stay indoors until emergency evacuators arrive or the emergency is over (refer to References *62, 63, 64, 65, 66,* and *67*).

tion of sulfur dioxide exceeding 2 ppm in the atmosphere (refer to Par. 4.1 and Appendices A and B).

7.6 IMMEDIATE ACTION PLAN

Each contingency plan should contain a condensed "Immediate Action Plan" to .be followed by designated personnel any time they receive notice of a potentially hazardous hydrogen sulfide or sulfur dioxide discharge. For the protection of personnel (including the general public) and abatement of the discharge, this "Immediate Action Plan" should include, but not be limited to, the following provisions:

a. Alert and account for facility personnel.
   I. Move away from the hydrogen sulfide or sulfur dioxide source and get out of the affected area.
   2. Don proper personal breathing equipment.
   3. Alert other affected personnel.
   4. Assist personnel in distress.
   5. Proceed to the designated emergency assembly area.
   6. Account for on-site personnel.

b. Take immediate measures to control the present or potential hydrogen sulfide or sulfur dioxide discharge and to eliminate possible ignition sources. Emergency shutdown procedures should be initiated as deemed necessary to correct or control the specific situation. When the required action cannot be accomplished in time to prevent exposing operating personnel or the public to hazardous concentrations of hydrogen sulfide or sulfur dioxide, proceed to the following steps, as appropriate for the site specific conditions.

c. Alert the public (directly or through appropriate government agencies) that may be subjected to an atmosphere exposure exceeding 30 ppm[21] of hydrogen sulfide or 1021 ppm of sulfur dioxide.

d. Initiate evacuation operations.

e. Contact the first available designated supervisor on the call list (refer to Par. 7.4.a). Notify the supervisor of circumstances and whether or not immediate assistance is needed. The supervisor should notify (or arrange for notification of) other supervisors and other appropriate personnel (including public officials) on the call list.

f. Make recommendations to public officials regarding blocking unauthorized access to the unsafe area and assist as appropriate.

g. Make recommendations to public officials regarding evacuating the public and assist as appropriate.

h. Notify, as required, state and local officials and the National Response Center to comply with release reporting requirements (i.e., 40 *Code of Federal Regulations Parts* 302 and 355) (refer to Par. 4.4).

i. Monitor the ambient air in the area of exposure (after following abatement measures) to determine when it is safe for re-entry.

Note: This sequence (Par. 7.6) should be altered to fit the prevailing situation. Certain actions, especially those dealing with the public, should be coordinated with public officials.

7.7 EMERGENCY TELEPHONE LISTS

A list of emergency telephone numbers should be prepared and maintained as a part of the contingency plan, considering the need to contact any of the following:

a. Emergency Services
   1. Ambulances
   2. Hospitals
   3. Medical personnel (e.g., doctors)
   4. Helicopter services
   5. Veterinarians

b. Government Agencies and Contacts
   1. Local Emergency Planning Committee
   2. National Response Center
   3. State Emergency Response Commission
   4. State and Local Law Enforcement Agencies
   5. Civil Defense
   6. Fire Departments
   7. Other applicable government agencies.

c. Operator and Contractors
   ·I. Operator personnel
   2. Contractor personnel
   3. Applicable service companies

d. Public

7.8 TRAINING AND DRILLS

The value of training and drills in emergency response procedures for oil and gas operations involving hydrogen sulfide or sulfur dioxide cannot be over emphasized. All personnel identified in the plan shall have appropriate training. It is important that the training conveys a full appreciation of the importance of each role and the effect that each person has on implementing an effective emergency response.

Exercises or drills that simulate an emergency in which personnel perform or demonstrate their duties are important tools that can convey the importance of contingency plans and result in their being kept current. The exercise can be a tabletop or classroom discussion; or can be a realistic driJI in which equipment is deployed, communication equipment is tested, and "victims" are sent to hospital facilities with simulated injuries. Public officials should be informed of (and preferably involved in) these exercises. After a plan is tested, it should be revised and retested until those responsible for the plan are confident the plan is operational. Refer to *NRT-1: Hazardous Materials Emergency Planning Guide.*

21Emergency Response Planning Guide Level 2 (ERPG-2), refer to Reference 27. ERPG-2 is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

7.9 UPDATING PROVISIONS

A contingency plan shall be periodically reviewed and updated any time its provisions or coverage change (refer to Par. 9.24).

8 Design and Construction Practices

8.1 DESIGN GUIDELINES

Recommendations presented in Section 8 apply to producing and gas processing plant operations where the fluids handled contain sufficient hydrogen sulfide to be within the scope of *NACE Standard MROJ75. NACE Standard MROJ* 75 may also be a useful reference when designing and constructing other facilities handling hydrogen sulfide. Refer to Appendix D for infonnation on defining a sour environment. All pressure vessels should be designed and constructed in accordance with *ASME Boiler and Pressure Vessel Code* [refer to *Synopsis of Boiler and Pressure Vessel Laws, Rules, and Regulations by States, Cities, Counties, and Provinces (United States and Canada)]*. All piping systems should be designed and constructed in accordance with applicable provisions of *ANSI B31.3*,*ANSI B31.4*, OR *ANSI B31.8*.

Manufactured equipment shall be designed, constructed, tested, and approved to meet or exceed system requirements for hydrogen sulfide service and should be installed in compliance with applicable codes and industry-accepted standards.

8.1.1 Process and Mechanical Considerations

Factors to be considered in facility design include, but are not limited to, the hydrogen sulfide concentration and impact of atmospheric and operating temperatures, system pressures, pH and water content of system fluids, mechanical stresses imposed on system components, operating and physical strength changes of system components resulting from corrosion and scale deposits, and conditions peculiar to individual processes that could be of a detrimental nature to the system.

8.1.2 Design Considerations

To minimize internal corrosion, piping and vessels should be designed and installed in such a way that areas of insufficient flow (incJuding dead-end piping) are eliminated. Where this cannot be accomplished, provisions should be made for draining of accumulated fluids. Drain systems for hydrogen sulfide laden fluids should be designed to prevent migration of hydrogen sulfide from one point in the facility to another.

8.1.3 Materials Considerations

When exposed to an environment containing hydrogen sulfide, many materials may suddenly fail in a brittle manner. Failure occurs by a form of embrittlement known as sulfide stress cracking (SSC). Susceptibility of a given material to sulfide stress cracking increases as strength and tensile stress (residual or applied) increase. Material hardness frequently is used as an indirect measure of strength and sometimes is referenced as a limiting parameter. The failure of certain producing and gas processing plant equipment components used in the sulfide stress cracking regime could result in the uncontrolled release of hydrogen sulfide to the atmosphere. Such components should be made from sulfide stress cracking resistant materials (refer to Par. 8.1.4).

8.1.4 Materials Selection

Metallic materials satisfactory for use in hydrogen sulfide environments and the conditions under which they should be used are described in *NACE Standard MR0/75*. The latest revision of this standard should be consulted when selecting materials for use in hydrogen sulfide environments. The provisions of *NACE Standard MR0/75* should be considered minimum standards, with the equipment user free to apply more stringent specifications. The material requirements of *NACE Standard MROI75* offer resistance to sulfide stress cracking (SSC); however, other forms of corrosion and modes of failure (such as pining, hydrogen-induced cracking, and chloride cracking) should be considered in the design and operation of equipment. Control of failures by mechanisms other than SSC should be mitigated by chemical inhibition, material selection, and environmental controls (refer to *NACE Standard MROJ* 75, Par. 1.1). Appendix D includes excerpts from *NACE Standard MROJ75*, providing the definition of a sour environment and graphs that may be used to determine when sulfide stress cracking resistant materials should be used. Users of this publication should check the latest edition of *NACE Standard MROJ* 75 for revisions to the defining criteria for a sour environment.

8.1.4.1 Manufacturer certification of compliance with *NACE Standard MROJ* 75 for equipment intended for hydrogen sulfide service may be required by the user, depending on severity of the service. Adequate quality assurance procedures should be followed to verify compliance by the manufacturer for the original equipment and for any subsequent equipment modifications.

8.1.4.2 Materials not covered in *NACE Standard MR0/75* that have been qualified for hydrogen sulfide environment service by the user or manufacturer, using recognized and acceptable testing procedures, may be used. A written agreement between the manufacturer and user may be appropriate. Recognized and acceptable testing procedures are those that demonstrate that the material(s) performs as well as or superior to similar material(s) set forth in *NACE Standard MR0/75*, using laboratory procedures or procedures for which testing has been completed under actual or simulated environmental conditions. The suitability of materials must be supported by appropriate documentation that should include a complete description of the materials, processing, and testing procedure. Laboratory, field, or other environmental testing results or service performance should be recorded in writing. Full documentation supporting the suitability of the material(s) for the selected service should be maintained by the user, manufacturer, or both. Materials use is subject to compliance with applicable regulations.

8.1.5 Site Selection

In selecting a facility site, consideration should be given to taking advantage of the prevailing wind direction, climatic conditions, terrain, transportation routes, and the proximity of populated or public areas. Site selection should consider maintenance of clear entrance and exit routes and should minimize existence of confined spaces. Applicable regulatory requirements concerning location, spacing, and height of flares or vent stacks shall be considered in site selection.

8.1.6 Warning Method

Facility design should incorporate a means to provide a warning of a hazardous upset or condition. Devices and equipment such as hydrogen sulfide monitoring equipment, hazardous warning equipment (audible or visual), and process monitoring devices (such as pressure and flow rate sensors) should be considered. The operator should specify, and the design should consider, the physical and environmental conditions that will be present at the installation site.

8.2 . CONSTRUCTION GUIDELINES

Construction of facilities within the scope described in Paragraph 8. I should be conducted in accordance with the following recommendations, as applicable.

8.2.1 Fabrication and Joining System Components

Welding rods of proper composition and size, applied at recommended temperature and rate, should be used to join pipe and system components by welding. Preheating, postheating, stress relieving, and hardness control requirements should be in accordance with a welding procedure specification (WPS). Proper bolting and gasket materials should be selected in accordance with *NACE Standard MR0J75*. Proper alignment should be maintained for all piping, and all system components should be adequately supported to reduce stresses.

8.2.2 Qualification of Personnel

Fabrication of system components and joining of pipe should be done by experienced and qualified **workers.** Piping system welders should have passed a perfonnance qualification test in accordance with Section IX, *ASME Boiler and Pressure Vessel Code* or *AP/ Standard l 104.* Qualification under *AP! Standard l 104* **will** satisfy U. S. Department of Transportation (DOT) requirements for pipelines. Welders shall be permitted only to weld on materials, and to use only procedures, for which they are currently qualified.

8.2.3 Handling and Storage of Equipment

Materials and equipment used in facility construction, reconstruction, repair, or in routine maintenance should be stored and handled in a manner that will not jeopardize their integrity. Where equipment storage is required or where use after installation is delayed, adequate precautionary measures against corrosion, fouling, deterioration, and other harmful effects should be employed. Reliable warehouse control methods shall be employed to assure that material and equipment unsuitable for hydrogen sulfide service is not inadvertently used in hydrogen sulfide service.

8.2.4 Inspection

Pressure-containing components should be thoroughly cleaned and pressure tested in accordance with applicable construction codes. Welded connections should be tested by non-destructive tests (such as ultrasonic or radiographic methods). Final facility inspection should be conducted by knowledgeable personnel to determine that the completed facility complies with design specifications and material records and that markings indicate materials used are suitable for the intended service. Refer to *AP! 510* and *AP! Recommended Practice J2R1.*

8.2.5 Repairs

Equipment or systems damaged or worn to the extent that their safety and reliability are doubtful shall not be placed or retained in service. Vessel, piping, and equipment repairs shall be made by qualified and, where required, certified personnel in accordance with applicable codes and good work practices. Only compatible materials, suitable for use in the existing hydrogen sulfide environment shall be used to repair or replace equipment for use in this service. Refer to *AP/ 510.*

8.3 ELECTRICAL DESIGN CONSIDERATIONS

In addition to being toxic, hydrogen sulfide is flammable at concentrations of 4.3 to 46 percent (by volume) in **air.** Electrical equipment installed in areas subject to exposure to a methane-hydrogen sulfide mixture composed of *25%* or more (by volume) of hydrogen sulfide should be suitable for Class I, Group C classified areas (refer to Par. 3.5, "National Electric Code Grouping of Atmospheric Mixtures," in *AP/ Recommended Practice 500*).

9 Operating Practices

9.1 INTRODUCTION

Section 9 discusses operating practices that should be followed to provide integrity of equipment and continuity of work practices in operations involving the design and handling of materials in hydrogen sulfide service (refer to Par. 4.1 and applicable regulatory requirements). Each equipment installation or work procedure should be reviewed and observed as often as necessary to detect when changes may be needed in operating practices or equipment. *Water injection and other enhanced recovery operations may result in the introduction of bacteria that can cause water soluble hydrogen sulfide to develop over time and be present in produced fluids.*

9.2 EMERGENCY PROCEDURES

Emergency operating and shutdown procedures sha11 be posted or readily available to operating personnel.

9.3 TEST PROCEDURES

Tests of the gas phase of produced fluids shall be conducted periodica11y to determine the hydrogen sulfide concentration. Procedures should be established and routine operational tests should be conducted periodically for hydrogen sulfide detection and monitoring equipment and alarm devices, forced air ventilation systems, and similar safety devices. Results of these tests should be recorded.

9.4 SAFE WORK PRACTICES

Safe operating procedures should be developed for performing operations and maintenance (e.g., tank gauging, water line blowdown, line repair, valve replacement, and sampling) so hazards due to the release of hydrogen sulfide can be avoided. A safety review of the work should be performed prior to beginning any maintenance or operating work activities requiring personnel to be in areas that could contain concentrations of hydrogen sulfide or sulfur dioxide exceeding the levels stipulated in Par. 4.1. Legible warning signs, such as "HYDROGEN SULFIDE OPERATIONS-ENTER ONLY WHEN MONITORING SHOWS THE AREA TO BE SAFE" or "RESPIRATORY PROTECTION MUST BE **WORN** BEYOND THIS POINT", should be prominently posted in the area where produced fluids containing hydrogen sulfide (refer to Par. 4.1 for applicability) are being handled or processed.

Note: Regulatory requirements for sign posting shall be observed.

9.5 LEAK DETECTION

In produced fluids handling systems containing hydrogen sulfide in concentrations capable of causing abllosphere concentrations in excess of IO ppm, monitoring techniques or procedures (for example, visual observation, soap bubble test, portable detection equipment, fixed monitoring equipment) should be employed to detect leaks. Particular attention should be given to enclosed facilities (refer to Section 12).

9.6 SAFE WORK PERMITS

For activities without previously established operating procedures, special safety review documentation (e.g., hot work permits and check-off lists) outlining specific safety precautions with specific authorization should be used. Documentation should include personnel protective equipment required; equipment that should be properly blinded, blanked, or disconnected; equipment and piping that should be properly vented; procedures for excavation of buried lines in processing areas; etc.

9.7 VALVES, CONNECTIONS, AND GAUGES

Valves, flanges, gauges, connections, and other components should be observed for evidence of needed inspection, repair, or maintenance. The cause of equipment failure should be investigated and determined. If failure is caused by exposure to hydrogen sulfide, alternate methods or equipment should be considered.

9.8 ARTIFICIAL LIFT WELLS

Artificial lift wells should be observed for any change in operating conditions that could cause leaks or failures. Significant changes in wellhead pressure, gas-oil-water ratios, flow rates, and similar parameters should be evaluated to prevent leaks or failures.

9.9 FLOWING WELLS

Annuli of flowing we11s should be tested at regular intervals for any pressure changes. Such pressure changes may indicate a downhole failure of the packer, tubing, or casing. Changes in fluid volumes or ratios, fluid corrosiveness, and surface pressures should be evaluated to determine the need for corrective measures.

9.10 FLOW/GATHERING LINES

Flow line and gathering line right-of-ways should be observed for conditions conducive to pipeline failures, such as those caused by excavation, construction, trespassing, or surface erosion.

9.11 PRESSURE VESSELS

Relief valves and other applicable components on pressure vessels shall be tested according to regulatory requirements or company policy. Refer to *AP/ 510* and *AP/*

Recommended Practice 576.

9.12 PRESSURE RELIEF AND NORMALLY VENTING DEVICES

The discharge of pressure relief and nonnally venting devices should be located away from work areas and designed to maximize dispersion and minimize personnel exposure to hydrogen sulfide. Refer to Par. 8.1.4 for considerations for materials applications in hydrogen sulfide service.

9.13 STORAGE TANKS

Produced liquids storage tanks should be observed for needed repairs or maintenance. The tank thief hatch seals, inspection and clean-out plate seals, vent line back-pressure valves, etc., should be serviced or replaced as appropriate. Refer to *AP/ Recommended Practice l 2Rl.*

9.14 FLARE SYSTEMS

Ignition devices for flare systems handling hydrogen sulfide in hazardous concentrations should be inspected and serviced regularly to ensure proper operation.

9.15 MONITORING EQUIPMENT-MAINTENANCE, TESTING, AND CALIBRATION

Monitoring equipment used to detect occupational exposure levels of hydrogen sulfide shall be serviced and tested at intervals recommended by the manufacturer, and possibly more frequently under extreme humidity, temperature, dust, or other adverse environmental operating conditions. The monitoring equipment should be calibrated by qualified individuals at intervals frequent enough to enable the user to determine an acceptable calibration schedule. The equipment should be calibrated once every three (3) months, at intervals not exceeding 100 days. Refer to *ISA Recommended Practice 12.15,* the equipment manufacturer's instruction manual, and Section I0.

9.16 CORROSION MONITORING

A corrosion monitoring program should be established to detect and mitigate internal and external corrosion activity that can affect equipment in hydrogen sulfide service.

9.17 CONFINED SPACE ENTRY

Enclosures with known or potential hydrogen sulfide hazards and restricted means of entrance and exit deserve special attention. These enclosures are not norma11y occupied by people nor well ventilated. Examples of such enclosures in the oil and gas producing and gas processing plant industries may include tanks, ceUars, process vessels, tank trucks, temporary and permanent pits and trenches, and barges. A confined space entry pennit shall be required for entry into a confined space. A confined space entry pennit should as a minimum:

a. identify the job site.
b. indicate the date and duration of the pennit.
c. specify testing requirements and other conditions to safely perform the job.
d. ensure that sufficient monitoring is conducted to ascertain that the hydrogen sulfide, oxygen,[22] or hydrocarbon concentrations do not become a health or fire hazard, and
e. bear the approval specified in the operator's procedure.

As an alternate to foregoing Par. 9.17, Item d, proper personal protective breathing equipment may be worn during the work operation; however, sufficient monitoring of the enclosure atmosphere shaJI be performed to ensure that it is free of an ignitable mixture of hydrocarbons. Refer to OSHA's Confined Space Entry Standard {29 *Code of Federal Regulations* Part I910.146)

9.18 ENCLOSED FACILITY ENTRY

Personnel shaJI use extreme caution before entering enclosed facilities such as buildings housing oil, gas, or produced water processing and handling equipment containing hazardous concentrations of hydrogen sulfide. Personnel shall either establish that entry without personal protective breathing (respiratory protection) apparatus will be safe or shall wear protective breathing equipment. Refer to Section 12 for additional details and precautions.

9.19 IRON SULFIDE PRECAUTIONS

Iron sulfide, a reaction product of hydrogen sulfide and iron or spent iron sponge (a treating material), when exposed to **air,** can autoignite (spontaneous combustion) and bum. Iron sulfide, when exposed to air, should be kept wet until it can be disposed of in accordance with applicable regulations. Iron sulfide scale can accumulate on inside surfaces of vessels and on filter elements used in amine systems and become an autoignition hazard if exposed to atmospheric oxygen. One of the products of burning iron sulfide is sulfur dioxide; proper safety procedures must be effected to deal with this toxic substance.

9.20 DRILLING OPERATIONS

Refer to *AP/ Recommended Practice 49* for recommended procedures for drilling and drill stem testing operations involving hydrogen sulfide.

[22] *AP/ PUBL 2217A: Guidelines/or Work in Confined Spaces in the Petroleum Industry* specifies an oxygen content of less than 19.5% as oxygen deficient and an oxygen content of less than 16% is considered immediately dangerous to life and helath (IDLH).

9.21 SAFETY PRECAUTIONS FOR SAMPLING AND TANK GAUGING OPERATIONS

When it is known or suspected that the system to be sampled or gauged may contain hydrogen sulfide, special precautions shall be observed. Production tanks shall be tested to determine their hydrogen sulfide content (refer to Par. 9.3). Tests should also be conducted within the normal worker breathing zone to determine if the levels stipulated in Par 4.1 may be exceeded and if engineering controls, administrative procedures, or personal protective breathing equipment (refer to Par. 6.4) may be required for sampling or tank gauging operations. The tests should be conducted under operating and atmospheric conditions to determine the maximum hydrogen sulfide exposure level.

If the hydrogen sulfide level in the worker breathing zone exceeds IDLH level (300 ppm), in addition to appropriate personal protective breathing equipment (refer to Par. 6.4), rescue precautions and procedures (refer to Pars. 6.5 and 6.6) shall be utilized.

9.22 FACILITIES ABANDONMENT-SURFACE EQUIPMENT

Precautions should be taken to ensure that hazardous quantities of hydrogen sulfide do not remain in abandoned surface equipment, including buried pipelines and flow lines. Pipelines and flow lines left in place should be purged, bullplugged, or otherwise capped. Vessels should be flushed with water, purged, drained, and left open to the atmosphere. Precautions should be taken to prevent an iron sulfide fire (refer to Par. 9.19).

CAUTION: Prior to abandonment, vessels should be checked for the presence of naturally occurring radioactive material (NORM) and appropriate safety and handling procedures should be exercised. Refer to *AP/ Bulletin E-2* for guidance on management of NORM.

9.23 WELL ABANDONMENT

The following recommended practices are not intended to supersede federal, state, or local regulations for well abandonment. Where not covered by applicable regulations, the practices and well conditions should be considered in planning and effecting pennanent well abandonment. It is recommended that cement be set across formations that are known to produce or could produce hydrogen sulfide in hazardous concentrations. Refer to *AP/ Bulletin E-3* for guidance and procedures for plugging and abandoning wells.

9.24 CONTINGENCY PLAN REVISIONS

Operating personnel should be observant for changes that would make reconsiderations and possible revisions advisable in contingency plan coverage, location(s) of monitoring equipment, and location(s) of lease equipment. Some changes that should be observed and considered are new residences or residential areas, stores, businesses, parks, schools, or roads; changes in well operations; and changes in lease facilities. Refer to Section 7 for suggested procedures for planning and implementing contingency plans and emergency procedures.

1O Guidelines for Evaluation and Selection of Continuous Hydrogen Sulfide Monitoring Equipment

10.1 INTRODUCTION

Section 10 is provided to make users of hydrogen sulfide monitoring equipment aware of some equipment limitations and certain desirable features of such equipment. There are a number of detection principles and analytical procedures available for monitoring the concentration of hydrogen sulfide in ambient air where the potential exists for exposure to levels that may be hazardous to health. These guidelines are intended to aid in the selection and application of continuous monitoring equipment for use in production operations involving hydrogen sulfide. The term "continuous hydrogen sulfide monitoring equipment" as used herein is defined as equipment capable of continuously measuring and displaying the concentration of hydrogen sulfide in ambient air. Section IO is not applicable to personnel monitoring badges or length-of-stain or color-comparison type detector devices (refer to *ANSI I /SEA I* 02).

10.2 GENERAL

All monitors, both portable and stationary, shall be designed on sound engineering and scientific principles and constructed of materials suitable for the application. Their design and construction should allow for ease of maintenance and repair. Instruments should be verified by a national recognized testing laboratory (NRTL) as meeting the minimum performance requirements of *ISA-S/2.15,* Part I. Equipment should be installed, operated, and maintained in accordance with *ISA Recommended Practice 12.15,* Part II. It generally is recommended (and frequently required) that electrical controls for safety systems such as hydrogen sulfide monitoring equipment and other gas detector systems be installed normally-energized ("fail-safe"). This means that power is supplied continuously during normal operations to devices which provide alarm(s) and corrective action if concentrations corresponding to specific alarm set points are reached. Under these conditions, interruption of power due to either deliberate safety device actuation or loss of power will initiate corrective action. It is desirable to provide a test means that will allow the system to be tested (and calibrated) without shutting in producing or gas processing plant operations (or other corrective action), but it should be evident to operating personnel that the system is in the test (bypass) mode.

To better ensure proper application, it is recommended that an environmental and application checklist (similar to the example shown in Appendix 1, *ISA Recommended Practice 12.l 5,* Part II) be provided to prospective vendors by the user.

10.3 CONSTRUCTION CHARACTERISTICS

The following construction and useability characteristics are desirable for hydrogen sulfide monitoring equipment.

10.3.1 Portability

Portable monitors, including all required parts and accessories, should weigh a maximum of ten (l 0) pounds and have a maximum volume of one (1) cubic foot.

10.3.2 Power Supply, Portable Monitoring Equipment

Portable hydrogen sulfide monitoring equipment is defined as self-contained, battery-operated, carriable or transportable instruments capable of operating within specifications from integral batteries for a period of eight hours minimum, including a 15 minute period of maximum load conditions (with alarms, lights, etc. activated), while exposed to clean air at a nominal temperature of 14°F(-10°C). Applications requiring in excess of eight hours of continuous operation or operation at lower temperatures should be specified by the end user.

10.3.3 Readout

Monitors should provide a direct readout of hydrogen sulfide concentration in parts per million (ppm) by volume.

10.3.4 Recorder Output

For certain applications, it may be desirable for monitors to provide an output signal (e.g., 4-20 ma) proportional to hydrogen sulfide concentration for use in connection with recorders or for other purposes.

10.3.5 Simplicity of Operation

Monitoring and detection equipment should be readily operable by personnel without scientific background or training in instrumentation.

10.3.6 Instruction Manuals

An instruction manual should be provided by the manufacturer with each instrument The instruction manual should contain complete operating instructions, including procedures for startup, warm-up time, zero checks, calibration, alarm setting and testing, preventive maintenance, performance checks, and trouble-shooting. Monitors with rechargeable power supplies should be furnished with instructions for charging, storing, and maintaining the power supply. Information also should be included regarding instrument recovery time after the exposure of sensor(s) to hydrogen sulfide. The manufacturer should provide response time data and a list of interfering, desensitizing, or contaminating substances or water vapor concentrations known to the in: strument manufacturer which may adversely affect proper operation and performance of the instrument (refer to Par. 10.4.7). Instruction manuals should include wiring diagrams and estimates of the life expectancy of all consumables. The manual should include a complete parts list suitable for identification of all replaceable parts and sources for procurement of these parts.

10.3.7 Electrical Approval

Any portion of a stationary hydrogen sulfide monitoring instrument intended for installation or use in a hazardous (classified) location and all portable monitoring instruments shall be approved for use in such a hazardous (classified) location and marked accordingly. Refer to *NFPA 70,* Article 500-3, FPN No. 2.

10.3.8 Ruggedness

Portable monitoring units should be sufficiently rugged to withstand routine transporting, handling, and use in the field environment, as specified by the user. Refer to *ISA-S12.15* for details of a recommended "drop test" to evaluate portable unit ruggedness and a "vibration test" to evaluate ruggedness of fixed and portable monitors.

10.3.9 Calibration Equipment

All accessories required to calibrate the instruments should be made available by the manufacturer. The life expectancy and any special handling required of any hydrogen sulfide test concentrations should be provided by the supplier.

10.3.1 O Zero and Span Adjustments

Zero and span adjustment controls should be readily accessible for field adjustment, and the monitor design should include provisions to apply zero and calibration gases to the sensor(s) in a non-laboratory environment. All accessories for calibration and zero should be made available with the monitor and should be useable under field conditions.

10.3.11 Alarm Systems

Fixed monitors shall have provisions for external alarms. Portable monitor units should contain integral audible, visual, or physical presentation (e.g., vibrator signal) alarms as specified by the user. Hydrogen sulfide alarms should be unique to the location.

10.3.12 Testing Alarm Circuitry

Provisions should be included for the testing of alarms and alann outputs. The test procedure should be included in the equipment instruction manual.

10.3.13 Remote Sampling

A remote sampling accessory (such as a probe) may be desirable for use with a portable monitoring unit.
CAUTION: Optional probe attachments for portable monitoring units, which allow the user to manually draw samples from remote locations, inherently prevent continuous monitoring of the immediate local environment. Users should consult the manufacturer's instruction manual to determine the proper number of bulb strokes required to draw samples when non-continuous monitoring attachments are used. The remote sampling attachment should be removed after use to restore the instrument to the normal continuous monitoring mode.

10.3.14 Equipment Trouble {Malfunction) Alarm

A trouble (malfunction) signal (indicator or output) should be provided for all monitors.

10.3.15 Detection Range Indication

The range(s) of detection should be conspicuously marked on the instrument.

10.4 PERFORMANCE GUIDELINES

The following recommended performance parameters are . applicable to fixed and portable hydrogen sulfide monitoring equipment.

10.4.1 Accuracy

Instruments should meet requirements of the accuracy test specified in *ISA-S12.15.* Part I. Users are cautioned that the class of instruments suitable for field use are not "laboratory-grade" instruments, and *an equivalent degree of precision should not be expected.*

10.4.2 Zero Drift

Instruments should meet the requirements of the "Long-term Stability Test" specified in *ISA-S12.15,* Part I. Excessive zero drift is undesirable and can require instrument calibration at unreasonably short intervals.

10.4.3 Warm-up Time

The minimum warm-up time when power is first applied should be stated in the equipment instruction manual. A monitor ready-status indicator is a desirable feature.

10.4.4 Response Time

ISA-S12.15. Part I specifies monitoring equipment minimum response time to input step changes. The toxicity of hydrogen sulfide requires that monitoring equipment have rapid response time to alert personnel of potentially dangerous concentrations. Hence, response time of monitoring equipment is an important parameter for consideration in evaluation and selection of such equipment.

10.4.5 Operating Humidity Range

Monitoring equipment should meet the "Humidity Variation Test" specified in *ISA-S12.15,* Part I. Users should advise equipment manufacturers of the humidity ranges expected for specific equipment applications.

10.4.6 Operating Temperature Range

Monitoring equipment should be suitable for viable use in an ambient temperature range of 14°F to 122°F (-10°C to 50°C}. Applications requiring equipment exposure to temperatures outside this range should be specified by the user.

10.4.7 Interferences

A list of interfering, desensitizing, and contaminating substances (e.g., carbon monoxide, sulfur dioxide, aromatic mercaptans, methanol, oxides of nitrogen, aldehydes, carbon sulfide, monoethanolamine, carbon dioxide, benzene, and methane) known by the manufacturer should be listed in the equipment instruction manual. Also, water vapor concentrations which may adversely affect proper equipment operation should be included in the instruction manual.
CAUTION: Monitoring and detector equipment and sensors should be protected from exposure to liquid spray or wash down. Such exposure can affect equipment performance and reliability.

10.4.8 Functional Field Test

Functional field testing of monitoring equipment should be conducted under "as installed" or "as used" conditions. All instrument and system accessories normally used with this equipment should be installed and operated during functional field tests. Functional field tests may include, but are not limited to, exposing the sensor to a sample containing sufficient hydrogen sulfide to cause response of the system. Functional field testing *does not* necessarily include zero and span adjustments. The hydrogen sulfide concentration used in functional field testing of monitoring equipment should not exceed the maximum operating range of the equipment being tested.

10.4.9 Air Velocity

Monitoring equipment should meet the "Air Velocity Variation Test" specified in *ISA-S12.15,* Part I. Accessories are often available and may be desirable for use with detector equipment installed in areas of high air velocity.

10.4.1O Electromagnetic Interference (EMI)

Some monitoring equipment may be susceptible to electromagnetic interference (EMI). particularly radio frequency interference (RFI). Caution should be taken when using monitoring equipment in close proximity to a radio transmitterorother EMI generators. Refer to *ISA-S12.15,* Part I, Sections 9.5 and 11.6.

11 Offshore Operations

11.1 INTRODUCTION

Section 11 presents some additional recommendations that are needed offshore due to the uniqueness of offshore operations. Many recommendations in other sections of this publication also are applicable to offshore operations. Refer to Appendix F, "Toxic Gases•: *AP/ Recommended Practice 14C.*

11.2 UNIQUENESS OF OFFSHORE OPERATIONS

Problems that might be considered minor in onshore operations can be more critical in offshore operations. This is due to the remoteness of offshore operations, compactness of facilities. limited escape and evacuation routes, and sophisticated escape and evacuation equipment.

11.3 FEDERAL REGULATORY REQUIREMENTS

Refer to 30 *Code of Federal Regulations* Parts 250 and 256 for Minerals Management Service, U. S. Department of Interior (DOI) requirements for Outer Continental Shelf (OCS) oil and gas producing operations involving hydrogen sulfide..These regulations include requirements for training personnel involved in OCS oil and gas producing operations and for hydrogen sulfide contingency plans for OCS oil and gas producing operations.

11.4 CONTINGENCY PLANNING

Where potentially hazardous atmospheric concentration of hydrogen sulfide could occur offshore, contingency planning is particularly essential due to the uniqueness of facilities as discussed in Par. 11.2. Although the recommendations for contingency planning presented in Section 7 are applicable to offshore operations, there are additional items that should be addressed. These include. but are not limited to. the following:

a. Training. All personnel shalJ be familiar with the location and use of emergency escape equipment and routes. Personnel regularly assigned to offshore facilities shaU be trained in the requirements of Par. 5.2. as weU as be proficient in the use of oxygen resuscitation equipment.

b. Evacuation Procedures. The U.S. Coast Guard's (Department of Transportation) requirements for emergency evacuation plans for manned Outer Continental Shelf facilities are contained in 33 *Code of Federal Regulations* Parts 140, I 43, and 146 (refer to 54 *Federal Register,* May 18. 1989. 21566). Surface and/or air transportation to the site should be available since it may be necessary to evacuate visitors and other non-essential personnel and to bring in specialists or equipment if a hazardous hydrogen sulfide condition is suspected or does occur. Monitoring for combustible gases (primarily methane) and hydrogen sulfide should be provided to avoid unnecessarily exposing personnel and equipment to the dangers of a fire, explosion, or hazardous concentration during transport or transfer operations. If a hazardous hydrogen sulfide condition is known or suspected to be imminent, boats and helicopters should approach the site from an upwind direction, when possible.

Proper personal protective breathing equipment must be provided for heJicopter and boat crew members and a11 passengers. Evacuation routes and deboarding procedures sha11 be well planned and posted. Evacuation drills shall be regularly performed.

11.5 SIMULTANEOUS OPERATIONS

Particular emphasis must be given to coordination between drilling. well servicing, producing, and construction operations when two or more of these activities are conducted simultaneously. An individual shall be designated to be the person-in-charge for simultaneous operations, and the chain of command shall be communicated to all appJicable personnel.

12 Operations Involving Enclosed Facilities

12.1 INTRODUCTION

Section 12 presents some additional recommendations that are unique to oil and gas producing and gas processing plant operations in enclosed facilities[23] and involving hydrogen sulfide (refer to Par. 4.1). An enclosed facility may be as simple as a single piece of equipment within an enclosure or as complicated as complex onshore or offshore enclosed facilities located in cold climates.

12.2 UNIQUENESS OF OPERATIONS INVOLVING ENCLOSED FACILITIES

The uniqueness of oil and gas producing and gas processing plant operations in enclosed facilities is due to the potential that escaping quantities of hydrocarbon gases containing hydrogen sulfide can be contained in an enclosed space[23], particularly if ventilation is inadequate. This space may be entered by personnel. A small leak of product containing hydrogen sulfide gas that would normally dissipate as it escaped can be contained in the enclosed space surrounding the leak and increase the hazard to entering personnel unless adequate ventilation is provided to reduce the hazard.

12.3 DESIGN CONSIDERATION

The design and construction practices of Section 8 generally apply to enclosed facilities, but there are areas of design that should be considered due to the unique operating situations they present. Additional design considerations for enclosed facilities can include, but are not limited to, the following:

a. Means to prevent flammable liquids and gases from coming into contact with surfaces hot enough to cause ignition. The autoignition temperature for natural gas is approximately 900°F (482°C). The autoignition temperature for other natural gas mixtures ranges from 700°F to 900°F (371°C to 482°C). The autoignition temperature for hydrogen sulfide is approximately 500°F (260°C).
b. Ventilation.
c. Onsite respiratory protection equipment.
d. Electrical equipment (possibly Group C versus Group D equipment required). Refer to Par. 3.5, "National Electrical Code Grouping of Atmospheric Mixtures•: of *AP/ Recommended Practice 500.*
e. Emergency relief and depressuring 'devices and their discharge points.
f. Hydrocarbon vents from diaphragm valves, machinery, and regulators.
g. Compressor depressuring and blowdown lines.
h. Floor drains.
i. Process-drains, manual and automatic.
j. Vents from gas conditioning equipment (glycol and amine).
k. Hydrogen sulfide monitoring system.

12.4 FIXED HYDROGEN SULFIDE MONITORING SYSTEM

In many locations where personnel enter frequently, on a regular basis, or occupy enclosed facilities for relatively long periods of time, fixed hydrogen sulfide monitoring systems (with adequate alarms) can enhance safety. In some locations, an alternative to fixed monitoring systems may be implementation of personnel entry procedures (refer to Pars. 9.18 and 12.5).

Fixed hydrogen sulfide monitoring systems should be installed in facilities containing process equipment (vessels, machinery, etc.) handling gases or fluids containing hydrogen sulfide when a release of these gases or fluids is capable of causing atmospheres with hydrogen sulfide in concentrations exceeding IO ppm when the locations are both:

a. an enclosed area (room, building, or space) as defined by Par. 12.l and *AP/ Recommended Practice 500.*
b. inadequately ventilated. *[Inadequately ventilated* is defined as ventilation (natural or artificial) which is *not* sufficient to prevent the accumulation of significant quantities of hydrogen sulfide-air mixtures in concentrations exceeding 10 ppm]. Adequacy of ventilation should be assessed on a site-specific basis.

Fixed monitoring systems shall contain audible alarm devices (and visual alarm devices in high noise areas, refer to Par. 10.3.11) activated by hydrogen sulfide concentrations at preset levels (not to exceed IO ppm), as required to alert personnel. Hydrogen sulfide monitoring equipment should be calibrated in accordance with Par. 9.15.

It is recognized in specific instances that a fixed combustible gas detection system may detect the existence of a potentially hazardous annospheric condition before a fixed hydrogen sulfide monitoring system that is set to alarm at 10 ppm of hydrogen sulfide would be activated. For example, in a release of a 300 ppm hydrogen sulfide in methane mixture, a combustible gas detector set to alarm at 20% lower explosive limit (LEL) would activate and sound an alarm at a hydrogen sulfide concentration of approximately 3 ppm.

In such instances, a regular testing program should be established to monitor content of the process stream to ensure that the concentration of hydrogen sulfide has not increased. If an increase in the hydrogen sulfide concentration is confirmed, the user should verify adequacy of the detection system in use. This verification should consider an variable criteria that will affect performance of the detection equipment as well as factors that could increase the concentration of hydrogen sulfide in the work atmosphere should a malfunction or equipment failure occur.

CAUTION: This option is limited in its scope and should be used only when an applicable limitations and site specific parameters have been duly considered.

Fixed monitoring systems are also desirable to monitor the air intake for enclosed areas when the air is used for makeup or for pressurizing the enclosed facilities (refer to *NFPA 496).*

12.5 PERSONNEL PROTECTION TECHNIQUES

A method of protecting personnel from exposure to atmospheric concentrations of hydrogen sulfide exceeding 1 0 ppm should be provided in all enclosed faci1ities containing process equipment (vessels, machinery, etc.) handling hydrogen sulfide bearing fluids and capable of causing hydrogen sulfide atmospheric concentrations in excess of 10 ppm. Acceptable methods include:

[23]An enclosed facility (room, building, or space) is defined as a three-dimensional space enclosed by more than two-thirds (213) of the possible projected plane surface and of sufficient size to allow the entry of personnel. For a typical building, this would require that more than two-thirds (213) of **the** walls, ceiling, andior floor be present Refer to *AP/ Recommended Practice* 500.

a. Requiring personnel to wear proper protective breathing apparatus (refer to Par. 6.4) before entering and when in the facility.
b. Installing fixed hydrogen sulfide monitoring equipment (refer to Par. 6.2, Section 10, and Par. 12.4).
c. Properly ventilating the facility to maintain hydrogen sulfide concentrations in the work atmosphere less than IO ppm, confinned by monitoring with a fixed hydrogen sulfide monitoring system. Recirculation of air is allowed, but recirculated air streams should be monitored with fixed monitoring systems to alarm when concentrations of hydrogen sulfide exceed IO ppm in the recirculated air.
d. Testing the facility before entry and continuously while in the facility, using portable hydrogen sulfide detection equipment (refer to Par. 6.3), to ensure that hydrogen sulfide concentration in the work area atmosphere does not exceed I0 ppm.

Note: PersoMel shall either establish that entry without protective breathing (respiratory protection) equipment will be safe or shall wear appropriate personal protective breathing equipment (refer to Par. 6.4).

12.6 WARNING SIGNS

Legible warning signs, such as "HYDROGEN SULFIDE OPERATIONS-ENTER ONLY WHEN MONITORING SHOWS THE AREA TO BE SAFE" or "RESPIRATORY PROTECTION EQUIPMENT MUST BE WORN BEYOND IBIS POINT: shall be prominently posted outside all access doorways leading into enclosed facilities where produced fluids or gases containing hydrogen sulfide (refer to Par. 4.1 for applicability) are being processed or handled.

Note: Regulatory requirements for sign posting shall be observed.

13 Gas Processing Plant Operations

13.1 INTRODUCTION

Section 13 presents some additional recommendations that are unique to gas processing plant operations involving hydrogen sulfide (refer to Par. 4.1.). Some recommendations in other sections of this publication also are applicable to gas processing plant operations.

13.2 GENERAL CONSIDERATIONS

Gas processing plant operations typica11y include more c;omplex processes than field operations (e.g., gas conditioning facilities). Some differences include:

a. potentially higher volumes of gas containing hydrogen sulfide,
b. potentia11y higher concentrations of hydrogen sulfide,
c. generally a greater number of personnel and more equipment, and
d. the assignment of personnel on a more regular basis.

These differences often require special considerations to ensure safe operations involving activities such as vessel and line openings and confined space entry. When such activities are to take place, a coordinating meeting between operations, maintenance, contractor, and other-involved parties should be held to ensure that facility personnel are aware of the activities involved, their effect(s) on plant operations, and the necessary safety precautions that are to be followed.

13.3 GAS CONDITIONING FACILITIES

Many gas treating and sulfur recovery processes are employed in gas processing plants. These processes can be classified into chemical reaction, physical solution, and adsorption processes, and can be further subdivided into regenerable and non-regenerable processes. Regenerable type processes include amine solvents, hot potassium carbonate, molecular sieve, and chelants. Non-regenerable type processes include iron sponge, caustic scrubbers, metal oxides, direct oxidation, and various other sulfur recovery processes. Because most of these methods result in a concentrated hydrogen sulfide stream or reaction product, operators shall be familiar with the various chemical and physical characteristics of the process(es) at the particular facility. The amount of hydrogen sulfide in residence within a process may be sufficient to require implementation of requirements contained in 29 *Code of Federal Regulations* Part 1910.119.

13.4 MATERIALS OF CONSTRUCTION

The failure of gas processing plant equipment components can permit the uncontroUed release of hydrogen sulfide to the atmosphere. Those equipment components in the sulfide stress cracking regime should be made from sulfide stress cracking resistant materials (refer to Par. 8.1.3).

13.5 CORROSION MONITORING

A corrosion monitoring program should be established to minimize internal and external corrosion activity which can affect equipment in hydrogen sulfide service.

13.6 LEAK DETECTION

In gas or liquid handling systems containing hydrogen sulfide in concentrations capable of causing atmospheric concentrations of IO ppm or more of hydrogen sulfide, monitoring techniques or procedures (for example, visual observation, soap bubble test, portable detectors, or fixed monitoring equipment) should be employed to detect leaks. Particular attention should be given to enclosed facilities, such as control rooms, compressor buildings, ce11ars, and sumps (refer to Section 12). Regularly scheduled inspection of equipment for leaks, such as pump seals, is recommended. Results should be retained for a minimum of one year as a part of the facility or equipment operating and maintenance records. Fixed hydrogen sulfide ambient air monitoring systems are recommended (refer to Section 10 and Appendix C) in gas processing plants located near populated areas to facilitate early detection and necessary warning to the general public.

13.7 CONTINGENCY PLANNING

Contingency plans for gas processing plant facilities shall cover plant personnel and the general public that could be exposed to a release of hydrogen sulfide (refer to Appendix B of *AP/ Recommended Practice 750*. Operating personnel must be familiar with emergency plant shutdown procedures, rescue operations, notification procedures, briefing areas, and locations of emergency equipment (refer to Section 7). Visitors shall be briefed on the physical layout of the gas processing facility, applicable warning signals, and how to respond in the event of an emergency.

APPENDIX A-PHYSICAL PROPERTIES AND PHYSIOLOGICAL EFFECTS OF HYDROGEN SULFIDE

A.1 Physical Data

Chemical Name: Hydrogen Sulfide

CAS Number: 7783-06-4

Synonyms: Sulfureted hydrogen, hydrosulfuric acid, dihydrogen sulfide.

Chemical Family: Inorganic sulfide.

Chemical Fommla: **H_2S.**

Normal Physical State: Colorless gas, slightly heavier than air. Vapor density (specific gravity) at 59°F (15°C) and 1 atmosphere - 1.189.

Autoignition Temperature: 500°F (260°C).

Boiling Point: -76.4°F (-60.2°C).

Melting Point: -l 17.2°F (-82.9°C).

Flammable Limits: 4.3 - 46 percent vapor by volume in air.

Solubility: Soluble in water and oil; solubility decreases as the fluid temperature increases.

Combustibility: Bums with a blue flame to produce sulfur dioxide (SO_2). Refer to Appendix B.

Odor and Warning Properties: Hydrogen sulfide has an extremely unpleasant odor, characteristic of rotten eggs, and is easily detected at low concentrations. However, due to rapid onset of olfactory fatigue and paralysis (inability to smell) ODOR *SHALL NOT* BE USED AS A WARNING MEASURE.

A.2 Exposure Limits

The Occupational Safety and Health Administration (OSHA) has established 20 ppm by volume as an acceptable ceiling concentration (ACC) and 50 ppm by volume as an acceptable maximum peak above the ACC for an 8-hour shift for hydrogen sulfide (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-2). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a Threshold Limit Value (TLV)@11i of 10 ppm (eight-hour TWA) and a short term exposure limit (STEL) of 15 ppm averaged over fifteen minutes. Exposure at the STEL should not be repeated more than four times per day with at least sixty minutes between successive exposures in this range. For Outer Continental Shelf (OCS) oil and gas producing operations, exposure levels exceeding 20 ppm instantaneous exposure require use of personal protective breathing equipment pursuant to U.S. Department of Interior, Minerals Management Service Final Rule, 30 *Code of Federal Regulations* Part 250.67, as published at 53 *Federal Register* 10596-10777, April 1, 1988m. The *NIOSH Recommended Standard for Occupational Exposure to Hydrogen Sulfide* should be consulted for additional detailed information. Re·-fer to Table A-2 for additional information on exposure values. CHECK WITH THE EMPLOYER CONCERNING EXPOSURE LIMITS FOR PARTICULAR CIRCUMSTANCES.

A.3 Physiological Effects

INHALATION AT CERTAIN CONCENTRATIONS CAN LEAD TO INJURY OR DEATH (refer to Table A-I). Hydrogen sulfide is an extremely toxic, flammable gas that may be encountered in the production and processing of gas well gas, high-sulfur-content crude oil, crude oil fractions, associated gas, and waters. Since hydrogen sulfide is heavier than air, it can collect in low places. It is colorless and has a foul, rotten-egg odor. In low concentrations, it is detectable by its characteristic odor. However, smell cannot be relied on to forewarn of dangerous concentrations because exposure to high concentrations (greater than 100 ppm) of the gas rapidly paralyzes the sense of smell due to paralysis of the olfactory nerve. A longer exposure to lower concentrations has a similar desensitizing effect on the sense of smell. IT SHOULD BE WELL UNDERSTOOD THAT THE SENSE OF SMELL WILL BE RENDERED INEFFECTIVE BY HYDROGEN SULFIDE, WHICH CAN RESULT IN AN INDIVIDUAL FAILING TO RECOGNIZE THE PRESENCE OF DANGEROUSLY HIGH CONCENTRATIONS. Excess exposure to hydrogen sulfide causes death by poisoning the respiratory system *at the cellular level.* There is some indication that the presence of alcohol in the blood aggravates the effects of hydrogen sulfide in acute poisoning cases. Even at low concentrations (10-50 ppm) hydrogen sulfide is irritating to the eyes and respiratory tract. Closely repeated short-term exposures at low concentrations may lead to irritation of the eyes, nose, and throat. Symptoms from repeated · exposures to low concentrations usually disappear after not being exposed for a period of time. Repeated exposures to low concentrations that do not produce effects initially may eventually lead to irritation if the exposures are frequent.

A.4 Respiratory Protection

The National Institute for Occupational Safety and Health (NIOSH) has examined the criteria for respirator tests and sources of respirator leakage and recommends that positive pressure, either supplied-air or self-contained breathing apparatus, as appropriate, with a full face piece be worn by

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ι1!"11...V" is a tradellllllXed tenn of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer *to Threshold Umit Values and Biological Exposure Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240 (check latest edition).

12JAvailable from Superintendent of Documents, U.S. Government Printing Office, Washington, OC 20402.

anyone exposed to atmosphere containing hydrogen sulfide concentrations above OSHA's ACC (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-2) Refer to Par. 6.4 for proper breathing equipment recommendations for oil and gas producing and gas processing plant operations involving hydrogen sulfide.

Note: There are differences of opinion in the medical community about whelher a person with a perforated eardrum can become overexposed 10 a toxic substance via the ear, even when wearing proper personal breathing apparatus, and whether they should be excluded from work in a hydrogen sulfide environmenr3J. Theoretical calculations by Richard Ronk and M. K. WhiterJJ have led the authors to conclude that tympanic m-embrane (eardrum) defects do not significantly compromise respiratory protection against hydrogen sulfide and that individuals with perforated tympanic membranes should not be excluded from work in a hydrogen sulfide environment The validity of these calculations is supponed by the absence of case reports of hydrogen sulfide poisoning due to tympanic membrane defect.

Ronk and *Whitef3>* also concluded that wearers of positive-pressure, either supplied-air or self-rontained personal breathing apparatus, with a full face piece, as recommended by the National Institute for Occupational Safety and Health (NIOSH), who have a tympanic membrane defect and a concurrent tympanomaxillary shunt or a patulous eustachian tube (the tube remains open) may experience the sensation of outward air flow which can be annoying.

In 1982, the Minerals Management Service (MMS). U.S. Department of Interior, amended requirements of the Outer Continental Shelf (OCS) Hydrogen Sulfide Standard, *MMS-OCS-1*, "Safety Requirements for Drilling Operations in a Hydrogen Sulfide Environment, Outer Continental Shelf", Section 5.2, February I976. MMS rescinded the requirement for personnel eardrum examinations and rescinded the prohibition against persons with perforated eardrums orking in. a hydrogen sulfide environment (refer to 47 *Federal Register* 28888-28890, July 1, 1982).

The U.S. Occupational Safety and Health Administration may address this subject in future revision of its Respiratory Protection Standard (29 *Code of Federal Regulations* Part 1910.134).

fJJCompare **Poda, George A.,** "'Hydrogen Sulfide Can Be Handled Safety•: *Archives ofEnvironmemal Heallh,* Vol. 12, 795-800, June 1966. and Ronk, Richard and White, M. K., "Hydrogen Sulfide and the Probabilities of Inhalation Through Tympanic Membrane Defect': *Journal of Occupational Medicine*, Vol. 25, No. *5*, 337-340, May 1985.

Table A-1-Hydrogen Sulfide

Concentration in Air				
Percent by Volume	Parts Per Million By Volume	Grains Per 100 Std. Cubic Feet	Milligrams Per Cubic Meter/4/	Typical Characteristics Regarding Hydrogen Sulfide Exposure<5J
0.0000 I 3	0.1316!	0.00816)	0.1816)	Obvious and unpleasant odor generally at 0.13 ppm and quite noticeable at 4.6 ppm. As the concentration increases, the sense of smell fatigues and the gas can no longer be detected by odor.16!
0.01	10	0.63	14.41	Unpleasant odor. Possible eye irritation. ACGIH recommended Threshold Limit Value (TI..V)® (eight-hour 1WA).C7i
0.0015	15	0.94	21.61	ACGIH STEL averaged over 15 minutes.m
0.02	20	1.26	28.83	Burning sensation in eyes and irritation of the respiratory tract after one hour or more exposure. OSHA ACC (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-2).
0.005	50	3.15	72.o7	Loss of sense of smell after about 15 or more minutes exposure. Exposure over one hour may lead to headache, dizziness, and/or staggering. Pulmonary edema reported following extended exposure to greater than 50 ppm.18! Exposure at 50 ppm or greater can cause serious eye irritation or damage.
O.QJ	100	6.30	144.14	Coughing, eye irritation. loss of sense of smell after 3 to 15 minutes. Altered respiration, pain in eyes, and drowsiness after 15 to 20 minutes, followed by throat irritation after one hour. Prolonged exposure results in a gradual increase in the severity of these symptoms.
O.o3	300	18.90	432.40	Marked conjunctivitis and respiratory tract irritation. Note: Concentration considered immediately dangerous to life or health (IDLHY9J(refer to *DHHS No. 85-114, NJOSH Pocket Guide to Chemical Hav:irds.1101*
0.05	500	31.49	720.49	Unconsciousness after short exposure, cessation of breathing if not treated quickly. Dizziness, loss of sense of reasoning and balance. Victims need prompt artificial ventilation and /or cardiopulmonary resuscitation (CPR) techniques.
0.07	700	44.08	1008.55	Unconscious quickly. Breathing will stop and death will result if not rescued promptly. Artificial ventilation and/or cardiopulmonary resuscitation (CPR) is needed immediately.
0.10+	looo+	62.98+	1440.98+	Unconsciousness at once. Permanent brain damage or death may result. Rescue promptly and apply artificial ventilation and /or cardiopulmonary resuscitation (CPR).

Note: Data in Table A-1 are approximate values for guidance. There are published data that show slightly different values.

14JBased on 1% hydrogen sulfide - 629.77 gr/100 SCF@ 14.696 psia and 59°F (101.325 KPa and 15°C).

15/Hydrogen sulfide has physiological effects on humans. These effects vary from person to person. FOR ADDmONAL INFORMATION, CONSULT WITH THE EMPLOYER AND RESEARCH THE MATERIAL SAFETY DATA SHEETS (MSDS).

16/fhere are wide variations in reported odor thresholds for hydrogen sulfide. A U.S. Environmental Protection Agency draft report states a range for the odor threshold of0.1-0.2 ppm (refer to Review Draft: *Health Assessmenr Document for Hydrogen Sulfide,* EPA/600/8-86/026A, August 1986). A Petroleum Association for Conservation of the Canadian Environment (PACE) report, *Review of Ambient Hydrogen Sulfide Standards in Canada,* No. 85-5, December 1985, cites an odor threshold range of 0.005-0.05 ppm from the National Resource Council of Canada (1981) at Table 3.1 (page 3-10). The PACE document also cites reports of wider ranges of odor threshold from 0.0005-1.4 ppm at Table 4.1 (page 4-4).

17!'11..V" is a trademarked term of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, Ohio 45240 (check latest edition).

18JEPA Draft Review Document, supra Note *(6),* page 1-2.

19ilDLH means an atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere (refer to 29 *Code of Federal Regulations* Part 1910.120). NIOSH considers 300 ppm or more to be the IDLH concentration for hydrogen sulfide (refer to *NIOSH Pocket Guide to Chemical Hazards).*

110/Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Table A-2-Summary of Occupational Exposure Values for Hydrogen Sulfide

OSHA ACCs[1]				ACGIH TLVs[2]				NIOSH RELs[3]			
ACC		Maximum Peak Above ACC For 8-hours		1WA		STEL		1WA		CEIL(C)	
ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³
20	29	50	72	IO	14	15	21	NIA	NIA	CI0	C15

ACC Acceptable Ceiling Concentration.
TI.Vs Threshold Limit Values.
RELs Recommended Exposure Limits.
1WA Eight-hour Time Weighted Average (refer to specific reference document for different methods of weighting used).
STEL Shon Term Exposure Limit averaged over a period of IS minutes.
NIA Not Applicable.
CEIL(C) NIOSH Ceiling Exposure Limit averaged over a period of 10 minutes.

[1] Refer to 29 *Code of Federal Regulations* Pan 1910.1000, Subpan Z, TableZ-2.
[2] Refer to *Threshold limit Values and Biological Exposure Indices, 1993-94.*
[3] Refer to *NJOSH 77-158: Criteria for a Recommended Standard for Occupational Exposure to Hydrogen Sulfide.*

APPENDIX B-PHYSICAL PROPERTIES AND PHYSIOLOGICAL EFFECTS OF SULFUR DIOXIDE

8.1 Physical Data

Chemical Name: Sulfur Dioxide.
CAS Number: 7446-09-05.
Synonyms: Sulfurous anhydride, sulfurous oxide.
Chemical Family: Inorganic.
Chemical Formula: SO_2.
Normal Physical State: Colorless gas appreciably heavier than air. Vapor density (specific gravity) at 32°F (0°C) and 1 atmosphere - 2.26.
Boiling Point: l4°F (-I0.0°C).
Flammable Limits: Non-flammable (produced from burning hydrogen sulfide).
Solubility: Readily soluble in water and oil; solubility decreases as the fluid temperature increases.
Odor and Warning Properties: Sulfur dioxide has a pungent odor associated with burning sulfur. It produces a suffocating effect and produces sulfurous acid on membranes of the nose and throat.

8.2 Exposure Limits

The Occupational Safety and Health Administration (OSHA) has established a permissible exposure limit (PEL) of 5 ppm as an 8-hour TWA for sulfur dioxide (refer to 29) *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-1. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends 2 ppm as an eight-hour TWA Threshold Limit Value (TLV)@ and 5 ppm as a STEL averaged over I5 minutes for sulfur dioxide.'14[1] Refer to Table B-2 for additional information on exposure values. CHECK WITH THE EMPLOYER CONCERNING EXPOSURE LIMITS FOR PARTICULAR CIRCUMSTANCES.

8.3 Physiological Effects

B.3.1 ACUTE TOXICITY

INHALATION AT CERTAIN CONCENTRATIONS CAN LEAD TO INJURY OR DEATH (refer to Table B-I). Exposure to concentrations below 20 ppm can cause eye irritation, throat irritation, respiratory tract irritation, chest constriction, and some nausea. Exposure to concentrations above 20 ppm can result in marked coughing, sneezing, eye irritation, and chest constriction. Exposure to 50 ppm causes irritation to the nose and throat, running nose, coughing, reflex broncho-constriction with possible increase in bronchial mucous secretion, and increased pulmonary resistance to air flow (breathing congestion) occurs promptly. This atmosphere (50 ppm or more) will not be tolerated by most persons for more than I 5 minutes. Some reported acute reactions of exposure to high concentrations include, but are not limited to, inflammation of the eyes, nausea, vomiting, abdominal pain, and sore throat. These symptoms are sometimes followed by bronchitis, pneumonia, and /or complaints of weakness for a period of weeks.

B.3.2 CHRONIC TOXICITY

It has been reported that prolonged exposures to sulfur dioxide may lead to increased risk of chronic nasopharyngitis, alteration in sense of smell and taste, shortness of breath on exertion, and a higher frequency of respiratory tract infections compared to unexposed persons. It has also been postulated that sulfur dioxide in the work environment "possibly enhances" the suspected carcinogenic (cancer) effect of arsenic or other cancer agentsasi. No definite evidence is available regarding co-carcinogenesis or promotion of cancer by sulfur dioxide exposure. A few persons apparently have or develop a hypersusceptibility to sulfur dioxide. Decrements in pulmonary function tests have been noted after both acute and chronic exposures.

B.3.3 EXPOSURE RISKS

It is not yet clear what concentrations of low level exposure or lengths of exposure increase the risks, n r by how much the risks are increased. Sulfur dioxide exposures should be minimized. Smoking by persons exposed to sulfur dioxide should be strongly discouraged.

Note: Any pre-existing chronic respiratory impairment must be considered in regard to job placement since these conditions can be aggravated by exposure to sulfur dioxide.

B.4 Respiratory Protection

The National Institute for Occupational Safety and Health **(NIOSH)** has examined the criteria for respirator tests and sources of respirator leakage and recommends that positive pressure, either supplied-air or self-contained personal breathing apparatus, as appropriate, with a full face piece be worn by anyone exposed to atmosphere containing sulfur dioxide concentrations above OSHA's permissible exposure limit (PEL) (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-1). Refer to Par. 6.4 for proper breathing equipment recommendations for oil and gas producing and gas processing operations involving sulfur dioxide.

"[4]¥11.V" is a trademarked term of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Exposure Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240 (check latest edition).

11[5]J*Criteriafor a Recommended Standard/or Occupational Exposure to Sulfur Dioxide,* NIOSH, 1974, **P.** 26. **Refer** also to the 1977 edition.

Table B-1-Sulfur Dioxide

Concentration in Air				
Percent by Volume	*Parts* Per Million By Volume	Grains Per 100 Std. Cubic Feet	Milligrams Per Cubic Meterf/6/	Typical Characteristics Regarding Hydrogen Sulfide Exposure<17₁
0.0001	I	0.12	2.71	Pungent odor, may cause respiratory changes.
0.0002	2	0.24	5.42	ACGIH *1LV®'l81,* and NIOSH REL.
0.0005	*5*	0.59	13.50	Burning eyes, breathing irritation, and minor throat irritation. Note: OSHA PEL (referto29 *CFR* 1910.1000, Table Z-1; ACGIH and NIOSH STEL. as averaged over 15 minutes.
0.0012	12	1.42	32.49	Throat-irritating cough, constriction in chest, watering eyes, and nausea.
0.010	100	12.0	271.00	Concentration considered immediately dangerous to life or health (IDLH)_l/9/ Refer to *DHHS No.85-114, NlOSH Pocket Guide to Chemical Hazards.<201*
0.015	150	17.76	406.35	Extreme irritation. Can be tolerated for only a few minutes.
0.05	500	59.2	1354.50	Causes a sense of suffocation, even with the first breath. Rescue promptly and apply artificial ventilation and/or cardiopulmonary resuscitation (CPR) techniques.
0.10	I000	118.4	2708.99	Death may result unless rescued promptly. Artificial ventilation and/or cardiopulmonary resuscitation (CPR) techniques should be immediately applied.

Note: Data in Table B-1 are approximate values for guidance. There are published data that show slightly different values.
06/Based on 1% sulfur dioxide - 1184 gr/I00 SCF@ 14.696 psia and 59°F (101.315 kPa and 15°C).
07/Sulfur dioxide has physiological effects on humans. These effects vary from person to person. FOR ADDmONAL INFORMATION, CONSULT WITH THE EMPLOYER AND RESEARCH THE MATERIAL SAFETY DATA SHEEI'S (MSDS).
(JBf'TLV is a trademarked term of American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, Ohio 45240.
I /9JJDLH means an attnospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous attnosphere (refer to 29 *Code of Federal Regulations* Pan 1910.120). NIOSH considers JOO ppm or more to be the IDLH concentration for sutfur dioxide (refer to *NJOSH Pocket Guide to Chemical llaZJJrds).*
/20/Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

Table B-2-Summary of Occupational Exposure Values_ for Sulfur Dioxide

OSHA PELs/2/J				ACGIH 1LVs122J				NIOSH RELsl2JI			
TWA		STEL		TWA		STEL		TWA		STEL	
ppm	mg/m^3	ppm	ppm	ppm	mg/m^3	ppm	mg/m^3	ppm	rng/m3	ppm	mg/m^3
5	14	NIA	*NIA*	2	*5*	*5*	13	2	*5*	*5*	13

PELs Permissible Exposure Limits.
1LVs Threshold Limit Values.
RELs Recommended Exposure Limits.
TWA Eight-hour Time Weighted Average (refer to specific reference document for different methods of weighting used).
STEL Short Term Exposure Limit averaged over a period of 15 minutes.
NIA Not Applicable.
*<21*JRefer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-1.
1221Refer to *Threshold Limit Values and Biological Exposure Indices, 1993-94* (check latest edition).
/2JJRefer to *NIOSH 77-158: Crireriafor a Recommended Srandardfor Occupational Exposure* ro *Sulfur Dioxide.*

APPENDIX C-A SCREENING APPROACH TO DISPERSION OF HYDROGEN SULFIDE

Note: The exposure radii shown in Figures C-1 through C-4 represent estimates developed by APJ's Air Modeling Task Force (AQ7) using simple screening models and modeling techniques. These models should be reasonably accurate for low velocity releases of neutrally-buoyant mixtures of hydrogen sulfide and carrier gas. Figures C-1 through C-4 are useful as a conservative screening tool for high velocity releases and for light hydrogen sulfide carrier gas mixtures. Figures C-1 through C-4 are not recommended for low velocity releases of heavier-than-air hydrogen sulfide/carrier gas mixtures or of potential aerosol-generating mixtures, since these illustrations sometimes will underpredict exposure radii for these mixtures. Site specific conditions should be assessed to determine the need for additional, more rigorous modeling techniques. Users should evaluate their operations and select proper modeling applications for their specific emergency planning purposes.

C.1 Introduction

The material presented in Appendix C is generic in nature and is intended for emergency response planning purposes to arrive at conservative hydrogen sulfide dispersion estimates. Figures C-1 through C-4 present the screening-level, model-predicted radius of exposure (ROE) for annospheric concentrations of hydrogen sulfide at IO, 30, 100, 300, and 500 ppm for both continuous and puff (instantaneous) releases of pure hydrogen sulfide. The ROE represents the distance from the emission source to the concentration of interest measured along the plume's centerline at ground level. Equations were developed for predicting the ROE as a furiction of the quantity/rate of hydrogen sulfide released for each of the hydrogen sulfide concentrations modeled and the type of release (continuous and puff). The equations and corresponding coefficients are presented in Par. C.8 and Table C-1. Meteorological conditions typical of worst-case daytime and nighttime conditions were modeled.

Various regulations dealing with hydrogen sulfide operations prescribe a method(s) or technique(s) for ROE predictions. Such methods must be taken into account because specific compliance actions may require use of a method(s) specified by the regulation, unless use of other methods are allowed.

C.2 Methodology

The ROEs shown in Figures C-l, C-2, C-3, and C-4 were predicted using standard EPA-approved modeling procedures based on Gaussian dispersion theory. The ROEs shown in Figures C-1 and C-2 were predicted by modeling a continuous, steady-state point source release of l00 percent hydrogen sulfide. The ROEs shown in Figures C-3 and C-4 were predicted by modeling an instantaneous hydrogen sulfide release. Both hydrogen sulfide release types were modeled as releases of a neutra1ly-buoyant material under steady-state meteorological conditions. An effective plume height (release height plus plume rise) of 10 feet was used in all the modeling work. It was assumed that the predicted ROEs do not vary significantly with effective plume height in the range of 0-50 feet.

Table C-1-Linear Regression Coefficients for Mathematical Predictions of ROE as a Function of Downwind Hydrogen Sulfide Concentration and Release Quantity/Rate

Time*	Type of Release	Concentration. ppm	Coefficients A	Coefficients B
Day	Continuous	10	0.61	0.84
Day	Continuous	30	0.62	0.59
Day	Continuous	100	0.58	0.45
Day	Continuous	300	0.64	-0.08
Day	Continuous	500	0.64	-0.23
Night	Continuous	10	0.68	1.22
Night	Continuous	30	0.67	1.02
Night	Continuous-	100	0.66	0.69
Night	Continuous	300	0.65	0.46
Night	Continuous	500	0.64	0.32
Day	Puff	10	0.39	2.23
Day	Puff	30	0.39	2.10
Day	Puff	100	0.39	1.91
Day	Puff	300	0.39	1.70
Day	Puff	500	0.40	1.61
Night	Puff	10	0.39	2.77
Night	Puff	30	0.39	2.60
Night	Puff	100	0.40	2.40
Night	Puff	300	0.40	2.20
Night	Puff	500	0.41	2.09

*Day Meteorological Conditions: Stability Class PG D (Neutral)-5 mph Wind Speed.
*Night Meteorological Conditions: Stability Class PG F (Stable)-2.2 mph Wind Speed.

For the purposes of dispersion modeling, the amount of turbulence in the ambient air is categorized into defined increments or stability classes. The most widely used categories are the Pasquill-Gifford (PG) Stability Classes A, B, C, D, E, and F (Pasquill, F., *Atmospheric Difusion*, Second Edition, John Wiley & Sons, New York, New York, 1974). PG Stability Class A denotes the most unstable (most turbulent) air conditions and PG Stability Class F denotes the most stable (least turbulent) air conditions. PG Stability Class D denotes neutral annospheric conditions where the ambient temperature gradient is essentially the same as the adiabatic lapse rate. Under neutral conditions, rising or sinking air parcels cool or heat at the same rate as the ambient air, resulting in no enhancement or suppression of vertical air motion.

Standard Pasquill-Gifford (PG) dispersion coefficients for flat, open grassland were used in the continuous hydrogen sulfide release model. The Slade (refer to *NTJS-TID 24190:* Slade, D. H., *Meteorology and Atomic Energy*, l 968) dispersion coefficients for flat, open grassland were used in the puff (instantaneous) release model. When modeling instantaneous hydrogen sulfide releases it was assumed that the downwind (x) and the crosswind (y) dispersion coefficients

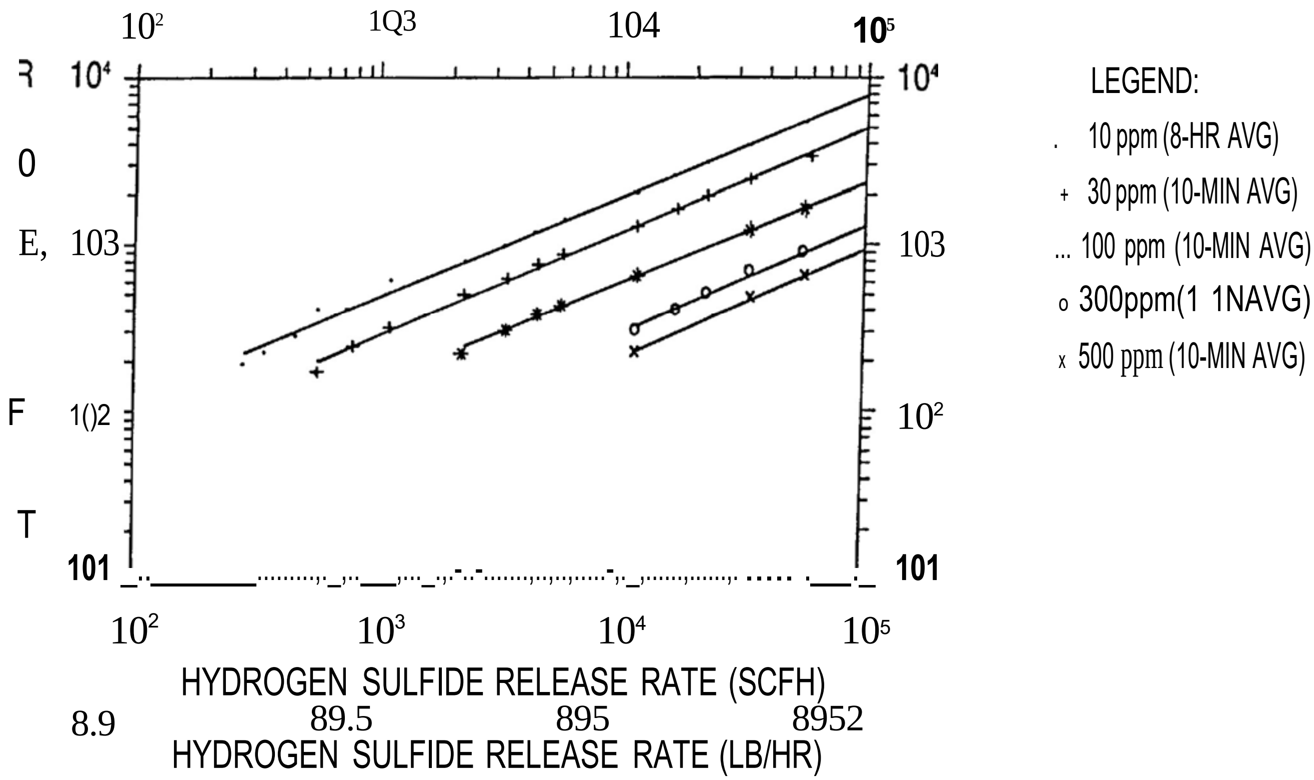

Figure C-1-Radius of Hydrogen Sulfide Exposure
Continuous Daytime Hydrogen Sulfide Releases **[PG D** (Neutral)-5 MPH Wind Speed]

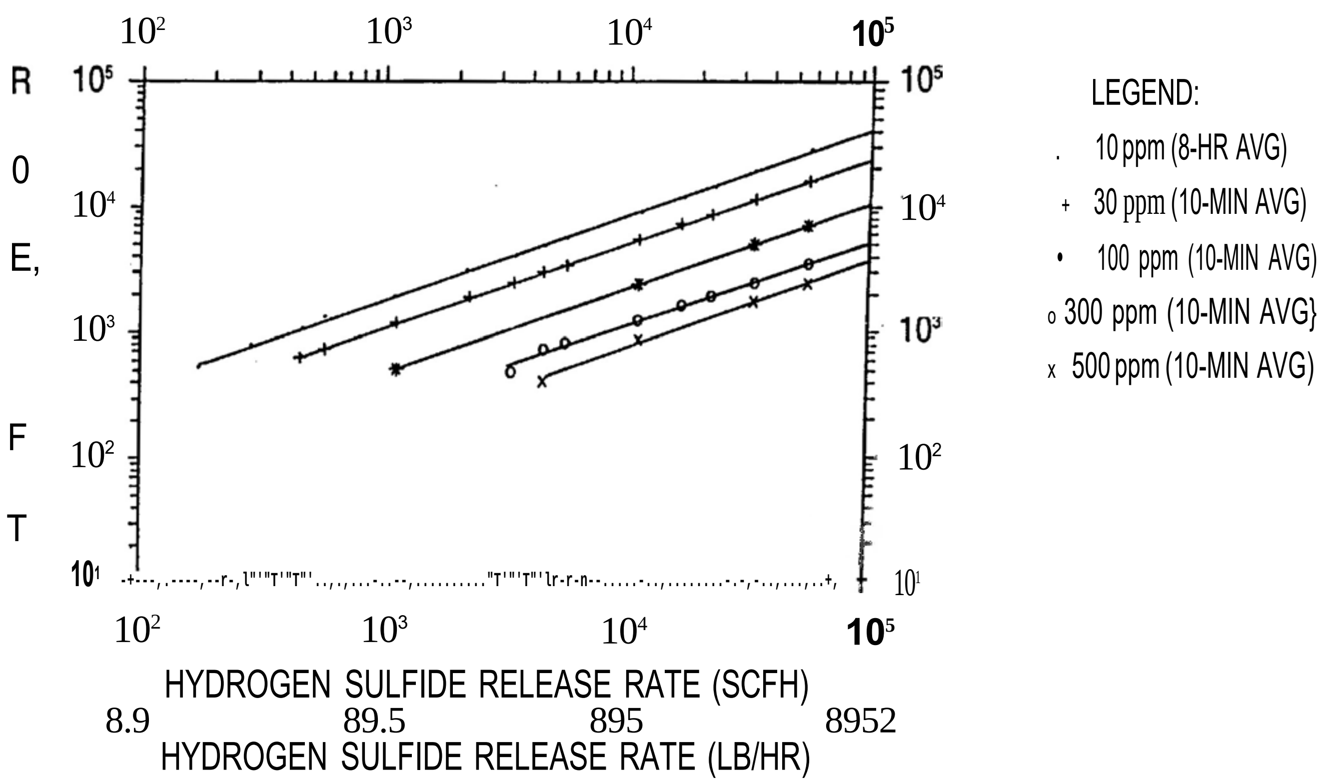

Figure C-2-Radius of Hydrogen Sulfide Exposure
Continuous Nighttime Hydrogen Sulfide Releases [PG F (Stable)-2.2 MPH Wind Speed]

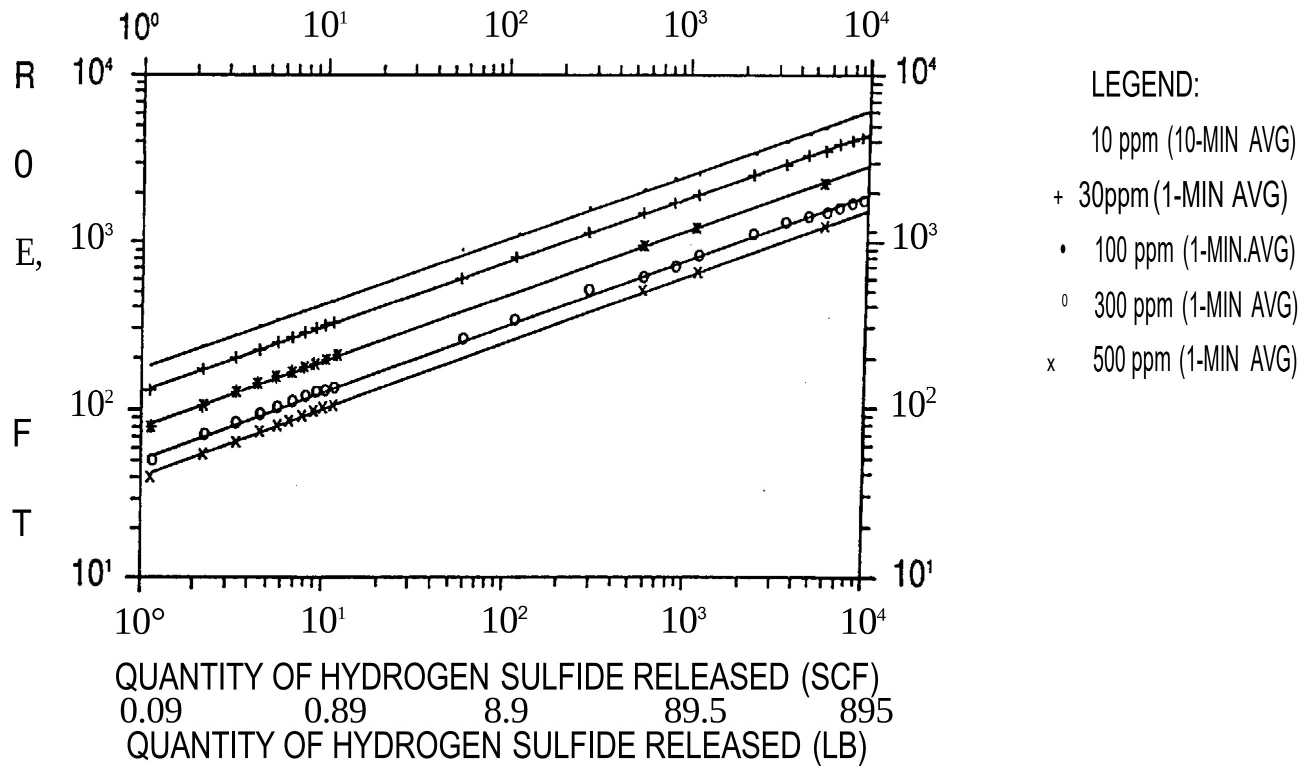

Figure C-3-Radius of Hydrogen Sulfide Exposure
Instantaneous Daytime Hydro.gen Sulfide Releases [Slade A (Slightly Unstable)-5 MPH Wind Speed]

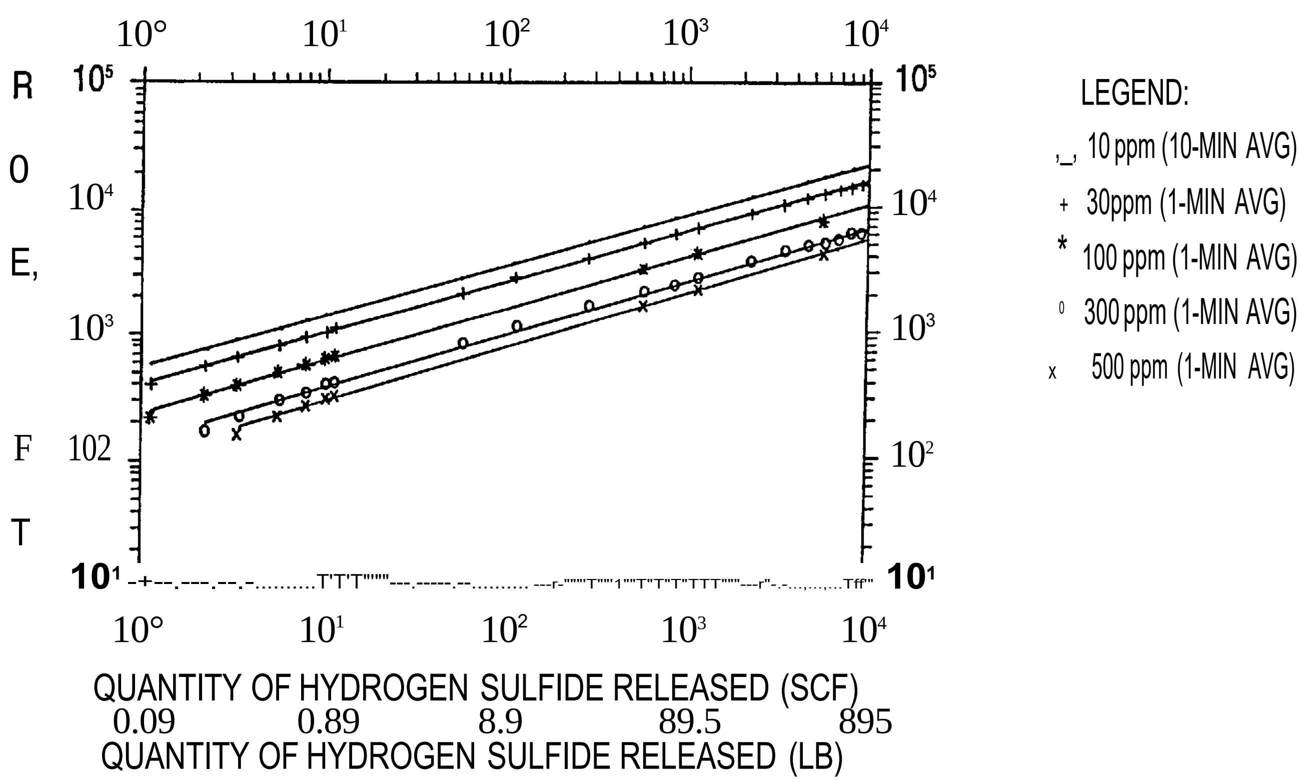

Figure C-4-Radius of Hydrogen Sulfide Exposure
Instantaneous Nighttime Hydrogen Sulfide Releases [Slade B (Neutral)-2.2 MPH Wind Speed]

were equivalent. This assumption results in conservative (worst case) estimates of the ROEs. The following meteorological conditions **were** assumed to be representative of worst case daytime and nighttime conditions. For continuous daytime releases a neutral Stability Class **(PG D)** and 5 miles per hour wind speed were chosen. For continuous nighttime releases, a stable Stability Class (PG F) **and a** 2.2 **miles per** hour wind speed were chosen. For instantaneous (puff) daytime releases, a slightly unstable **Stability** Class **(Slade A)** and a 5 **miles per** hour wind **speed** were chosen. For instantaneous nighttime **releases,** a neutral-to-stable Stability Class **(Slade** B) and a 2.2 **miles per** hour **wind speed were** chosen.

The RO Es for continuous hydrogen sulfide **releases** at 30, I**00, 300, and 500** ppm are valid for **averaging times** of IO minutes to I hour. **The RO**Es **shown for** 10 ppm (continuous **hydrogen sulfide release) are based** on **an 8-hour average** concentration, **since** IO ppm **represents the 8-hour time weighted average (1WA) for** hydrogen **sulfide. To obtain the 8-hour/** IO ppm **average** concentration a factor of 0.7 was **used to convert the** I-hour concentrations **(refer to EPA-450/4-88-009:** ***A Workbook** of **Screening Techniques for Assessing Impacts of Toxic Air Pollutants).*** **The ROEs for the puff (instantaneous) hydrogen** sulfide **releases at 30, 100,** 300, and **500 ppm are valid** for **averaging times of** 1 **to 10 minutes. EPA's** 0. 7 **conversion** factor **was used to obtain the** IO **minute/**10 ppm **time averaged** concentrations **from instantaneous peak concentrations predicted** by **the model.** For continuous **releases, the** EPA considers 10-minute and I-**hour averaging times to** be **equivalent. The modeling reported herein assumed that** an instantaneous **release would** be of **a very short duration** (10 to 15 **minutes maximum).**

Brief **descriptions** of the models used to predict **the ROEs** for both continuous and puff (instantaneous) **hydrogen sulfide releases are presented** in Par. C.13.

C.3 Results

ROEs for atmospheric plume-centerline, ground-level concentrations of hydrogen sulfide resulting from instantaneous and continuous hydrogen sulfide releases were predicted and are presented in Figures C-1 through C-4. Figures C-1 and C-2 present the predicted ROEs for continuous hydrogen sulfide releases during worst case daytime and nighttime meteorological conditions, respectively. Figures C-3 and C-4 present the predicted ROEs for instantaneous hydrogen sulfide releases during worst case daytime and nighttime meteorological conditions, respectively. The ROEs for concentrations of I0, 30, I 00, 300 and 500 ppm were modeled for both release types. The 10 ppm concentration ROEs represent an 8-hour averaging time for the continuous hydrogen sulfide release and a 10-minute averaging time for the instantaneous release. The 30, l00, 300, and 500 ppm concentration ROEs represent a I 0-minute averaging time for the continuous hydrogen sulfide release and a I-minute **averaging** time for the instantaneous release. A hydrogen sulfide release rate range of 10 to 10,000 lb/hr (111.8 to 111,765 SCFH) was modeled for the continuous type release. For the puff (instantaneous) type hydrogen sulfide release, a release quantity range of 0.1 to I 000 lbs (1.1 to 11,177 SCF) was modeled. If the hydrogen sulfide release is based on pounds, standard cubic feet (SCF) can be obtained by multiplying pounds by a factor of 11.2.

Note: The ROEs presented in Figures C-1 through C-4 are ploued against the amount of hydrogen sulfide released. For the release of a multi-component gas stream, the actual amount ofhydrogen sulfide released should be used to detennine the ROE.

Equation coefficients based on linear regression for predicting the ROE as a function of the release type (continuous/puff) and quantity/rate of hydrogen sulfide released for both daytime and nighttime meteorological conditions are presented in Table C-1. The equation is given in Par. C.8. The coefficients are applicable only over the ranges presented in Figures C-1 through C-4, and extrapolation could result in overly conservative estimates of the ROEs. Any release lasting significantly longer than 15 minutes should be interpreted as a continuous release. The modeling work presented in Appendix C assumes steady-state meteorological conditions. ROEs predicted for a long averaging time (8-hour) and long downwind distances are conservative because it is unlikely that the same meteorological conditions will persist during that time period.

C.4 Additional Considerations

The modeling work presented in Appendix C assumes a neutraJly-buoyant, gaseous hydrogen sulfide release in flat, rural terrain under steady-state meteorological conditions. Also, the ROEs shown in Figures C-1 through C-4 are for a generic class of hydrogen sulfide releases covering a wide range of site and release conditions. Actual ROEs will be dependent on the specifics of the type of release, release conditions, and release site. For instance, the ROEs for a release in a more urban setting where structures, buildings, etc. are present will be reduced significantly due to structure-induced turbulence. Some other conditions that could significantly affect the actual ROE include: a liquid/aerosol release, dense cloud behavior, a buoyant cloud (plume liftoff), a jet release, time-dependent release (well blowout, pipeline ruptures, etc.), and complex terrain. If any of these phenomena are present, then more rigorous modeling may be necessary.

The ROE curves of Figures C-1 through C-4 should not be used when the mixture of hydrogen sulfide and carrier gas being dispersed is significantly heavier than air and the mixture is released at a low velocity. If the hydrogen sulfide/carrier gas mixture specific gravity exceeds approximately 1.2, Figures C-1 through C-4 may not give conservative ROEs for all release rates and meteorological conditions. Hydrogen sulfide, as encountered in the petroleum industry, is usua11y a minor constituent of a carrier gas, such as natural gas or carbon dioxide. Carbon dioxide has a specific gravity of 1.52. Dispersion predictions for hydrogen sulfide/carbon dioxide mixtures, using a dense gas model sometimes under-predict hydrogen sulfide ROEs for low velocity gas releases. Low velocity gas releases would include those with initial velocities less than 200 feet/second and releases greater than 200 feet/second involve impact of the gas jet from the leak with a nearby surface, thereby breaking the jet's momentum. Likewise, Figures C-1 through C-4 should not be used with any hydrogen sulfide/carrier gas release that potentially could form an aerosol.

Figures C-1 through C-4 can also substantially overpredict ROEs. In the case of hydrogen sulfide/carrier gas mixtures significantly lighter than air (i.e., specific gravity less than 0.8) released at low velocity, use of these illustrations may overpredict ROEs by a factor of 2 to 3. Use of these illustrations can result in overestimation of ROEs for high velocity hydrogen sulfide/carrier gas releases (i.e., gas release velocities greater than 200 feet/second) regardless of the orientation of the release. However, this overprediction is particularly significant in the case of vertical, high-velocity releases. In such situations, the overprediction can be two orders of magnitude. The user should consult more rigorous atmospheric dispersion models.

When calculating the ROE for dilute concentrations of hazardous gases, a significant overestimation can result. For example, it would not be practical to expect higher downwind atmospheric concentrations than are present in the released gas stream. The user should consult more rigorous atmospheric dispersion models.

In summary, the composition of the hydrogen sulfide/carrier gas and the velocity and orientation of the release are critical variables, dramatically affecting predicted hydrogen sulfide ROEs. Also, other variables, such as released gas temperature and flashing or aerosol formation involving liquid containing dissolved hydrogen sulfide, can have significant impacts on ROE predictions. Accurate atmospheric dispersion techniques are, of necessity, complex. Under some circumstances, such as those mentioned above, more rigorous modeling may be required.

References and models are available to address special release scenarios. A partial list of models that may be used in such cases is shown in Pars. C.S and C.6. API does not endorse any one particular model. Further guidance on appropriate model selection and application can be obtained from the model developers as well as other individuals experienced in this field. A specific reference to address well blowout and pipeline ruptures is *"Release and Dispersion of Gas from Pipe Line Ruptures;•* Wilson, D. J., Department of Mechanical Engineering, University of Alberta, Edmonton, Canada.

In the event that hydrogen sulfide release quantities calculated by the user are below the ranges shown in Figures C-1 through C-4, extensions of the ROE curves are allowed to a minimum ROE of 50 feet. In some cases, ROEs of less than SO feet may be inferred from extrapolation of the curves. Figures C-1 through C-4 were developed using an assumed release height plus plume rise of 10 feet. Actual release heights of other than 10 feet will result in different ROEs.

C.5 Proprietary Dispersion Models

Note: Users should carefully evaluate applicability of these models to prevailing conditions.

A list of some proprietary models that can be used to address special site-specific scenarios follows:

CHARM-{Radian Corporation): CHARM is a Gaussian puff model for continuous and instantaneous releases of gases or liquids. The model is configured to handle chemicals that are buoyant, neutrally buoyant, and heavier than air. Heavy gas dispersion is estimated using the Eidsvik model. Source components in the model include a modified version of Shell Oil Company's SPILLS Model. (Radian Corp., 850 MOPAC Blvd., Austin, TX 78759.)

FOCUS-(Quest Consultants, Inc.): FOCUS is a modeling package that includes both emission rate models (two-phase discharges, pool evaporation, jet vapor releases, etc.) and dispersion models for both neutrally-buoyant and dense-gas plumes. The models can be run separately or in a linked mode. (Quest Consultants, Inc., 908 26th Avenue, NW, Suite 103, Norman, OK 73069-6216.)

TRACE-{Dupont): TRACE uses a multiple Lagrangian Wall dispersion model to handle both puff and continuous releases. Wind channeling can be incorporated. Liqui eva oration and buoyancy effects are considered also. (E. I. Dupont de Nemours & Company, 5700 Corea Avenue, Westlake Village, CA 91362.)

WHAZAN-(Technica International): WHAZAN is a package of dispersion models for both neutrally-buoyant and dense-gas plumes. Submodels are included to handle two-phase discharges, evaporation, and vapor dispersion as a free jet. The model can be run both individually and in a linked mode. (Technica International Associates, Inc., Box 187, Woodstock, GA 30128-4420.)

C.6 Publicly-available Models

Note: Users should carefully evaluate applicability of these models to prevailing conditions.

A list of some publicly-available models that can be used to address special site-specific scenarios follows:

DEGADIS-(U. S. Coast Guard): DEGADIS, the Dense Gas Dispersion Model, is designed to simulate dispersion of heavier-than-air gas releases. It can handle both evaporative emissions from 1iquid spills and jet emissions. It is basically steady-state but simulates transient conditions by a series of steady-state calcu1ations. Vapor generation rate, spi11 area, and meteorologica1 parameters are important inputs to the model. Infonnation available through National Technical Infonnation Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

HEGADAS-(Shell Research B.V.): HEGADAS is a dispersion model for neutrally-buoyant and dense gases. The basic model components are solutions to the advection/diffusion equations and are in the standard fonn of Gaussian dispersion models. The model can handle a wide variety of source types, including transient horizontal jets. Information available through National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

SLAB-(Lawrence Livermore National Laboratory): SLAB is designed for application to dense gases that are emitted from liquid spills. The model considers the concentration integrated over a cross-section perpendicular to the plume centerline. The downwind variation of the integrated concentration is calculated. The size and emission rate of the liquid spill are required inputs to the model. Information available through Lawrence Livermore National Laboratory, Box 808, Livennore, CA 94550, or contact American Petroleum Institute, Health & Environmental Sciences Department, 1220 L Street, NW, Washington, D.C. 20005.

C.7 Sample Calculations for Figures C-1 through C-4

The following calculations may be used to estimate volume and mass of hydrogen sulfide when total gas volume and its hydrogen sulfide content are known:

Continuous Release.

Assume: Release of 5,000,000 SCFD of natural gas containing 8,000 ppm (by volume) of hydrogen sulfide.

Note: 11le user must know both the volume (or flow rate) of natural gas and its hydrogen sulfide concentration so that Figures C-1 through C-4 can be effectively used.

To determine standard cubic feet per hour (SCFH) of hydrogen sulfide released, the following calculations should be performed using appropriate values for the conditions being evaluated:

$$\frac{5{,}000{,}000 \text{ SCFD} \times 8{,}000 \text{ ppm } H_2S}{24{,}000{,}000}$$
$$- \ 1{,}667 \text{ SCFH of } H_2S \text{ released.}$$

To determine the pounds of hydrogen sulfide released per hour, the following calculations should be performed using appropriate values for the conditions being evaluated:

$$\frac{5{,}000{,}000 \text{ SCFD x } 8{,}000 \text{ ppm } H_2S}{267{,}605{,}634}$$
$$- \ 150 \text{ lb/hr of } H_2S \text{ released.}$$

Instantaneous Release.

Assume: Release of 100,000 SCF of natural gas containing 8,000 ppm (by volume) of hydrogen sulfide. Also, assume this example is a daytime release, 5 miles per hour wind speed (refer to Figure C-3).

To determine the volume (SCF) of hydrogen sulfide released, the following calculations should be performed using appropriate values for the conditions being evaluated:

$$\frac{100{,}000 \text{ SCF x } 8{,}000 \text{ ppm H2S}}{1{,}000{,}000}$$
$$- \ 800 \text{ SCF of} H_2S \text{ released}$$

After applying the appropriate calculations and using known factors to arrive at either hydrogen sulfide release rate or quantity of hydrogen sulfide released, refer to the appropriate chart (Figs. C-1 through C-4) or the equation in Par. C.8 (example calculations in Pars. C.9 through C.12) for obtaining radius of exposure (ROE) information.

The following equation can be used to convert percent hydrogen sulfide to parts per mi1lion on a volume basis:

$$\text{Percent } H_2S \text{ x } 10{,}000 - \text{ ppm } H_2S$$

C.8 Radius of Exposure (ROE) Calculation

Using the values of coefficients "A" and "B" in Table C-1, the radius of exposure (ROE) for various hydrogen sulfide release rates (H_2S) can be mathematically predicted using the following equation:

$$\text{ROE} - \text{Antilog } [A \times \text{Jog } (H_2S) + \text{BJ}$$

For a continuous release, enter the hydrogen sulfide release rate (H_2S) in standard cubic feet per hour (SCFH). For a puff (instantaneous) release, enter the quantity of hydrogen sulfide (H_2S) released in standard cubic feet (SCF).

C.9 Sample Calculation-Continuous Release (Daylight)

Determine the $ROE_{100 \text{ ppm}}$ for a continuous release of 100 percent hydrogen sulfide gas at a rate of 11,170 SCFH in daylight (PG D stability) conditions and *5* mph wind speed. Using Table C-1, the coefficients applicable to this scenario are: A- 0.58; B - 0.45. Using the equation in Par. C.8:

$$ROE_{1oo ppm} - \text{Anti]og } [0.58 \times \log (11{,}170) + 0.45) - 628 \text{ feet.}$$

C.1O Sample Calculation-Continuous Release (Nighttime)

Determine the $ROE_{100 \text{ ppm}}$ for a continuous release of I00 percent hydrogen sulfide gas at a rate of 11,170 SCFH in nighttime (PG F stability) conditions and 2.2 mph wind speed. Using Table C-1, the coefficients applicable to this scenario are: A - 0.66; B - 0.69. Using the equation in Par. C.8:

$$ROE_{100ppm} - \text{Antilog } (0.66 \times \text{Jog } (11{,}170) + 0.69]$$
$$- \ 2{,}300 \text{ feet}$$

C.11 Sample Calculation-Instantaneous Release (Daylight)

Determine the ROE_{100ppm} for an instantaneous release of 100 percent hydrogen sulfide gas of 1,117 SCF in daylight (Slade A stability) conditions and 5 mph wind speed. Using Table C-1, the coefficients applicable to this scenario are: A - 0.39; B • 1.91. Using the equation in Par. C.8:

ROE_{100ppm} -Antilog [0.39 x log (1,117) + 1.91)- 1,255 feet.

C.12 Sample Calculation-Instantaneous Release (Nighttime)

Determine the ROE,00ppm for an instantaneous release of I 00 percent hydrogen sulfide gas of I,117 SCF in nighttime (Slade B stability) conditions and 2.2 mph wind speed. From Table C-1, the coefficients applicable to this scenario are: A - 0.40; B - 2.40. Using the equation in Par. C.8:

ROE_{100ppm} - Antilog (0.40 x log (1,117) + 2.40] - 4,161 feet.

C.13 Descriptions of Gaussian and Puff Dispersion Models

C.13.1 INTRODUCTION

The emergency response Gaussian and Puff screening models are designed to predict the downwind dispersion (plume-centerline, ground-level concentration and maximum ground-level plume width as a function of downwind distance) of a neutrally-buoyant, steady-state point source gaseous release under steady-state meteorological conditions. Classical EPA-approved Gaussian dispersion theory is applied in the models. The programs are in BASIC and are designed for use on personal computers. The models are described below. The program listings and runs should use the IDLH, ERPG-2, and TLV and STEL levels as the concentrations of interest because they usually are the concentration values of concern. Both models can be run for other concentrations by substituting the values of interest in place of the values for IDLH, ERPG-2, and TLV and STEL in the computer programs. Copies of the example program listings and computer runs are available on request from American Petroleum Institute, Exploration & Production Department, 700 North Pearl Street, Suite 1840, Dallas, Texas 75201-2845.

C.13.2 Gaussian Model

This model calculates the plume-centerline, ground-level concentration, and maximum ground-level plume width for a single, steady-state, continuous-point release at user-specified, steady-state meteorological conditions and downwind distances. The model uses standard Gaussian dispersion modeling with Pasquill-Gifford dispersion coefficients. The user inputs the release rate, effective release height (release height plus plume rise), nominal wind speed, incremental downwind distance for which calculations are to be made, type of material released, and the stability class. A total of eight compounds are currently accepted by this model. Additional compounds can be entered by replacing compounds presently in the model. The model uses a default D Stability Class; but, can be run with any of the standard six Pasquill-Gifford Stability Classes (A, B, C, D, E, or F-with A being the most unstable and F being the most stable).

C.13.3 Puff Model

This model calculates the plume-centerline, ground-level concentration, and maximum ground-level plume width for a single, instantaneous-point release at user-specified, steady-state meteorological conditions and downwind distances. The model uses standard Gaussian dispersion theory for an instantaneous (puff) release with Slade dispersion coefficients. User inputs to the model are the same as those used in the Gaussian model except that the total amount of material released is entered rather than the rate of release. Three values are accepted for the Stability Class (A, B, or C-with A being unstable, B being neutral, and C being stable).

APPENDIX 0-DEFINITION OF A SOUR ENVIRONMENT (REPRINTED FROM *NACE STANDARD MR0175-94: STANDARD MATERIAL REQUIREMENTS SULFIDE STRESS CRACKING RESISTANT METALLIC MATERIALS FOR OILFIELD EQUIPMENT1*[24]*1*

0.1 Sour Environments

D.1.1 Sour Environments are defined as fluids containing water as a liquid and hydrogen sulfide exceeding the limits defined in Pars. D.1.1. l and D.1.1.2; these environments may cause sulfide stress cracking (SSC) of susceptible materials.

CAUTION: It should be noted that highly susceptible materials may fail in less severe environments. The SSC phenomenon is affected by complex interactions of parameters including:

a. chemical composition, strength, heat treatment, and microstructure of the material;
b. hydrogen ion concentration (pH) of the environment;
c. hydrogen sulfide concentration and total pressure;
d. total tensile stress (applied plus residual);
e. temperature; and
f. time.

The user shall determine whether the environmental conditions fall within the scope of this standard. *(Editorial Comment:* The critical hydrogen sulfide levels in D.1.1.1 and D.1.1.2 and Figures D-1 and D-2 were developed from data derived from low alloy steel.)

0.1.1.1 Sour Gas

Materials shall be selected to be resistant to SSC or the environment should be controlled if the gas being handled is at a total pressure of0.4 MPa (65 psia) or greater and if the partial pressure of hydrogen sulfide in the gas is greater than 0.0003 MPa (0.05 psia). Systems operating below 0.4 MPa (65 psia) total pressure or below 0.0003 MPa (0.05 psia) hydrogen sulfide partial pressure are outside the scope of this standard. Partial pressure is determined by multiplying the mole fraction (mo] % + 100) of hydrogen sulfide in the gas by the total system pressure. Figure D-1 provides a convenient method for detenning whether the partial pressure of hydrogen sulfide in a sour environment exceeds 0.0003 MPa (0.05 psia). A few examples are provided: ·

a. partial pressure of hydrogen sulfide in a system conta;ning 0.01 mo! % hydrogen sulfide (100 ppm or 6.7 grains per 100 standard cubic feet [SCF]) at a total pressure of 7 MPa (1,000 psia) exceeds 0.0003 MPa (0.05 psia) (Point A on Figure D-1).
b. partial pressure of hydrogen sulfide in a system containing 0.005 mo!% hydrogen sulfide (50 ppm or 3.3 grains per 100 SCF) at a total pressure of 1.4 Mpa (200 psia) does not exceed 0.0003 Mpa (0.05 psia) (Point B on Figure D-1).

D.1.1.2 Sour Oil and Multiphases

Sour crude oil systems that have operated satisfactorily using standard equipment are outside the scope of this standard when the fluids being handled are either crude oil, or two- or three-phase crude, water, and gas when:

a. the maximum gas:oil ratio is 5000 SCF:bbl (barrel of oil);
b. the gas phase contains a maximum of I*5%* hydrogen sulfide;
c. the partial pressure of hydrogen sulfide in the gas phases is a maximum of 0.07 MPa (l0 psia);
d. the surface operating pressure is a maximum of 1.8 MPa (265 psia) (see Figure D-2); and
e. when pressure exceeds 1.8 MPa (265 psia), refer back to D.l.1.1.

The satisfactory service of the standard equipment in these low-pressure systems is believed to be a result of the inhibitive effect of the oil and the low stresses encountered under the low-pressure conditions.

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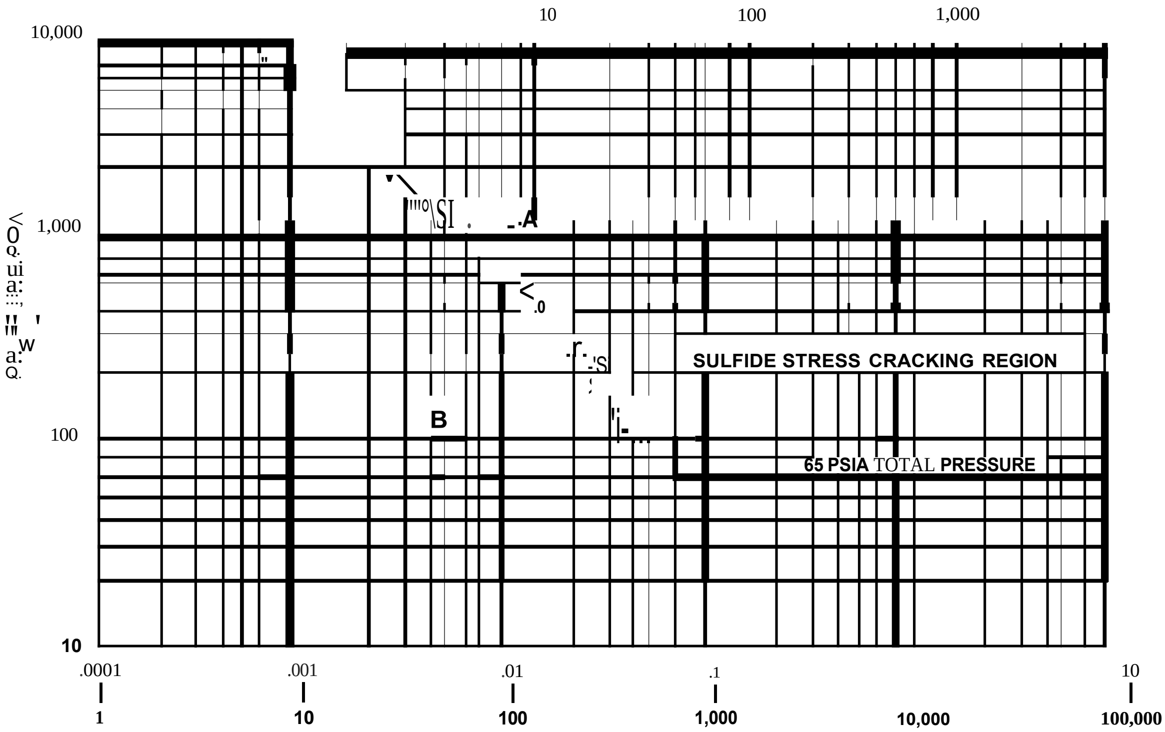
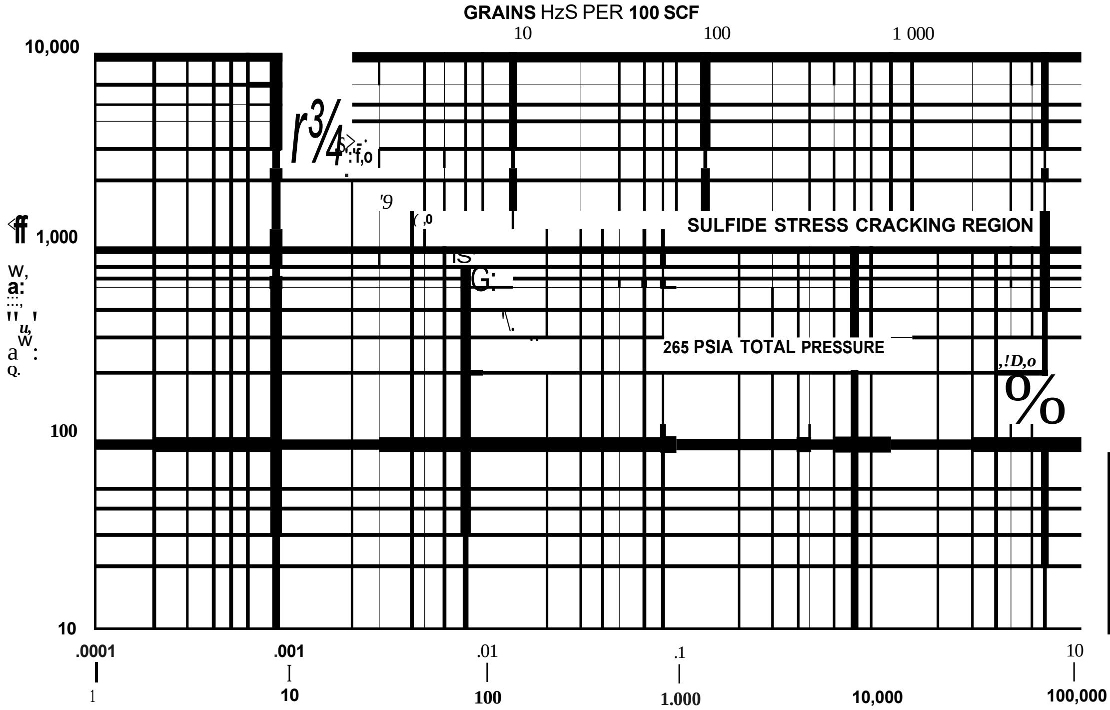


Figure 01 *-Sour Gas Systems (Refer to Par. 0.1.1.1)



Metric Conversion Factor: 1 MPa = 145.089 psia

Figure 02*-Sour Multiphase Systems (Refer to Par. D.1.1.2}

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	GE4002	Bull E4, Release Reporting for the Oil and Gas Exploration and Production Industry as Required by the CWA, CERCLA, and SARA Title III		$151.00	
	G12R15	RP 12R1, Recommended Practice for Setting, Maintenance, Inspection, Operation, and Repair of Tanks in Production Service		$118.00	
	G14C07	RP 14C, Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms.		$180.00	
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The most life for the price. Have a two-year detector for H_2S or CO that you're not using? Hibernate it, and get the time back - for up to a year. Spread your detector's 24 months of operation over up to three years instead of the standard two. **Great for turnarounds, short-term projects or employee leave.**

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Compatible with both the MicroDock II and the IntelliDoX instrument management systems, the BW Clip is engineered to the highest standards of quality and reliability, keeping you safe and compliant.

Easy gas identification with color coded labels and LCD indication:

- H_2S
- CO
- O_2
- SO_2

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Use our unique advanced technology for safety, compliance and productivity.

- **Surecell™:** unique dual reservoir sensor design dramatically improves instrument performance, response time, and longevity compared to traditional electrochemical sensors and consistently delivers reliable instrument performance under the harshest environmental conditions
- **Reflex Technology™:** advanced automated self-test function routinely checks the operating condition of the sensor to increase safety, up-time, and overall worker confidence
- **IntelliDoX:** instrument management system
  - The quickest bump test in the industry
  - Configuration of alarm set points and more
  - Performing different tests for up to five BW Clip detectors at once — for maximum productivity
  - Easy and accurate record-keeping

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BW Clip

maintenance-free single-gas detector

BW Clip Standard Features:

- Maintenance-free: no sensor or battery changes necessary
- Compact, lightweight design with one-button operation
- Designed for a range of harsh environments and extreme temperatures
- Hibernation mode with case accessory or IntelliDoX
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- Wide-angle flash, which alerts simultaneously with audible and vibrating alarm
- Automatic logging of the 35 most recent gas events and bump test results
- Compatible with MicroDock II and Fleet Manager II software
- Affordable, with low cost of ownership

Configureable Options:

- Configuration of high and low alarm set points before the device is activated
- Adjustment of alarm set points and other parameters as needed throughout the lifespan
- Option to enable the noncompliance indicator, which flashes red when a bump test is due or a gas event occurs
- Option to display gas reading during alarm
- User settable bump test reminder
- Option to display the Real Time Clock

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Hibernation Case


Hard Hat Clip


IntelliDoX

For a complete list of kits and accessories, please contact BW Technologies by Honeywell.

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BW Clip Specifications

Size	1.6 x 2.0 x 3.4 in. / 4.1 x 5.0 x 8.7 cm
Weight	3.2 oz. / 92 g
Temperature	H_2S: -40 to +122°F / -40 to +50°C CO: -22 to +122°F / -30 to +50°C O_2: -4 to +122°F / -20 to +50°C SO_2: -22 to +122°F / -30 to +50°C
Humidity	5% - 95% RH (non-condensing)
Alarms	Visual, vibrating, audible (95 dB) • Low, High
Tests	Activated detectors automatically perform one internal diagnostic test every 24 hours.
Typical battery life	Two years (H_2S, CO, O_2 or SO_2) or three years (H_2S or CO)
Event logging	35 most recent events
Ingress Protection	IP 66/67
Certifications and approvals	c UL us CLASSIFIED: Class I, Div. 1, Gr. A, B, C, D Class I, Zone 0 , Gr. IIC **ATEX:** CE Ex 0539 II 1G Ex ia IIC T4 Ga IP66/67 DEMKO 14 ATEX 1356 **IECEx:** Ex ia IIC T4 Ga IP66/67 IECEx UL 14.0063 CE: European Conformity
Warranty	Two or three years from activation (given normal operation), plus one year shelf life (6 months for O2). Up to three years for two-year H2S and CO detectors when used with the hibernation feature, limited to 24 months of detector operation.

Sensor Specifications

Gas	Measuring Range	Low Alarm Level	High Alarm Level
2 or 3 year detector			
H_2S	0 -100 ppm	10 ppm	15 ppm
CO	0 - 300 ppm	35 ppm	200 ppm
2 year detector only			
O_2	0 - 25.0 % by vol.	19.5 %	23.5 %
SO_2	0 - 100 ppm	5 ppm	10 ppm

Alarm setpoints are user adjustable before and after activating the detector.

Set points shown are default values as shipped from the manufacturer. Additional default values are available.

DUE TO ONGOING RESEARCH AND PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

BW Technologies by Honeywell

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GEN²

OI-6900-X-X-O-2B Sensor Assembly

WireFree Dual Battery Ambient Air Toxic Gas Detector

The Otis Instruments WireFree OI-6900 Series Ambient Air Toxic Gas Detector is a versatile assembly that uses an electrochemical, PID or low-power infrared sensor element to detect a variety of gases. WireFree, dual battery power (3.6 V Lithium-Thionyl Chloride battery) with 900 MHZ or 2.4 GHz Radio options. Magnetic switches allow for non-intrusive calibration while in the field as well as full system settings and diagnostics.

Gas Type	Range	T_{90}	Warranty
EC-AsH3	0-1 ppm	< 30 sec.	10 months
EC-CH2O	0-10ppm	< 30 sec.	12 months
EC-CH3SH	0-10 ppm	< 100 sec.	12 months
IR-CH4	0-100% vol.	< 30 sec.	60 months
EC-CL2	0-20 ppm	< 60 sec.	12 months
EC-CLO2	0-5 ppm	< 120 sec.	12 months
EC-CO	0-1000 ppm	< 30 sec.	24 months
IR-CO2	0-5% vol.	< 30 sec.	60 months
EC-ETO	0-10 ppm	< 80 sec.	12 months
EC-F2	0-1 ppm	< 80 sec.	12 months
EC-H2	0-4%	< 60 sec.	18 months
EC-H2S	0-100 ppm	< 30 sec.	24 months
EC-H2S2K	0-2000 ppm	< 25 sec.	24 months
EC-HBr	0-30 ppm	< 40 sec.	12 months
EC-HCL	0-30 ppm	< 300 sec.	12 months
EC-HCN	0-50 ppm	< 70 sec.	12 months
EC-HF	0-10 ppm	< 90 sec.	12 months
IR-LEL	0-100% LEL (0-5% vol.)	< 30 sec.	60 months
EC-NH3	0-100 ppm	< 90 sec.	12 months
EC-NH3300	0-300 ppm	< 120 sec.	12 months
EC-NH3A	0-1000 ppm	< 120 sec.	12 months
EC-NO	0-250 ppm	< 40 sec.	12 months
EC-NO2	0-20 ppm	< 25 sec.	12 months
EC-O2	0-25% vol.	< 15 sec.	24 months
EC-O3	0-5 ppm	< 60 sec.	12 months
EC-O3H	0-100 ppm	< 60 sec.	12 months
EC-PH3	0-5 ppm	< 30 sec.	12 months
EC-SO2	0-20 ppm	< 35 sec.	24 months
PID-VOC10	0-10 ppm	< 3 sec.	6 months / 24 months
PID-VOC20	0-20 ppm	< 3 sec.	6 months / 24 months
PID-VOC50	0-50 ppm	< 3 sec.	6 months / 24 months
PID-VOC1K	0-1000 ppm	< 3 sec.	6 months / 24 months
PID-VOC2K	0-2000 ppm	< 3 sec.	6 months / 24 months

Product Features

- Electrochemical, PID or Low-Power Infrared Sensor
- WireFree (Wireless) Communication; Dual Battery-Powered: 3.6 V (19 Ah each, 38 Ah total) Lithium-Thionyl (Li-SOCl2) Chloride Battery with Connector (Non-Rechargeable)
- Battery Life: 1-Year Maximum - Low-Power Infrared, 2-Year Maximum - Electrochemical
- 3 Push-Button Interface (ADD, MENU, SUB) with 3 Corresponding Magnetic, Non-Intrusive Switches
- Adjustable Background Gas Setting
- 102x64 Resolution Graphical LCD Screen; Transflective (Sunlight Readable) with LED Backlight
- QPS Explosion/Flame-Proof Certification for Select Gases
- Radio Options: 900 MHz Radio and 52 Networks or 2.4 GHz Radio and 78 Networks
- Sensor Element Warranty Varies with Gas Type
- Battery Warranty is 90 Days from Product Ship Date
- 1-Year Limited Hardware Warranty
- Optional OI-501 Remote Sensor Kit with Enclosure

OTIS INSTRUMENTS INC.

301 S. Texas Avenue
Bryan, Texas 77803
P: 979-776-7700

sales@otisinstruments.com

GEN2

OI-6900-X-X-O-2B Sensor Assembly

WireFree Dual Battery Ambient Air Toxic Gas Detector

OI-6900-X-X-O-2B Product Specifications

Product Specifications	
Sensor Type	Electrochemical, PID or Low-Power Infrared Sensor
Power Type	Dual Battery-Powered
Operating Voltage	3.6 V (19 Ah each, 38 Ah total) Lithium-Thionyl (Li-$SOCl_2$) Battery, with Connector (Non-Rechargeable)
Battery Life	1-Year Max. (Low-Power Infrared), 2-Year Max. (Electrochemical), 14+ Days (PID)
RF Connection	External N-Female Radio Frequency (RF) Connector
Display Screen	102x64 Resolution Graphical LCD Screen Transflective (Sunlight Readable) with LED Backlight
Interface	3 Push-Buttons (MENU, ADD, and SUB) 3 Magnetic Non-Intrusive Switches for Calibration (MENU, ADD, and SUB)
Customizable Settings	Adjustable Background Gas Setting
T_{amb} Temperature Range	-40 to +54°C
WireFree Radio Options	GEN II 900 MHz (200 mW) Radio (1-1.5 Miles Range) or GEN II 2.4 GHz (125 mW) Radio (1-1.5 Miles Range)
Networks	52 Networks (GEN II 900 MHz Radio) or 78 Networks (GEN II 2.4 GHz Radio) 255 Addresses per Network
Product Dimensions	5.42 in. L x 6.03 in. W x 17.03 in. H (Max. Dimensions w/ Attachments)
Total Weight	6 lbs.
Remote Sensor Kit Additional Feature	OI-501 Remote Sensor Kit with Enclosure (7 pin) Available in lengths of up to 250 feet for Electrochemical and lengths of up to 40 feet for Low Power IR
Approvals	QPS Certified Explosion/Flame Proof
Hazardous Location Certifications and Approvals	**CSA** Class I, Division 1, Groups C & D Ex d IIB T6 Gb Class I, Zone 1, AEx db IIB T6 Gb Tamb -40ºC to +54ºC **ATEX** Models w/ Radio Option: Ex II 2 (1) G; Ex db mb ia [ia Ga] IIB T6 Gb; Ta= -40ºC to +54ºC Models w/out Radio Option: Ex II 2 G; Ex db mb IIB T6 Gb; Ta= -40ºC to +54ºC **IECEx** Models w/ Antenna Fitting: Ex db mb ia [ia Ga] IIB T6 Gb; -40ºC ≤ Ta ≤ +54ºC Models w/out Antenna Fitting: Ex db mb IIB T6 Gb; -40ºC ≤ Ta ≤ +54ºC
Hardware Warranty	Limited one year
Sensor Element Warranty	Varies with Sensor Element and Type
Battery Warranty	90 Days from Ship Date
Part Number Formula	OI-6900-[Gas]-[Radio]-[Enclosure]-[2 Battery] OI-6900-X-X-O-2B

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Amperometric H_2S micro-sensor for probe systems

- Operating Instruction shallow water version -

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Edaphic Scientific Pty Ltd
www.edaphic.com.au
info@edaphic.com.au
Ph: 1300 430 928

2 Technical Data of the H_2S sensor for shallow water

measuring principle:	amperometric sensor
power supply:	9 ... 30 VDC
output:	0 ... + 5 VDC
dimensions:	maximum diameter: 24 mm total length: 235 mm
connector:	wet con BH-4-MP, titanium (others on request)
housing:	titanium
concentration ranges:	type I: 50 µg/l ... 10 mg/l H_2S type II: 500 µg/l ... 50 mg/l H_2S type III: 10 µg/l ... 3 mg/l H_2S others on request
accuracy:	2% (measuring value) 1 digit
pressure range:	up to 10 bar
pH-range:	0 ... 8,5 pH
temperature range:	0...30°C (for measuring and storage !)
response time:	$t_{90\%}$: approx. 1 second
duration of life:	5..9 months (depends on H_2S stress and on matrix of the analyte)
special features:	exchangeable sensor head, integrated electronic device for transformation of current into 0...+5 V DC and for provision of polarisation voltage
warranty:	3 months for the sensor tip; 12 months for the electronic body. Warranty does not cover damaged caused by poor handling or mishandling of the sensor.

Pin definitions of the sensors plug:

Pin 1: ground

Pin 2: not connected

Pin 3: H_2S-signal output: 0 ... +5 V DC
(main working range: 0...500 mV)

Pin 4: power supply 9 ... +30 V DC

Wiring:

Grey .... Power Ground

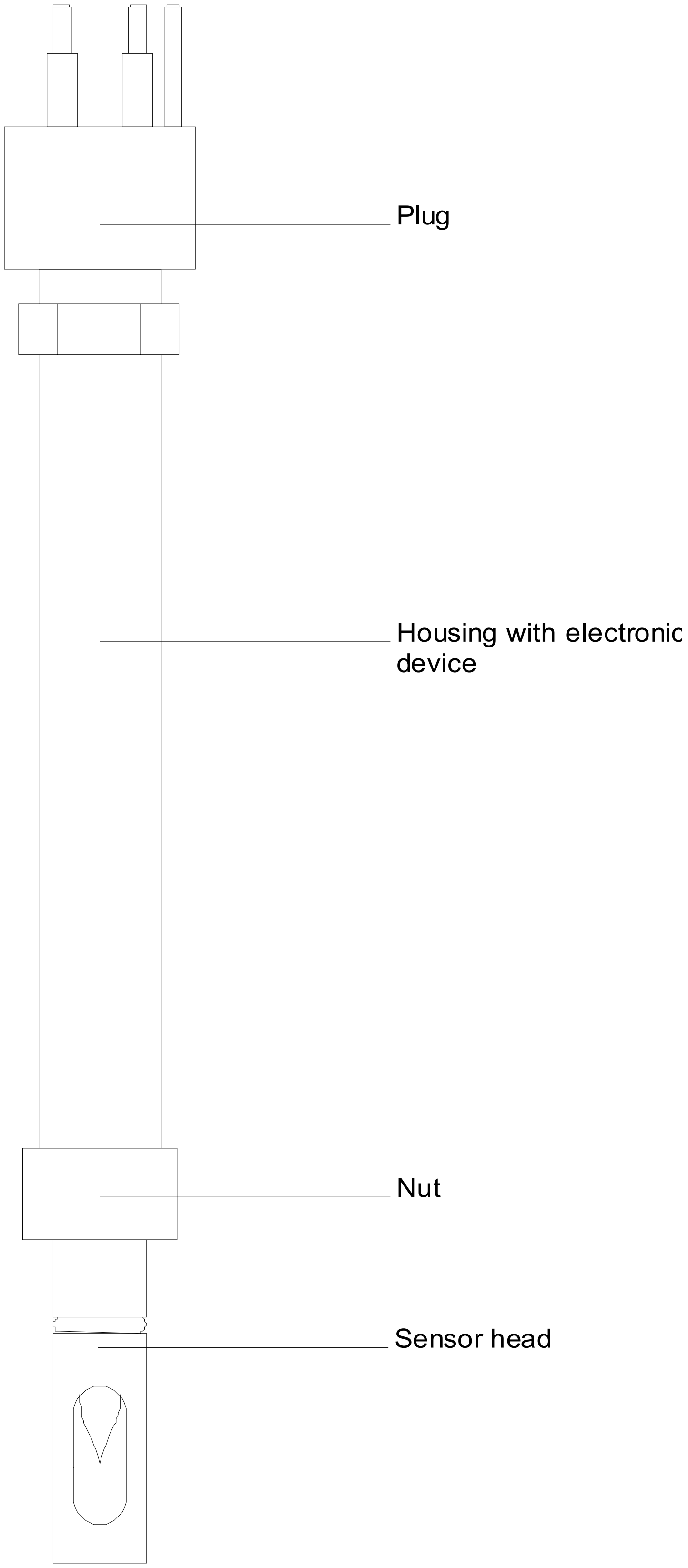
White ... Signal Ground

Brown ... 0 to 5 V DC Signal

Green ... 12 to 30 V DC

Shield ... Power Ground

3 Structure of the H_2S micro-sensor



PH-ORP
User manual

edaphic scientific

environmental research & monitoring equipment

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www.edaphic.com.au
info@edaphic.com.au
Ph: 1300 430 928

Version 1.1
Update: March 2016

1. General

In order to maintain and ensure the good working order of the PHEHT sensor, users must comply with the safety precautions and warnings featured in this manual.

Assembly and activation:

- Assembly, electrical connection, activation, operation and maintenance of the measuring system must only be carried out by specialist personnel authorized by the user of the facilities.
- Trained personnel must be familiar with and comply with the instructions in this manual.
- Make sure the power supply complies with the specifications before connecting the device.
- A clearly-labeled power switch must be installed near the device.
- Check all connections before turning the power on.
- Do not attempt to use damaged equipment: it may represent a hazard and should be labeled as faulty.
- Repairs must only be carried out by the manufacturer or by AQUALABO CONTROL's after-sales service department.

➢ Marking on the body of the sensor:

The marking on the body of the sensor indicates the serial number of the sensor (for the traceability) and the LOGO CE.

1 2 3

1	Datamatrix (contains the serial number)
2	**Serial number PHEHT sensor : SN-PPHRX-YYYY** X : version YYYY : number
3	CE mark

2. Characteristics

2.1 Technical characteristics.

The technical characteristics can be modified without advance notice.

pH	
Measure principle	pH/ Redox : Potentiometric measure ; pH : pair of electrodes with a reference (Ag/AgCl gel) / H_3O^+ ions sensitive glass Redox : pair of electrodes with a reference (Ag/AgCl gel) /platinum disk Temperature : NTC
Range	0 – 14 pH
Resolution	0,01 pH
Accuracy	+/- 0,1 pH
Redox	
Measure principle	Combined electrode (Redox/reference) : Platinum tip, Ag/AgCl AgAgCl. Gelled reference (KCl)
Range	- 1000 to + 1000 mV
Resolution	0,1 mV
Accuracy	± 2 mV
Temperature	
Technology	NTC
Range	0,00 °C to + 50,00°C
Resolution	0,01 °C
Accuracy	± 0,5 °C
Response time	< 5 s
Storage temperature	0°C to + 60°C

Sensor	
Dimensions	Diameter : 27 / 21 mm ; Length : 207 mm
Weight	350 g (sensor + 3 m cable)
Wetted material	Body (electronic part) and clamp in PVC. Cartridge in DELRIN, Special pH glass, platinium, Inox 316L (protective sleeve of the temperature probe) Cable : polyurethane jacket Steam gland : Polyamide Patch with active material (black) – DO DISK : Optical isolation silicon
Safeway	The glass electrode is vulnerable to: - chemicals (organic solvents, acids and strong bases, peroxide, hydrocarbons), - mechanical treatments (impacts). The redox potential electrode is sensitive to sulphide adsorption on platinum.
Maximum pressure	5 bars
IP classification	IP68
Connection	9 armoured connectors, polyurethane jacket, bare-wires or waterproof Fisher connector
Sensor cable	Standard : 3, 7 and 15 m (other length on request). 100 m Max. Up to 100 m with junction box.

Communication – Power supply	
Signal interface	Modbus RTU RS-485 and SDI-12
Power requirements	5 to 12 volts for cable 0-15 m 7 to 12 volts for cable >15 m Max. 13.2 V
Consumption	Standby : 25µA Average RS485 (1 measure/seconde) : 3,9 mA Average SDI12 (1 measure/seconde) : 6,8 mA Current pulse : 500 mA Heating time : 100 mS Protection against the inversions of polarity

Appendix G
North Ranch Surface Waste Management Facility
Leachate Management Plan

Leachate Management Plan

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 2019
Project No. 35187378

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

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Figures

1.0 INTRODUCTION

This Leachate Management Plan (LMP) pursuant to **19.15.36.8.C** for the NGL North Ranch Surface Waste Management Facility (Facility) presents information for leachate collection, handling, storage, treatment and disposal. Design drawings for the leachate collection system, related to the proposed SWMF, are presented in **Appendix K** of the permit application (PA) narrative. A site plan illustrating the general layout of the Leachate Collection System (LCS) and storage facilities at the site is shown on **Figure 1** attached.

This LMP includes the following:

- Collection System and Collection Pipe Design **19.15.36.14.C.5**;
- Leak Detection System Design **19.15.36.14.C.3**;
- Secondary Containment Outside Lined Areas;
- On-site leachate storage and evaporation design **19.15.36.17.B**; and
- Certification of Construction.

The primary LCS conveys leachate to a perforated collection pipe imbedded within washed gravel and wrapped in a geotextile. The six-inch diameter perforated leachate collection pipes are sloped at a minimum grade of about 2%. The lines drain leachate to side-slope riser sumps/pump systems where the leachate is then sent to the leachate evaporation pond via a 4-inch dual contained forcemain.

2.0 COLLECTION SYSTEM/DETECTION SYSTEM DESIGN AND DOCUMENTATION

2.1 Leachate Collection System, Pipe and Riser Design

The leachate collection system was designed and existing components have been constructed to comply with NMOCD **19.15.36.14.C** and **F** requirements. Design calculations and construction details are available in **Appendices J** and **K**, respectively. According to the Hydrologic Evaluation of the Landfill Performance (HELP) analyses contained in the Design and Construction Plan in Appendix J, the peak leachate amount expected to be generated from the landfill is 5,640 gallons per acre per day for the worst open cell case. This is a nominal generation rate assuming the largest waste cell is open with no waste placed and all precipitation from a 25-year, 24-hour storm is collected and pumped to the evaporation pond. Due to the inorganic, non-putrescible nature of the waste being filled and that all waste will pass a paint filter test prior to placement, insignificant volumes of leachate being generated from the waste is anticipated. As the waste mass becomes deeper over the liner system, the annual leachate generation rate is expected to decrease.

3.0 NEW LEACHATE DESIGN SYSTEMS

3.1 General Requirements

In accordance with **19.15.36.14.C** and **19.15.36.14.F** of NMAC*,* the design of a leachate collection system associated with the waste disposal area includes a lateral drainage layer and a series of pipes, sumps, and pumps designed to provide a positive means for rapid removal of leachate from the waste mass to prevent buildup of leachate head on the liner system.

In accordance with **19.15.36.14.F**, the leachate collection system is designed and operated to maintain less than 12 inches of leachate head on the liner system at any time.

The Permit Drawings contain figures depicting the layout of the leachate collection system and general cross sections of the bottom liner and leachate collection and leak detection system. As shown, the leachate collection sump generally consists of a 12-inch thick protection/drainage layer and a six-inch diameter perforated High Density Polyethylene (HDPE) leachate collection pipe encompassed by at least 6-12 inches of clean washed gravel and an eight-ounce non-woven geotextile. Refer **Appendix K** of the PA narrative, **Drawing 29, Detail I/29** for details. Alternative performance-based bottom liner system designs utilizing GCL are included as part of the Permit Application. Design calculations related to the alternative bottom liner system are included in **Appendix J** of the PA narrative.

The lateral drainage layer is designed to drain leachate to a main collection header. The leachate collection header is sloped at a minimum 2% grade longitudinally along each cell (six-inch diameter perforated HDPE pipe). The collection header line drains leachate to an individual side slope riser sump/pump system.

3.2 Gravity Flow and Pump Systems

The leachate collection system within each cell of the Landfill is designed to gravity drain to a sump that is equipped with a pump system. Leachate is automatically pumped from the sump of each cell to an above ground evaporation pond storage system using submersible leachate pumps. The Landfill sump, pumps and pond system are designed to provide adequate peak flow storage to assure continual removal of leachate from the landfill. The leachate pumps will be designed to handle the anticipated peak flow. A portable back-up pump may be provided in case of pump problems or electrical outages. Sump and pump systems will be provided with a remote notification telemetry system to bring attention to high level alarm status to both Facility operators and to NGL control center personnel.

3.3 Evaporation Pond

The leachate evaporation pond, designed in accordance with **19.15.36.17**, will be provided with adequate peak and reserve storage plus adequate freeboard. The leachate evaporation pond will be equipped with visual high-water indicator and alarms as a means to easily measure leachate levels and provide for high water level indication. The pond will also be provided with a remote notification telemetry system to bring attention to high level alarm status to both Facility operators and to NGL control center personnel.

The leachate evaporation pond at the Facility is a 3.03 million gallon, double-lined impoundment located north of the landfill near the site entrance. All leachate is conveyed from the landfill cells to the evaporation pond through dual contained HDPE pipes which ensures the safe movement of liquids and greatly reduces the potential for leakage. Leachate is evaporated from the pond to take advantage of the high potential evaporation desertic environment.

3.4 Safety and Maintenance

The leachate sump, pump and evaporation pond systems will be designed with automatic controls, alarms, and trouble lights to indicate the need for servicing, as well as automatic cut-off devices to prevent overfilling of the evaporation pond. Spare parts and back-up equipment will be maintained at the site in the event of equipment failure or loss of power.

The evaporation pond will be monitored for protection of migratory bird as discussed in **Appendix D** of the permit narrative.

3.5 Secondary Containment

In accordance with **19.15.36.17.B**, the leachate evaporation pond will have a primary liner and a secondary liner with a leak detection system. Piping that is outside the lined area of the landfill and evaporation pond will be designed and constructed with secondary containment. Leachate force main piping outside the lined area will be dual contained HDPE piping.

19.15.36.17.C.2 states that the operator shall monitor leak detection systems pursuant to the approved surface waste management facility permit conditions, maintain monitoring records in a form readily accessible for Division inspection and report discovery of liquids in the leak detection system to the Division within 24 hours.

4.0 CERTIFICATION OF CONSTRUCTION

Each leachate collection system, sump system and the evaporation pond at the Facility will be designed and constructed in accordance with engineering plans and specifications. New construction will be documented in the form of a certification report prepared by a professional engineer registered in the State of New Mexico. The certification report will include summaries of construction activities, testing data sheets and summaries, and other documentation required by the Construction Quality Assurance (CQA) Plan contained in **Appendix J** of the PA narrative.

The certification report shall include "as-constructed" or record drawings certified in the same manner as liner or cover systems.

"As constructed" features for leachate collection systems will include the following:

- Leachate collection pipe size, type, horizontal and vertical locations, and slope;
- Leachate collection trench and sump locations with elevations;
- Manhole, skimmer or riser locations with top and invert elevations;
- Leachate pump station locations and elevations of the bottom of the wet well, inlet invert, pump on, and pump alarm;
- Location and description of the leachate evaporation pond and other handling facilities; and
- Certification that the leachate system was constructed in accordance with the permit drawings and narrative.

5.0 LEACHATE MANAGEMENT AND DISPOSAL

5.1 Evaporation Pond Disposal

The primary leachate disposal mechanism for the landfill will be evaporation from the evaporation pond. The evaporation pond will be operated in accordance with the approved permit drawings and narrative and the NMOCD permit conditions.

5.2 Salt Water Disposal Well Disposal

The secondary disposal method of trucking the leachate via vacuum truck to an off-site SWD well will be used if desired, or if made necessary during normal operations or maintenance.

6.0 POST CLOSURE MANAGEMENT

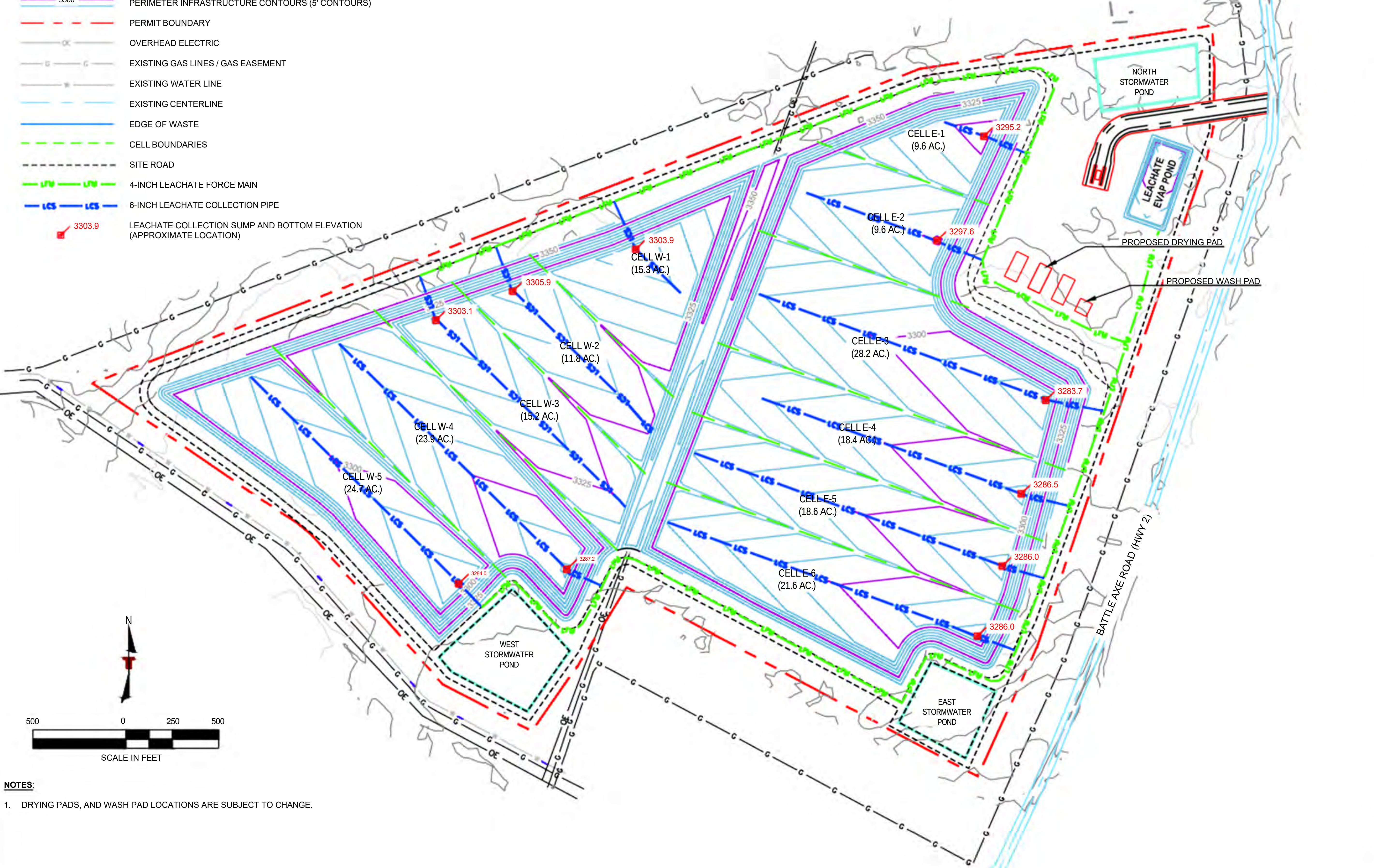
It is expected that during post-closure care of the landfill, leachate production will decrease until no pumped liquids are accumulating in the landfill cell sumps. Once the entire landfill is closed with the final cover barrier system, the HELP model analysis presented in **Appendix J** of the PA narrative indicates that an imperceptible amount of leachate will be collected in the lateral drainage layer (layer 9) of the bottom liner system. At a point one year after pumping of landfill leachate has ceased, the Facility proposes to close the evaporation pond in accordance with **19.15.36.17.E** and begin the post closure care period for the pond.

During post closure care for the evaporation pond, leachate levels in the landfill leachate collection sumps will be monitored for leachate head depth. Closure of the evaporation pond can only occur after the landfill's post closure period has begun. The operator will demonstrate to the Division that leachate generation has decreased to the point that a pond in unnecessary and request authorization to close. The operator will not close the pond without Division authorization. Once the pond has been removed and if, during semi-annual inspections of the landfill, high levels of leachate are observed, the leachate will be pumped from the sumps with a vacuum truck and disposed of an off-site SWD well.

Figure 1

LEGEND:

Symbol	Description
3300	EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
3300	SUBGRADE CONTOURS (5' CONTOURS)
3300	PERIMETER INFRASTRUCTURE CONTOURS (5' CONTOURS)
	PERMIT BOUNDARY
OE	OVERHEAD ELECTRIC
G	EXISTING GAS LINES / GAS EASEMENT
W	EXISTING WATER LINE
	EXISTING CENTERLINE
	EDGE OF WASTE
	CELL BOUNDARIES
	SITE ROAD
LFM	4-INCH LEACHATE FORCE MAIN
LCS	6-INCH LEACHATE COLLECTION PIPE
3303.9	LEACHATE COLLECTION SUMP AND BOTTOM ELEVATION (APPROXIMATE LOCATION)



NOTES:

1. DRYING PADS, AND WASH PAD LOCATIONS ARE SUBJECT TO CHANGE.

FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

LEACHATE MANAGEMENT SYSTEM PLAN

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 1

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

Appendix H
North Ranch Surface Waste Management Facility
Closure and Post-Closure Care Plan

Closure and Post-Closure Care Plan

North Ranch Disposal Facility
Surface Waste Management Facility
Lea County, New Mexico

May 2020
Project No. 35187378

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
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FIGURES

ATTACHMENTS

1.0 INTRODUCTION

1.1 Purpose, Scope, and Applicability

This Closure and Post-Closure Care Plan addresses sections **19.15.36.8.C.9**, **19.15.36.11**, **19.15.36.14.A.8**, **19.15.36.14.C.8** and **19.15.36.18** of NMAC **19.15.36** Surface Waste Management Facilities for the North Ranch SWMF. This plan assumes the operating permit will terminate after the 10-year term and unclosed portions of the Facility still open at that time will be closed. This plan includes a description of the steps that will be taken to close each Facility closure area, a general schedule for closure, a description of the landfill final cover system and the methods used to install the cover, and a description of post-closure care activities. Information supplemental to this closure plan, such as Permit Drawings (**Appendix K** of the Permit Narrative), are included as part of the permit application (PA). A copy of the Closure and Post-Closure Care Plan will be placed in the Facility permanent operating record (POR).

1.2 Facility Description and Design

NGL Waste Services, LLC owns and operates the North Ranch Surface Waste Management Facility (Facility) located near Jal, Lea County, New Mexico. The site is generally located in portions of Sections 9 and 10 of Township 25 South, Range 34 East in Lea County. The Facility includes an approximately 205-acre oil field waste landfill, a 2.2-acre leachate evaporation pond, 3 drying pads, a truck wash, vehicle/equipment routing areas, borrow areas, and an administration building. The facility has been designed to accept all eligible wastes as outlined in **19.15.36.13**. The primary source of waste will be derived from within Lea County and surrounding oil field areas. For specific design information, see **Appendices J** and **K** of the PA narrative. See **Figure 1** for a site location map.

2.0 CLOSURE PLAN

The following sections describe the general layout, design, and operations of the North Ranch facility. This Closure Plan has been developed as a Facility plan that addresses the landfill and leachate evaporation pond surface waste management and disposal areas at the Facility.

2.1 General Site Layout

The North Ranch Facility consists of approximately 303 acres and includes an oil field waste landfill; a leachate evaporation pond; and various support facilities including the entrance/scale facilities, wet waste drying areas, vehicle/equipment routing areas, borrow area(s), and an administration building..

2.2 Solid Waste Landfill Area, Leachate Evaporation Pond, Waste Drying Pads, and Truck Wash Pad

The Facility's solid waste landfill area currently includes approximately 205 acres of Oil Field

Waste landfill footprint. The bottom liner system, leachate collection system, stormwater control system, and final cover system design are in accordance with **19.15.36** requirements and as described in the PA narrative and incorporated appendices.

An approximately 2.2 acre leachate evaporation pond is associated with the landfill area and will be used as the primary means for disposal of landfill leachate. The pond consists of a lined impoundment designed in accordance with **19.15.36** requirements and as described in the PA narrative and incorporated appendices.

The Facility will be equipped with three waste drying pads. These pads will be concrete with a liquid collection sump and geomembrane leak detection/collection secondary containment underlayment. The three drying pads are installed and operational.

The Facility will be equipped with a truck wash pad to allow customers to wash tires and undercarriage prior to exiting the Facility to minimize contaminant transport. The wash pad will be concrete with a liquids collection sump and geomembrane leak detection/collection secondary containment underlayment. The truck wash pad has been installed and is operational.

2.3 SWMF Closure Plan

In accordance with **19.15.36.18,** this Closure Plan contains the following:

- An alternative cover system, designed in accordance with **19.15.36.14.C.9** and the methods and procedures to be used to install the cover;
- An estimate of the approximate area that will be open and needing closure after a 10-year permit term, including closure of the evaporation pond, drying pads, and truck wash pad.
- A preliminary schedule for completing all activities necessary to satisfy the closure criteria in this section.

The following sections discuss how the Facility conforms to the above requirements. The steps that are necessary to close all of the SWMF areas at any point during its active life in accordance with the proposed cover design are presented.

*2.3.1 Description of Oil Field Waste Landfill Final Cover System - (*19.15.36.14.C.8*)*

The SWMF will be closed when the facility has reached the design grades and/or the capacity of the landfill within the current cell(s). The final cover system for the Landfill includes elements to promote final cover system stability while minimizing infiltration into the waste mass. The various components of the final cover system permitted for the Landfill are listed below and include the following from top to bottom:

- A soil erosion/vegetation layer composed of at least 12-inches of vegetated soil with a permeability of 1x10-5 cm/s or less. A 70% coverage of at least two native grasses shall be maintained in accordance with the post closure provisions of 19.15.36.18.C.2.b. The seed list shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains.

- A compacted soil infiltration barrier layer composed of at least 36-inches of soil with a permeability of 1x10-5 cm/s or less.
- A compacted soil intermediate cover layer composed of at least 12-inches of soil with a permeability of 1x10-5 cm/s or less.

A typical detail of the final cover system showing the thickness of each layer is included in **Figure 2**. The closure cost estimates included in **Attachment A** for the Facility will be adjusted annually to account for any partial closures or modified permit conditions. Closure construction will be monitored and documented in accordance with the Facility's Construction Quality Assurance Plan found in **Appendix J** to the permit narrative. Documents related to the final cover system construction activities will be placed in the POR and be subject to New Mexico Oil Conservation Division (NMOCD or Division) inspection.

The current planned use of the Facility after final closure is open range-land. If the applicant considers an alternative land-use that requires an alternative surface treatment of closed cells, the NMOCD will be notified and the Facility Operator will submit a request to implement the alternative to re-vegetation.

2.3.2 Estimate of Largest Closure Area

The estimated largest area of a SWMF unit requiring closure at the end of the Facility's 10-year permit term is as indicated on the closure cost estimate presented in **Attachment A** to this Closure Plan. The costs provided in **Attachment** A are developed by Terracon Consultants, Inc., a third-party contractor. This acreage represents the SWMF footprint that is active and/or has intermediate cover only and has not already undergone final certified closure, plus any previous cell with final cover applied that has not had closure financial assurance released in accordance with **19.15.36.18.B**. This maximum area is used for calculation of the closure cost financial assurance obligation.

2.3.3 Schedule for Closure

When cessation of operations is anticipated within a unit or at the Facility. The operator shall follow the closure notification and schedule requirements of **19.15.36.18.A**. This includes Division notification 60 days prior to cessation, which includes a proposed schedule for closure. The operator will not begin closure without Division approval, recognizing that the Division has 60 days after the submitted date of cessation to approve the closure plan. However, if the Division fails to respond within 60 days of the submitted date of cessation with approval, additional requirements, hearing notification, or an extension notification, the operator may proceed with closure. In any case, the Operator will close in accordance with the approved Closure and Post Closure Plan, schedule, additional Division requirements, if any.

Table 1 Estimated Oil Field Waste Landfill Final Closure Schedule

Closure Area	**Maximum Acreage Requiring Closure**
Cells E1, E2 and half of E3. Assumed 10-year Term.	38
Support waste facilities (Leachate evaporation pond, 3 drying pads, truck wash, vehicle/equipment routing areas, borrow area(s), and an administration building)	68
Closure Activity/Task	**Number Of Days To Complete**
Notify the NMOCD of intent to perform final closure	60
NMOCD Response Period (60 days after submitted date of cessation)	60
Begin closure activities (incl. pond to ensure pond closure by 180 days after submitted date of cessation.)	14
Perform grading of waste	10
Install final cover system, concurrent with removal and cover of support waste facilities	120
Seed and mulch	40
Installation of erosion and sediment control structures	14
Complete certification report	14
Estimated Total Time To Complete Closure Event	332

NOTE: The sequence and size of actual closure of the Landfill may vary.

It is estimated that closure of the Facility will be completed no later than 332 days following notification to the NMOCD of the beginning of Facility final closure activities. If necessary, due to inclement weather or other circumstances, a request to extend this schedule may be made to the NMOCD.

2.3.4 Notification Requirements

The NMOCD will be notified when a landfill cell stops receiving waste for disposal and requires closure. The operator shall provide a minimum of three working days' notice to the NMOCD in advance of the top landfill cover's installation to allow the Division to witness the top landfill cover's installation. The NMOCD will be notified should the SWMF cease operations. The operator will notify the NMOCD at least 60 days prior to cessation of operations. All notifications will be placed in the POR.

2.3.5 SWMF Support Waste Facilities Closure

Specific requirements for closure of the leachate evaporation pond, 3 drying pads, a truck wash, vehicle/equipment routing areas, borrow area(s), and administration building. Note that any materials that test positive for regulated NORM shall be disposed of in accordance with the **SWMF Hazardous and Unauthorized Waste Exclusion Plan**. Also note that **19.15.36.17.E** requires that the operator shall properly close the evaporation pond within six months after cessation of use. Refer to the schedule in **Table 1**.

The operator shall ensure that:

- Liquids are removed and disposed of in a permitted SWD for injection. Sludge and residual sediments in the ponds or pits are removed, stabilized with dry soils to pass the paint filter test, documented on a paint filter test form, and disposed of in a permitted and lined oil field waste management facility. If transported offsite, an OCD approved C-133 hauler will be used to transport any liquid, stabilized sludge or solid oilfield waste, documented with a C-138 manifest.
- Liners, geogrid and geotextiles will be tested for NORM, be shredded and disposed of in a permitted and lined oilfield waste management facility.
- Concrete, washed gravel, piping, tanks, and appurtenances shall be removed, tested for NORM and disposed of at a permitted and lined oilfield waste management facility.
- **For clarity**, it is intended that all stabilized sludge and sediments, solids, liners, geotextiles, concrete, washed gravel, piping, tanks and appurtenances that have tested **negative** for regulated NORM shall be disposed of at this permitted facility just prior to final cell closure so that transportation offsite is not required.
- Equipment associated with the surface waste management facility is removed;
- The pond, truck wash, and drying pads subgrades are sampled, in accordance with the procedures specified in chapter nine of EPA publication SW-846, test methods for evaluating solid waste, physical/chemical methods for TPH, BTEX, metals and other inorganics listed in Subsections A and B of 20.6.2.3103, in accordance with the sample locations noted on **Figures 3 & 4**.
    - 37 samples total
    - Samples will be tested for:
        - TDS
        - TPH
        - BTEX
        - Aluminum
        - Antimony

- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Molybdenum
- Nickel
- Selenium
- Thallium
- Zinc
- Cyanide
- Sulfate
- Nitrate
- Nitrite
- Radioactivity

- Sample results are submitted to the environmental bureau in the Division's Santa Fe office.
- For seeding requirements see **Section 2.3.10.1**

2.3.6 Estimated Closure Costs

In accordance with **19.15.36.8.C.9**, estimated costs for closing the Facility have been developed, based on hiring a third-party contractor to close the largest area requiring final cover at any given time during the operation of the Facility. The current estimated Closure Cost for the Facility is included in **Attachment A** of this document. The costs provided in **Attachment A** are developed by NGL Waste Services, LLC, the operator of the facility.

2.3.7 Facility Recordkeeping and Report Requirements

A copy of the approved Closure and Post-Closure Plan will be kept in the POR. The Facility Operator will submit the final closure report to OCD that demonstrates completed closure based upon the approved plan. Annual post-closure reports be submitted to OCD to demonstrate compliance with the OCD approved post-closure protocols. The records will be permanently maintained in the Facility POR unless destruction of the records is authorized by the director of the NMOCD following the completion of the post-closure monitoring period. The NMOCD will be provided with the initial and any required, updated Closure and Post-Closure Cost Estimates for the SWMF. These estimates will also be placed within the POR.

2.3.8 Financial Assurance for Closure

Evidence of a financial assurance mechanism consistent with **19.15.36.11.E** for closure and post-closure care will be provided to the NMOCD and placed in the POR.

2.3.9 Site Survey

Upon completion of installing the final cover system, the site will be surveyed by a registered professional engineer or surveyor to document the final elevations of the SWMF including landfill cells, leachate evaporation pond, drying pads, truck wash, and administration building. Final closure of the site will be achieved when all permitted cells have been filled and the final cover system installed, and all SWMF support facilities including the leachate evaporation pond, drying pads, truck wash, and the administration building have been removed and final cover system installed. Closure will be considered complete after the final cover has been inspected and approved by the NMOCD.

2.3.10 Best Management Practices

The surface of the landfill will be shaped and contoured to have 4% minimum top deck slopes and maximum 4:1 side slopes to promote proper drainage away from the landfill. A series of intermediate and internal ditches will be necessary to divert stormwater run-off from the landfill to the perimeter ditches. The final cover system will also include a series of mid-slope drainage conveyances designed to control drainage off the landfill surface while minimizing erosion. All surface water run-off will be directed to area specific no-discharge stormwater sedimentation ponds located outside the active disposal area. Note that there are three stormwater sedimentation ponds in the SWMF design. Currently only the first pond, at the north end of the facility has been constructed and is the designed run-off pond for the development of Cells 1, 2 & 3, and is more than required for the 10-year development of Cells 1, 2, & half of Cell 3 (from **Table 1**). This Closure Plan considers only this first stormwater sedimentation pond for closure costs. When construction of Cell 4 is requested, the second stormwater sedimentation pond will be constructed and the Closure Plan will be updated, with the required added closure costs recognized at that time.

2.3.10.1 Seeding

Seeding of the landfill cover on recently completed waste cells shall be conducted as per 19.15.36.18.C(2)(b). The seed list shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains. Final cover and surrounding areas re-vegetated with at least two grasses not including noxious weeds or deep rooted shrubs or trees, and shall be established such that at least 70% of the area is covered and then maintained through the post-closure period.

Seeding of the leachate evaporation pond, drying pads, a truck wash, vehicle/equipment routing areas, borrow area(s), and the administration building area shall be conducted as per 19.15.36.18.A(6). The seed list shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains. Final cover shall consist of at least three native plant species, including at least one grass but not including noxious weeds, and maintained through two successive growing seasons.

Seed mixtures used in conjunction with the closure of the landfill will be applied using hydro mulching or other suitable technologies. Rolled erosion control products and other stabilization measures will be installed as needed in support of establishment of vegetation at the site.

2.3.10.2 Erosion Control Measures

Because exposed earth fill is subject to erosion, temporary and permanent erosion control measures are used to mitigate the potential for severe erosion and are part of the active maintenance program at the Landfill. In addition to seeding, other erosion control measures include, but may not be limited to, the following:

- Terracing;
- Slope drains;
- Rock-lined ditches and swales; and
- Grass-lined ditches and swales.

Temporary erosion control measures are used as necessary to reduce erosion of exposed slopes on waste disposal areas, berms, or stockpiles. Temporary erosion control measures include the following (use will depend on the time of year and the length of time it is anticipated the soil will remain exposed):

- Seeding;
- Tracking slopes perpendicular to the fall line;
- Covering with mulch;
- Terracing; and
- Diversion ditches and slope drains.

Tracking of slopes (bulldozer tracks made perpendicular to the fall line of the slope) is completed as soon as the slope is finished, regardless of the time of year. Mulching of exposed slopes is done during wet weather conditions when seeding is not possible, or in conjunction with seeding as necessary to establish vegetation. Diversion ditches and slope drains will be constructed as necessary to prevent surface water flow from eroding exposed and covered slopes as well as preventing runoff generated on surrounding land from running into the active areas of the landfill.

2.3.10.3 Sedimentation Control

The erosion control measures described in Section 2.3.9.2 will mitigate offsite sedimentation by reducing the amount of soil carried away in the runoff. Additional sedimentation controls include sediment barriers and the sediment basins are discussed below.

2.3.10.4 Sediment Barriers

Sediment barriers include sediment logs and silt fencing. They are placed as needed during operations. They are most frequently placed below disturbed slopes to prevent silt in overland flow from reaching channels or ditches. The barriers will be installed as necessary. Sediment control fences will also be constructed and maintained in the drainage channels of the active areas of the site. Sediment shall be removed to keep channels open and the soil replaced at the source as required.

2.3.10.5 Sediment Basins

The Facility was designed to have three sedimentation ponds that collect sediments from the landfill prior to releasing stormwater from the site. Water is released when necessary through controlled discharge devices from the ponds.

2.3.10.6 System Maintenance Procedures

It is very important that the stormwater management components of the cover system be maintained so that they may function properly during a storm event. The following maintenance is recommended, especially after large storm events.

- Keep all ditches and swales unobstructed;
- Remove sediment from ditches, swales, sediment basins, and sediment barriers routinely. Sediment controls are most effective when sediment is removed regularly;
- Inspect and clean check dams and outlet control structures of sediment and other materials that may restrict flow;
- Periodically inspect the stormwater system for damage and repair immediately; and
- Inspect and clean the stormwater system following a major storm event.

Additional inspection and maintenance requirements and procedures are included in the Facility Inspection and Maintenance Plan (see **Appendix E** of the permit narrative)

2.4 Surface Waste Management Facility Closure Certification

Following closure of the Facility, NMOCD will be provided a certification, signed by a registered professional engineer, verifying that closure of the landfill cells, evaporation pond, drying pads, truck wash and administrative building has been completed in accordance with the closure plan, and that the certification has been placed in the POR. A final closure report shall accompany the certification that includes:

- The final survey;
- Quality control and quality assurance data documenting proper construction and installation of the cover system, in accordance with the Facility CQA Plan; and
- Other information that the NMOCD may deem necessary to making the certification of construction criteria described in **19.15.36.14.C.8**.

3.0 POST-CLOSURE PLAN

3.1 Landfill Post-Closure Period

The landfill post-closure period shall be 30 years immediately following the date of written confirmation by the NMOCD that the Facility has been closed in accordance with the approved closure plan unless the period is decreased or increased by the NMOCD. The period may be decreased if the Facility demonstrates that the reduced period is sufficient to protect fresh water, public health and the environment and this demonstration is approved by the director of the NMOCD. During the post-closure care period, the closure cover shall be maintained, and monitoring activities will be performed as described in the following subsections.

3.2 Pond Post-Closure Period

The post-closure care period for a pond or pit shall be three years if the operator has achieved clean closure. During that period the operator or other responsible entity shall regularly inspect and maintain required re-vegetation and monitoring activities will be performed as described in the following subsections.

3.3 Post-Closure Inspection, Monitoring, and Maintenance

After closure, the Facility will be inspected on a semi-annual basis using the forms provided in the Inspection and Maintenance Plan (**Appendix E** of the PA narrative). The inspections will note areas of the facility that need maintenance and repairs, if any. If there has been a release to the vadose zone or to ground water, then the operator shall comply with the applicable requirements of **19.15.29** and **19.15.30**.

Access to the site after closure will be controlled through maintenance of existing fencing and signs, and all access gates will be locked to discourage unauthorized entry.

The integrity of the final cover shall be maintained, including the repair of the cover, as necessary to correct the effects of settlement, subsidence, and erosion, and prevent run-off and run-on from damaging the cover. Vegetation shall be maintained at least annually to control the growth of unwanted vegetation that may interfere with the integrity of the final cover. All cracked, eroded and uneven cover areas must be filled and reseeded and integral ditches maintained. Seeding of the landfill cover shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains. Final cover and surrounding areas re-vegetated with at least two grasses not including noxious weeds or deep rooted shrubs or trees, and shall be established such that at least 70% of the area is covered and then maintained through the post-closure period.

Seeding of the leachate evaporation pond, drying pads, truck wash, administration building area, and remaining SWMF areas shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains. Final cover shall consist of at least three native plant species, including at least one grass but not including noxious weeds, and maintained through two successive growing seasons.

The leak detection system will be maintained and properly operated, and the leachate collection system will be maintained and properly operated to maintain less than one foot of head on the liner system during the post-closure care period in accordance with the requirements of **19.15.36.14.C** and **F**. The Facility may demonstrate to the director of the NMOCD that the leachate no longer poses a threat to fresh water, public health and the environment in order to stop managing leachate.

If applicable, the Facility will continue to monitor the vadose zone, and groundwater if needed, semi-annually unless a less frequency has been authorized by NMOCD in accordance with the requirements of the Inspection and Maintenance Plan (**Appendix E** of the PA narrative).

During the post-closure period, the Facility will continue to maintain and monitor perimeter landfill gas probes, if applicable, during the post-closure period.

3.4 Contact Persons

The name, address, and telephone number of the person to contact about the Facility during the post-closure period will be provided upon notice of closure**.**

3.5 Post-Closure Annual Report

The operator will submit annual post-closure reports to NMOCD by September 1 of each year, for the July-June fiscal year, to include inspection reports, maintenance records, sample analysis reports, any faults in the facility closure installation and response/resolution to any fault issue. Annual reports will be maintained in the facility POR.

3.6 Post-Closure Cost Estimate

An estimate of the cost to perform post-closure activities is based on the estimated cost of hiring a third party to conduct the activities. The cost estimate is based on the most expensive costs of post-closure care during the post-closure care period. **Attachment A** presents the current Estimated Post-Closure cost for the Facility (in 2024 dollars). The Post-Closure Cost estimate will be updated upon request by the NMOCD during the life of the Facility to account for inflation.

3.7 Certification of Completion

Following the completion of the post-closure care period for the Facility, the NMOCD will be notified that a certification has been placed in the POR. The certification, signed by an independent registered engineer and approved by the NMOCD, will verify that post-closure care has been completed in accordance with the Post-Closure Care Plan.

3.8 Site Management and Use

It is anticipated that upon completion of post-closure care, the Facility site will become open range-land. The actual long-term use of the land will be determined upon notice of closure. The final Facility cover will not be disturbed without prior approval from the NMOCD.

Figures

REV.	DATE	BY	DESCRIPTION

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
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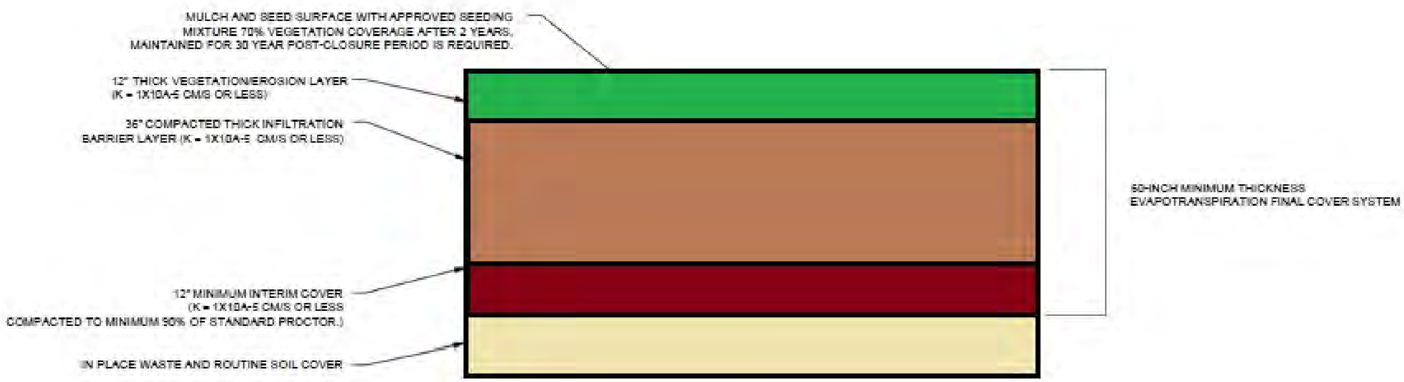
SITE LOCATION MAP
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. 1

DESIGNED BY:	-
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	1" = 100'
DATE:	SEPTEMBER 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	1 OF 1

N:\GECARCHIVE\CAD\572\002\MCCLOY\PERMIT TEXT FIGURES\PERMIT NARRATIVE\FIG 1 - SITE LOCATION MAP.DWG



TYPICAL LANDFILL FINAL COVER SYSTEM

DETAIL -/-
NTS

FIG. No. 2

FINAL COVER SYSTEM

PERMIT APPLICATION FIGURE

NGL WATER SOLUTIONS PERMIAN, LLC

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 INTERSTATE 30 S BRYANT, ARKANSAS 72022
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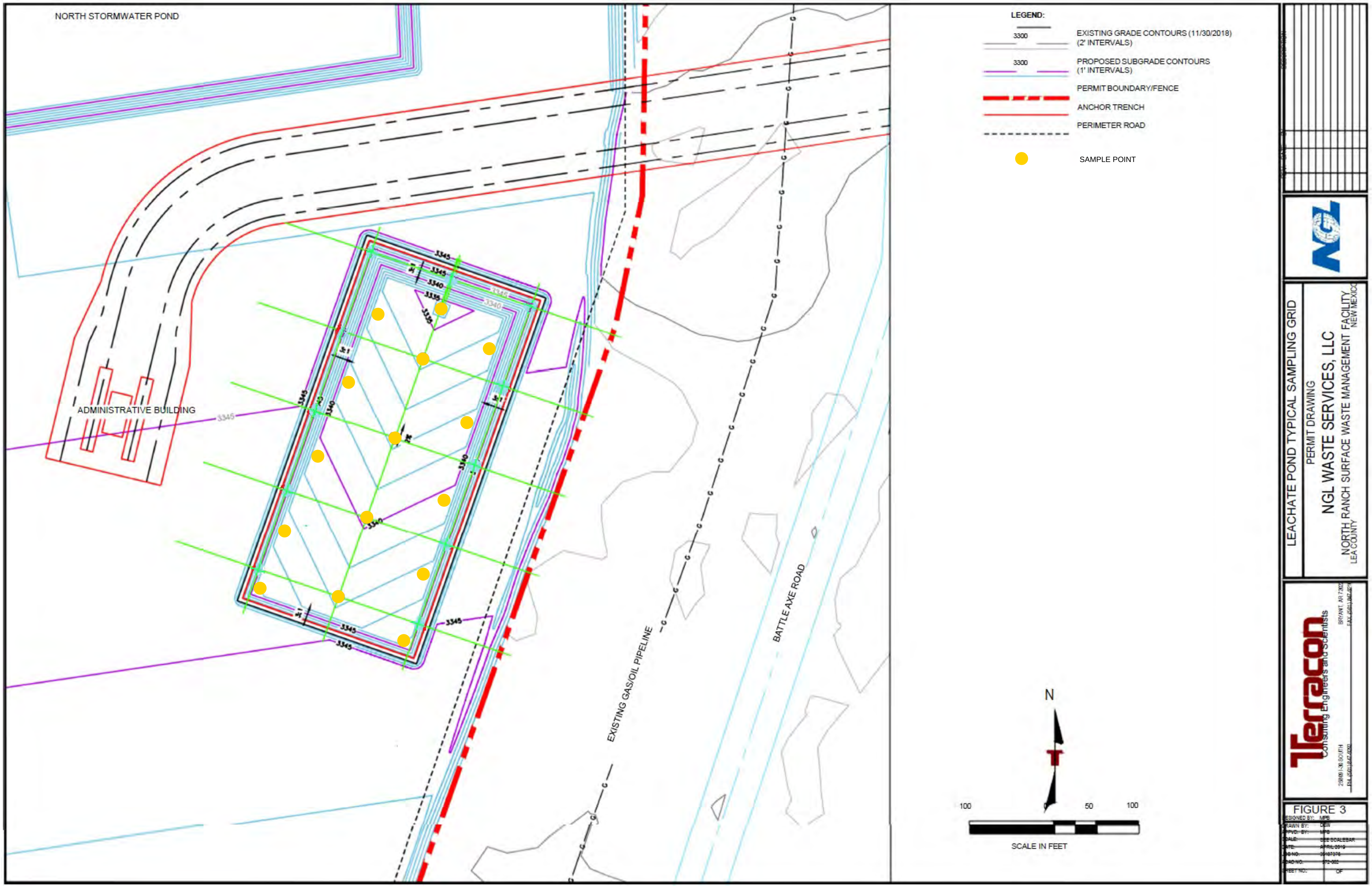
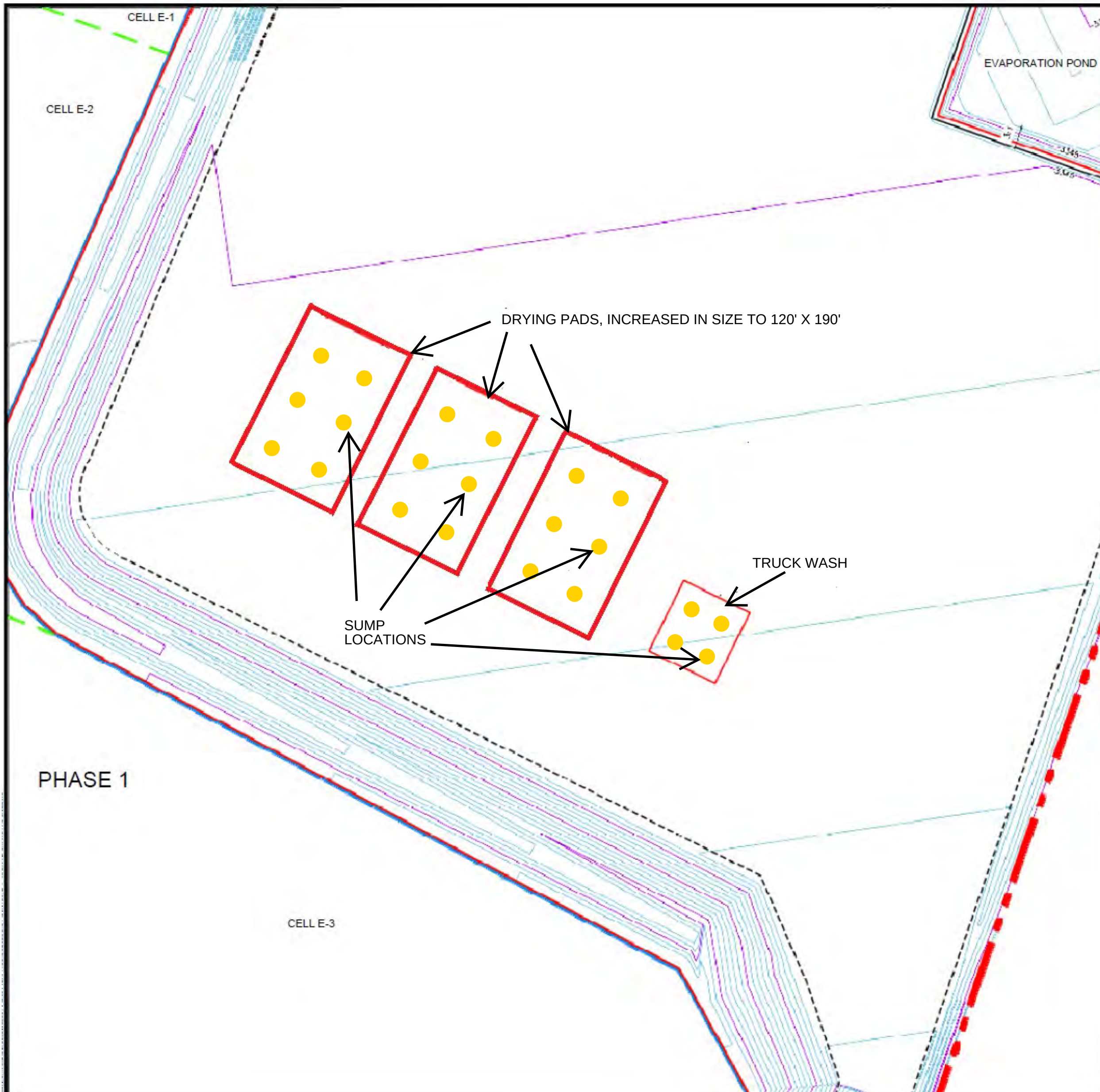
Project Mngr:	MPB	Project No.	35187378
Drawn By:	DEW	Scale:	AS SHOWN
Checked By:	MPB	File No.	572-002
Approved By:	FOC	Date:	APRIL 2019


NORTH STORMWATER POND
ADMINISTRATIVE BUILDING
EXISTING GAS/OIL PIPELINE
BATTLE AXE ROAD
LEGEND:
EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
PROPOSED SUBGRADE CONTOURS (1' INTERVALS)
PERMIT BOUNDARY/FENCE
ANCHOR TRENCH
PERIMETER ROAD
SAMPLE POINT
N
SCALE IN FEET
LEACHATE POND TYPICAL SAMPLING GRID
PERMIT DRAWING
NGL WASTE SERVICES, LLC
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 3



LEGEND:

- 3300 — EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
- 3300 — PROPOSED SUBGRADE CONTOURS (1' INTERVALS)
- PERMIT BOUNDARY/FENCE
- SAMPLE POINT

NOTE:

PAD SHOWN MAY BE CONSTRUCTED IN A DIFFERENT LOCATION THAN WHAT IS SHOWN AT THE OPERATORS DISCRETION. SAMPLING POINTS SHOWN WILL REMAIN IN THE SAME LOCATIONS SHOWN IN RELATION TO THE ASSOCIATED PAD REGARDLESS OF ORIENTATION AND LOCATION.

N

100 0 50 100

SCALE IN FEET

REV.	DATE	BY	DESCRIPTION

WASTE DRYING PAD AND TRUCK WASH PAD SUBSURFACE SAMPLING POINTS

PERMIT DRAWING

NGL WASTE SERVICES, LLC

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists

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FIGURE 4

DESIGNED BY:	MPB
DRAWN BY:	DBW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	APRIL 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

Attachment A
Estimated Closure and Post-Closure Cost

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY CLOSURE COST ESTIMATE WORKSHEET

OWNER: NGL WASTE SERVICES, LLC	PERMIT No.: NM1-66
OPERATOR: Same	ESTIMATOR: Dillon Baird DATE: MARCH 2024
TOTAL PERMITTED WASTE DISPOSAL ACRES: 303 ac (205 ac cell area)	
TOTAL PERMITTED ACRES CERTIFIED CLOSED: 0	ACRES CURRENTLY OPEN: 19.2 ac cell area, 68 ac support facilities area, 87.2 ac total
ACREAGE ASSUMED TO REQUIRE FINAL COVER AT THE END OF 10 YEAR PERMIT TERM: 106	

SUMMARY OF CLOSURE COST ESTIMATE

ITEM No.	ITEM	TOTALS
1	PROFESSIONAL SERVICES	$ 637,760
2	FINAL COVER	$ 985,307
3	EROSION CONTROL	$ 1,372,604
4	DRYING AND WASH PADS CLOSURE	$ 992,295
5	EVAPORATION POND CLOSURE	$ 513,727
6	MISCELLANEOUS	$ 568,229
	TOTAL CLOSURE COST (2024 Dollars)	**$ 5,069,922**

DETAIL OF CLOSURE COST ESTIMATE

ITEM No.	ITEM	QUANTITY	UNITS	UNIT COST	COST	SUBTOTALS	NMOCD COMMENTS
1.0.0	**PROFESSIONAL SERVICES**						
1.1.0	Engineering (Design, Bid Documents, Procurement, Bid Phase Management)	1	Lump Sum	$41,321.00	$ 41,321		
1.2.0	Topographic and Boundary Survey	1	Lump Sum	$11,806.00	$ 11,806		
1.3.0	Engineering Services (Construction Oversight, Survey, Testing, Reporting, Certification)	1	Lump Sum	$59,030.00	$ 59,030		
1.4.0	Construction Quality Assurance - Field Services	106	ACRE	$4,958.52	$ 525,603		
	Professional Services Subtotal					$ 637,760	
2.0.0	**LANDFILL FINAL COVER**						
2.1.0	Preparation of landfill to receive cover (final grading, disc and recompaction of existing 12-inch intermediate cover surface-placed during normal operations)	38	ACRE	$2,951.50	$ 112,157		
2.2.0	Infiltration Barrier Layer (excavate, transport, place, compact 36-inches from onsite stockpiles)	183,920	CU. YD.	$2.95	$ 542,840		
2.5.0	Erosion/Vegetative Layer (excavate, transport, place 12-inches from onsite stocklpiles)	61,307	CU. YD.	$2.95	$ 180,948		
2.6.0	Seeding and mulching	38	ACRE	$2,300.00	$ 87,400		
2.6.5	Seed & mulch water (100 bbl/acre @ $450 per 100 bbl)	38	ACRE	$450.00	$ 17,100		
2.7.0	Soil Amendments including Fertilizer	38	ACRE	$1,180.60	$ 44,863		
	Protective Soil and Vegetative Layer Subtotal					$ 985,307	
3.0.0	**EROSION CONTROL** (estimated as a percentage of all required features for the overall 205 acre landfill closure)						
3.1.0	Rip-rap Letdown Structures	3,034	Lin. FT.	$93.05	$ 282,314		
3.2.0	Checkdams and filters	38	EACH	$2,701.93	$ 102,287		
3.3.0	Tack-on Berms/Channels with RECP	41,843	Lin. FT.	$23.61	$ 988,003		
	Erosion Control Subtotal					$ 1,372,604	
4.0.0	**DRYING AND WASH PADS**						
4.1.0	Demolition and Removal of Concrete and Geosynthetics, Piping, Appurtenances, and Base Soils (Assume 3 pads and 1 wash pad, incl Administrative Office)	1	Lump Sum	$678,845.00	$ 678,845		
4.1.5	NORM testing (50 samples @ $350 each)	50	EACH	$350.00	$ 17,500		
4.2.0	Residual Leachate Disposal Costs	5,000	GAL.	$0.28	$ 1,417		
4.3.0	Backfill and Final Grading	5,500	CU. YD.	$2.95	$ 16,233		
4.4.0	Sampling and Analysis for Clean Closure	22	EACH	$1,400.00	$ 30,800		
4.5.0	Seeding and mulching	66	ACRE	$2,300.00	$ 151,800		
4.6.0	Seed & mulch water (100 bbl/acre @ $450 per 100 bbl)	66	ACRE	$450.00	$ 29,700		
4.6.0	Soil Amendments including Fertilizer	66	ACRE	$1,000.00	$ 66,000		
	Drying and Wash Pads Subtotal					$ 992,295	
5.0.0	**EVAPORATION POND CLOSURE**						
5.1.0	Excavation and Disposal of Residual Sludges, Protective Soil, Piping, and Geosynthetics	1	Lump Sum	$118,060.00	$ 118,060		
5.1.5	NORM testing (25 samples @ $350 each)	25	EACH	$350.00	$ 8,750		
5.2.0	Residual Leachate Disposal Costs	1,000,000	GAL.	$0.31	$ 310,000		
5.3.0	Pond Backfill and Final Grading	16,150	CU. YD.	$2.95	$ 47,667		
5.4.0	Sampling and Analysis for Clean Closure	15	EACH	$1,400.00	$ 21,000		
5.5.0	Seeding and mulching	2.2	ACRE	$2,300.00	$ 5,060		
5.6.0	Seed & mulch water (100 bbl/acre @ $450 per 100 bbl)	2.2	ACRE	$450.00	$ 990		
5.7.0	Soil Amendments including Fertilizer	2.2	ACRE	$1,000.00	$ 2,200		
	Evaporation Pond Subtotal					$ 513,727	
	Surface Waste Management Facility Closure Subtotal					**$ 4,501,693**	
6.0.0	**MISCELLANEOUS**						
6.1.0	10% Administration and Contingency (Total Closure Cost Subtotal x 10%)	1	Lump Sum	$450,169.28	$ 450,169		
6.2.0	Mobilization	1	Lump Sum	$118,060.00	$ 118,060		
	Misc. Subtotal					$ 568,229	
	TOTAL CURRENT CLOSURE COST					**$5,069,922**	

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
POST-CLOSURE CARE COST ESTIMATE WORKSHEET

OWNER: NGL WASTE SERVICES, LLC	PERMIT No.: NM1-66
OPERATOR: Same	ESTIMATOR: Dillon Baird DATE: MARCH 2024
TOTAL PERMITTED WASTE DISPOSAL ACRES: 303 ac (205 ac cell area)	
TOTAL PERMITTED ACRES CERTIFIED CLOSED: 0	ACRES CURRENTLY OPEN: 19.2 ac cell area, 68 ac support facilities area, 87.2 ac total
ACREAGE ASSUMED TO REQUIRE FINAL COVER AT THE END OF 10 YEAR PERMIT TERM: 106	

SUMMARY OF CLOSURE COST ESTIMATE

ITEM No.	ITEM	TOTALS
1	PROFESSIONAL SERVICES ($23,612 x 30)	$708,360.00
2	FINAL COVER ROUTINE MAINTENANCE ($3,777.92 x 30)	$113,337.60
3	FINAL COVER REPAIRS ($10,035.10 x 30)	$301,053.00
4	ACCESS ROADS REPAIRS ($15,798.30 x 30)	$473,949.00
5	SURFACE WATER MANAGEMENT OPERATION AND MAINTENANCE (O&M) ($7,083.60 x 30)	$212,508.00
6	LEACHATE COLLECTION SYSTEM O&M ($15,248.25 x 30)	$457,447.39
7	CORRECTIVE ACTION EVALUATION AND IMPLEMENTATION ($0.00 x 30)	$0.00
8	MISCELLANEOUS ($7,555.52 x 30)	$226,665.50
9	3 YEAR EVAPORATION POND INSPECTION & MAINTENANCE ($12,595.98 X 3)	$37,787.94
	ESTIMATED 30-YEAR POST CLOSURE CARE COST TOTAL (2024 DOLLARS)	**$2,531,108.43**

LANDFILL POST-CLOSURE CARE COST ESTIMATE

ITEM No.	ITEM	QUANTITY	UNITS	UNIT COST	COST	SUBTOTALS	NMOCD COMMENTS
1.0.0	**PROFESSIONAL SERVICES**						
1.1.0	Engineering (Semi-Annual inspection, Annual reporting, corrective action design and bid, contract management)	2	EACH	$8,854.50	$17,709.00		
1.2.0	Vadose Zone Monitoring	2	EACH	$2,951.50	$5,903.00		
	Professional Services Annual Subtotal					$23,612.00	
2.0.0	**FINAL COVER ROUTINE MAINTENANCE**						
2.1.0	Inspect soil cover, culverts, drainage letdowns and outfalls, etc...	2	Event	$1,770.90	$3,541.80		
2.3.0	Clean Drain/Culvert Openings	2	Event	$118.06	$236.12		
					$0.00		
	Final Cover Routine Maintenance Annual Subtotal					$3,777.92	
3.0.0	**FINAL COVER REPAIRS**						
3.1.0	Remove/incorporate unacceptable materials (e.g., dead vegetation, solid waste)		ACRE		$0.00		
3.2.0	Scarify and prepare surface		ACRE		$0.00		
3.3.0	Soil, On-Site (excavate, transport, place, compact)	100	CU. YD.	$2.95	$295.15		
3.4.0	Soil, Off-site (excavate, transport, place, compact)		CU. YD.		$0.00		
3.5.0	Seeding and mulching	5	ACRE	$1,770.90	$8,854.50		
3.6.0	Soil Amendments including Fertilizer	5	ACRE	$177.09	$885.45		
	Final Cover Repairs Annual Subtotal					$10,035.10	
4.0.0	**ACCESS ROADS REPAIRS**						
4.1.0	Reshape/regrade subgrade		SQ. YD.		0		
4.2.0	Gravel (transport, place, compact)	100	TON	$59.03	$5,903.00		
4.3.0	Drainage Structures (e.g., culverts,	50	Lin. FT.	$11.81	$590.30		
4.4.0	Riprap ditching/channels	100	Lin. FT.	$93.05	$9,305.00		
	Access Roads Repair Annual Subtotal					$15,798.30	
5.0.0	**SURFACE WATER MANAGEMENT OPERATION AND MAINTENANCE (O&M)**						
5.1.0	Collection system operation and maintenance (ditches, piping conveyances, outfalls, sampling points repair/replace)	2	Lump Sum	$1,770.90	$3,541.80		
5.2.0	Stormwater storage (sediment pond) operation/repairs	2	Lump Sum	$1,770.90	$3,541.80		
	Evap Pond & Surface Water Management O&M Annual Subtotal					$7,083.60	
6.0.0	**LEACHATE COLLECTION SYSTEM O&M**						
	Generation Rate = 100 gal./ac./yr.						
6.1.0	Collection operation/maintenance (pump, piping, skimmer, storage operation/repair/replace)	12	Months	$295.15	$3,541.80		
6.2.0	Leachate loading, off-loading and off-site transportation	1	Event	$5,903.00	$5,903.00		
6.3.0	Leachate Treatment/Disposal	10,600	Gal.	$0.28	$3,003.45		
6.5.0	Leachate sample collection	2	EACH	$300.00	$600.00		
6.6.0	Leachate sample analysis and reporting	2	EACH	$1,100.00	$2,200.00		
	Leachate Collection System O&M Annual Subtotal					$15,248.25	
7.0.0	**CORRECTIVE ACTION EVALUATION AND IMPLEMENTATION**						
7.1.0	Resurvey vadose zone well reference points and site benchmarks		EACH		$0.00		
7.2.0	Remove sediments from stormwater basins		EACH		$0.00		
7.3.0	Vadose Zone exceedances evaluation		EACH		$0.00		
7.4.0	Groundwater exceedances notifications		EACH		$0.00		
7.5.0	Groundwater compliance monitoring		EACH		$0.00		
7.6.0	Abate exceedances in subsurface water		EACH		$0.00		
	Corrective Action Evaluation and Implementation Annual Subtotal					$0.00	
	Total Post Closure Care Annual Cost Subtotal					$75,555.17	
8.0.0	**MISCELLANEOUS**						
8.1.0	10% Administration and Contingency (Total Closure Cost Subtotal x 10%)				$7,555.52		
	Misc. Subtotal					$7,555.52	
	TOTAL ESTIMATED ANNUAL POST CLOSURE CARE COST					**$83,110.68**	
	ESTIMATED 30 YEAR POST CLOSURE CARE PERIOD SUBTOTAL		30 X "Total Estimated Annual Post Closure Care Cost"			**$2,493,320.49**	

ITEM No.	ITEM	QUANTITY	UNITS	UNIT COST	COST	SUBTOTALS	NMOCD COMMENTS
9.0.0	**3 YEAR EVAPORATION POND INSPECTION & MAINTENANCE**						
9.1.0	Seeding and mulching	2	ACRE	$1,770.90	$3,541.80		
9.2.0	Soil Amendments including Fertilizer	2	ACRE	$177.09	$354.18		
9.3.0	Evaporation Pond 3 year post-closure costs (Semi-annual inspections & maintenance, in combination with landfill, drying pads, truck wash inspections & reporting)	6	EACH	$1,450.00	$ 8,700		
	Evap Pond Annual Subtotal					$12,595.98	
	3 YEAR ESTIMATED EVAPORATION POND POST CLOSURE CARE COST	3 X "Evap Pond Inspection & Maintenance Annual Subtotal"				**$37,787.94**	
	ESTIMATED 30 YEAR POST CLOSURE CARE PERIOD TOTAL		**Sum of "Estimated 30 Year Post Closure Care Period Subtotal" & "3 Year Estimated Evaporation Pond Post Closure Care Cost"**			**$2,531,108.43**	

Minor Modification For Surface Waste Management Facility

North Ranch Disposal Facility: Surface Waste Management Facility Lea County, New Mexico

May 2023
Project No. 35187378

Modified by:
NGL Waste Services, LLC
1008 Southview Circle
Center, TX 75935
(936)598-8587

Modified for:
R360 Antelope Draw, LLC
476 Battle Axe Rd
Jal, NM 88252
(575) 236-1734

Volume 2 of 3

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List of Appendices
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Appendix I

Hydrogeological Report

Hydrogeological Report

North Ranch Disposal Facility:
Surface Waste Management Facility

Lea County, New Mexico

May 2023
Project No. 35187378

Modified by:
NGL Waste Services, LLC
1008 Southview Circle
Center, TX 75935
(936) 598-8587

Table of Contents

List of Figures

List of Attachments

Attachment A	Geotechnical Engineering Report
Attachment B	United States Department of Agriculture, Web Soil Survey Report

1.0 Introduction

This Hydrogeological Report documents investigations conducted for the proposed NGL Waste Services, LLC North Ranch Surface Waste Management Facility (NRSWMF) located near Jal, Lea County, New Mexico. Data were compiled by Terracon Consultants, Inc. (Terracon) and Lonquist and Co., LLC (Lonquist), in accordance with the Energy, Minerals and Natural Resources Department, Oil Conservation Division (NMOCD or Division) requirements and the *New Mexico Administrative Code (NMAC)* Section **19.15.36**. NGL owns the property proposed for the landfill and associated facilities.

Section 2.0-3.0 of this report was prepared by Terracon and describes the regional geologic and hydrogeological characterization for the area and the site-specific information gathered for the generation of this document for the NRSWMF..

1.1 Site Location

The NRSWMF site is located within Section 9 and 10 of, T25S, R34E approximately 16 miles west of the City of Jal in Lea County, New Mexico.. See **Figure 1.**

1.2 Background

NGL is currently preparing a Permit Application to develop a new Surface Waste Management Facility (NRSWMF). The location of the site and the proposed development area is shown on **Figure 1**. This application will establish an oil field solid waste landfill footprint area consisting of approximately 205 acres with a waste capacity of approximately 40,264,324 cubic yards. **Figure 2** illustrates the site layout within the permitted boundary. The NMOCD requires a review and summary of the hydrogeology and geology of the region and facility that illustrates the location of the SWMF facilities and Wells.

2.0 North Ranch Surface Waste Management Facility Regional Characterization

This section discusses the regional hydrogeologic setting of the area surrounding the SWMF including hydrology, geology, hydrogeology, and groundwater quality. This information was compiled from published sources including sections of the 1961 Geology and Ground-Water Condition in Southern Lea County, New Mexico report by the State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology and Terracon's January 2019 Geotechnical Engineering Report of the site.

2.1 Regional Hydrology

The SWMF landfill is located within Pecos watershed ,a tributary to the Rio Grande Watershed. Surface drainage from the landfill property generally flows downward towards the east, see **Figure 3** for a regional watershed map. No integrated drainage is present in southern Lea County, thus there is no discharge to the Pecos River, which is located southwest of the area. Tributaries of the Pecos River are located approximately 20 miles southwest of the landfill site in southwestern Lea County. The Pecos River flows south and merges with the Rio Grande in southern Texas along the Texas-Mexico border.

2.2 Regional Geology

This section describes the geologic setting of the region, including soils, regional stratigraphy, and regional structural geology and geomorphology. A geologic map of the region around the NRSWMF is provided in **Figure 4.** A map showing the location of water wells within a one-mile radius of the site is presented in **Figure 5**, and a local depth to groundwater surface map is provided in **Figure 6**.

The New Mexico State Geologic Map (1:500 000) indicates the general surface geology of the landfill site consists of Quaternary eolian and piedmont deposits (Qep) (Holocene to middle Pleistocene). Qep is comprised of interlayered eolian sands and piedmont-slope deposits. The unconsolidated eolian sands consist of sands and loess; the piedmont-slope deposits include deposits of higher gradient tributaries near major stream valleys, alluvial veneers of the piedmont slope, and alluvial fans and may locally include uppermost Pliocene deposits.

2.2.1 Regional Soils

Based on the information provided by the Web Soil Survey (March 26, 2019) and the United States Department of Agriculture Soil Conservation Service (USDA SCS), the primary soils at the site are the Ratliff-Wink fine sandy loam in the southern portion (42%), the Wink loamy fine sand (WK) in the middle and southwestern portions (31%), and the Pyote and Maljamar fine sands (PU) in the northern portion (27%).

The Ratliff-Wink is a fine sandy loam from 0 to 4 inches overlying clay loam from 4 to 60 inches. The Wink loamy fine sand is described as a loamy fine sand from 0 to 12 inches and a sandy loam from 12 to 60 inches. Both the Ratliff-Wink and Wink loamy fine sand are well drained with a high capacity to transmit water (2.0 to 6.0 in/hr). The depth to water is greater than 80 inches.

The Pyote and Maljamar fine sands consist of fine sand from 0 to 24 inches, sandy clay loam from 24 to 50 inches, and cemented material from 50 to 60 inches. The Pyote is well drained with a very low to moderately low capacity to transmit water (0.00 to 0.06 in/hr). The depth to water is reported to be greater than 80 inches. See USDA SCS Web Soil Survey Report for the proposed site in **Attachment B.**

Based on the January 2019 Geotechnical Engineering report (**Attachment A**), encountered soils during drilling activities at the site were divided into three stratums: the first strata consisted of silty sand, silty sand with gravel, silty clayey sand, and poorly graded sand with interbedded layers of caliche and ranged in depths from 20 to 27 feet bgs; the second strata consisted of silty sand, poorly graded sand, interbedded caliche layers and ranged in depth from 27 to 65 feet bgs; the third strata ranged in depths between 40 to 65 feet bgs and consisted of fine-grained, poorly to moderately compacted sandstone.

The observed caliche materials are underlain by medium to finely weathered sandstone extending to boring-termination depths to 165 feet below existing grades. Soil porosity and permeability observed during drilling ranged from 0.34 to 0.36 and 1.12×10^{-12} to 6.72×10^{-11} cm^2, respectively, and hydraulic conductivity ranged from 1.09×10^{-07} to 5.56×10^{-06} cm/sec.

2.2.2 Regional Stratigraphy

The surface geology of the landfill site consists of the Quaternary Eolian and Piedmont Deposits (Qep) (Holocene to middle Pleistocene), which is the primary geologic formation at the surface in this area. Small outcrops of Quaternary Piedmont Alluvial Deposits (Qp) (Holocene to lower Pleistocene) are located to the north and east of the site and overlie the Qep deposits. Furthermore, Quaternary Older Alluvial Deposits of Upland Plains and Piedmont Areas (Qoa) (Middle to lower Pleistocene) are west of the site and typically underlie the Qep deposits. The Tertiary Ogallala Formation (To) (lower Pliocene and middle Miocene) underlies the Qoa and is exposed northwest and east of the site. The Ogallala consists of alluvial and eolian deposits and petrocalcic soils of the southern high plains.

Triassic rocks of the Chinle Formation and Santa Rosa Sandstone of the Dockum Group underlie southern Lea County and is exposed southwest of the site. The Chinle Formation is described as a red to green claystone with minor fine-grained sandstone and siltstones. The Chinle is present in all of the eastern part of southern Lea County but thins westward and is absent in extreme western portions. Thickness of the Chinle varies from 0 to 1,270 feet. The Santa Rosa Sandstone is described as a primarily red, fine-to-coarse grained sandstone, is exposed only in minor outcrops, and the thickness ranges from 140 to 300 feet.

Undifferentiated Paleozoic rocks, consisting of siltstone, shale and sandstone, underlie the Dockum Group in southern Lea County. Thickness of these undifferentiated rocks is approximately 90 to 400 feet.

2.2.3 Regional Structural Geology and Geomorphology

The major structure features of southern Lea County are the Permian age Delaware Basin and the Central Basin Platform in the subsurface. Few structural features are present in the area due to the lack of tectonic movement within the basin since the close of the Permian.

The landfill site is located within the Southern High Plains physiographic region of the state. The High Plains covers the eastern quarter of the state and consists of mildly deformed Permian and Triassic sedimentary rocks capped by the late Miocene-Pliocene Ogallala Formation and Quaternary deposits, which are exposed in the southeastern and east-central parts of the state. Furthermore, the northwest part of the oil and gas-rich Permian Basin underlies southeastern New Mexico. No major surface faults or structural features are located in the vicinity of the landfill site.

Geomorphic features consist of windblown eolian and loess deposits in generally flat terrain that lacks integrated drainage systems.

Figure 12 provides a structural geology map for the region surrounding the NRSWMF.

2.3 Regional Hydrogeology

Potable groundwater in southern Lea County comes from three principal geologic units: the Dockum Group, Tertiary Ogallala Formation, and Quaternary Alluvium. The Triassic Santa Rosa sandstone, or the basal unit of the Dockum Group, is the principal aquifer in the western third of southern Lea County, which includes the landfill area. The Ogallala Formation and Quaternary Alluvium aquifers are the principal aquifers in the eastern portion of Lea County and are considered unsaturated in the western portion.

According to published data, the Santa Rosa Sandstone yields an average of about 47 gallons per minute (gpm); however, some wells are reported to yield as much as 100 gpm in some areas. The Sandstone is recharged by precipitation on sand dunes, by precipitation and runoff on outcrops, and groundwater flow from the overlying Ogallala Formation and Quaternary Alluvium. Porosity of the Santa Rosa Sandstone is reported at around 13 percent with very low permeability, and incomplete well-test data indicate a specific capacity of less than 0.2 gpm per foot of drawdown. **Figure 7** provides a contour map of the approximated elevations of the top of the Chinle Formation below the NRSWMF. **Figure 8** provides a contour map of the approximated top of the Santa Rosa Sandstone formation below the NRSWMF. **Figure 9** provides a cross section of the geologic formation lithology as it relates to the NRSWMF's proposed base grades.

Depth to water reported for water wells within the Township and Range of the landfill vary from approximately 165 feet in the southern portion to 230 feet in the northern portion.

2.4 Regional Groundwater Quality

The Dockum Group is the principal potable aquifer in the landfill area. Several domestic and municipal wells penetrate this aquifer in the western portion of the region.

Groundwater from the Triassic rocks of the Dockum Group are typically low in silica, vary in range in calcium and magnesium, high in sodium, moderately high in sulfate, and moderately low in chloride. The dissolved solid concentrations are typically higher than water derived from the Ogallala Formation.

Geohydrology of the local aquifers was summarized in U.S. Geological Survey report 84-4077, 1985. Published water quality data from selected wells in the Santa Rosa Sandstone in Lea County ranged from 426 to 1950 ppm for Total Dissolved Solids. A value of 685 ppm was reported for wells in the Cenezoic Alluvium in Lea County.

3.0 North Ranch Surface Waste Management Facility Site Hydrogeologic Investigation

The material presented in this section describes site-specific information gathered for the generation of this document.

3.1 Geotechnical Engineering Report

A Geotechnical Engineering Report was prepared by Terracon to present subsurface exploration, geologic, hydrogeologic and geotechnical engineering findings. Several recommendations related to subsurface soil/rock conditions, groundwater conditions, seismic site classification, site preparation and earthwork and site excavation are presented and were generated in conformance with the Siting and Subsurface Investigation Work Plan dated October 17, 2018 submitted to and approved by the NMOCD. A copy of the Geotechnical Engineering Report is attached to this narrative in **Attachment A**.

3.2 Site Geology

The NGL North Ranch SWMF is located within an area of historical oil and gas production, largely in undeveloped ranch areas covered with creosote and mesquite trees. The area is underlain by interlayered eolian sands and piedmont-slope deposits which are underlain by the Dockum Group. Subsurface soil and rock are illustrated on geological cross-section figures attached to this report. **Figure 10** shows the alignments of the cross-sections on a NRSWMF map. **Figure 11a** through **Figure 11c** show geologic cross-sections based on the boring data collected in the Geotechnical Engineering Report in **Attachment A**.

3.3 Site Hydrogeology

Groundwater was not encountered at the site during the boring program which advanced seven borings to a depth of approximately 165 feet below ground surface. The uppermost aquifer is estimated to be encountered at depths of around 175 to 200 feet below ground surface. **Figure 6** shows the approximate depth to groundwater in the NRSWMF area.

4.0 References

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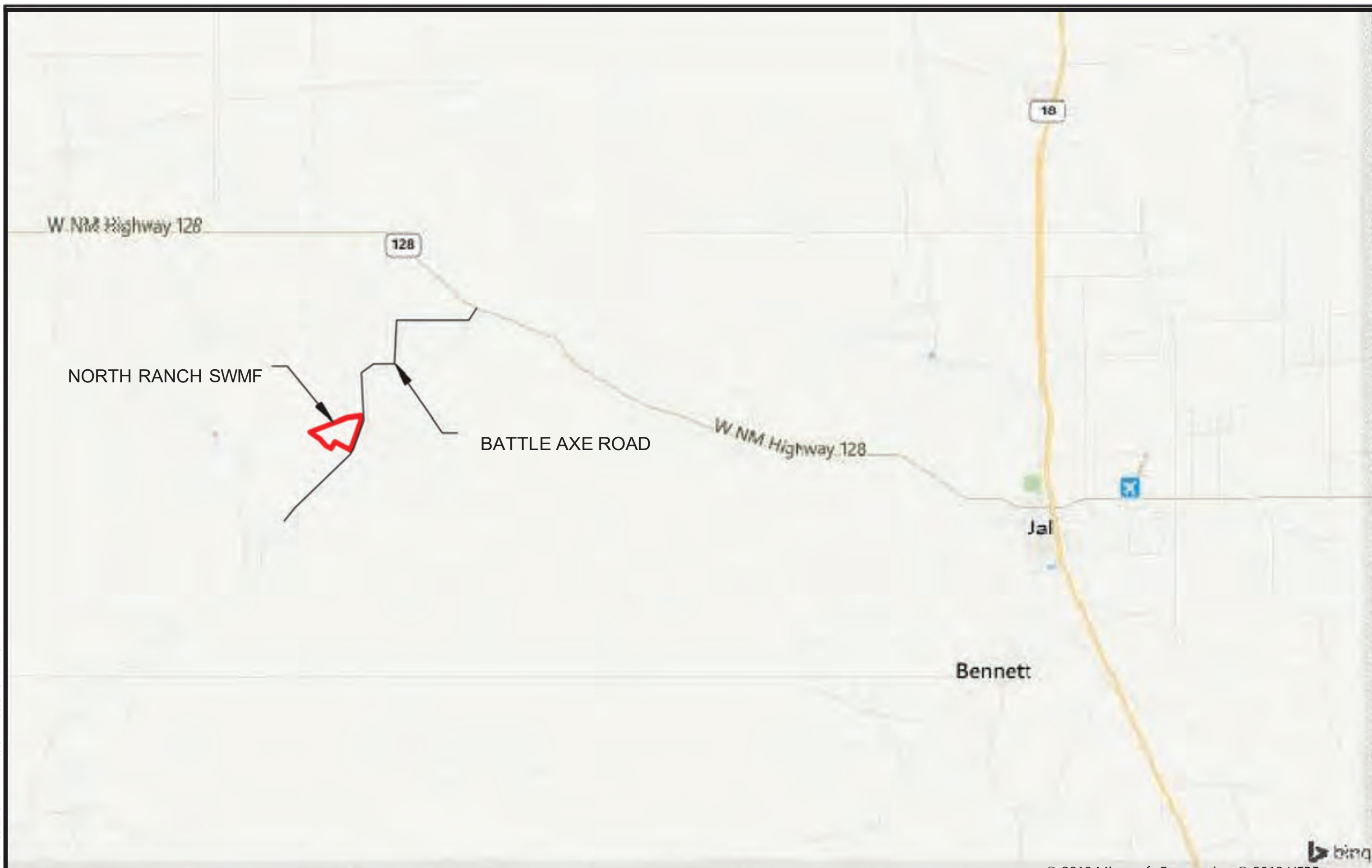
Figures



REV.	DATE	BY	DESCRIPTION

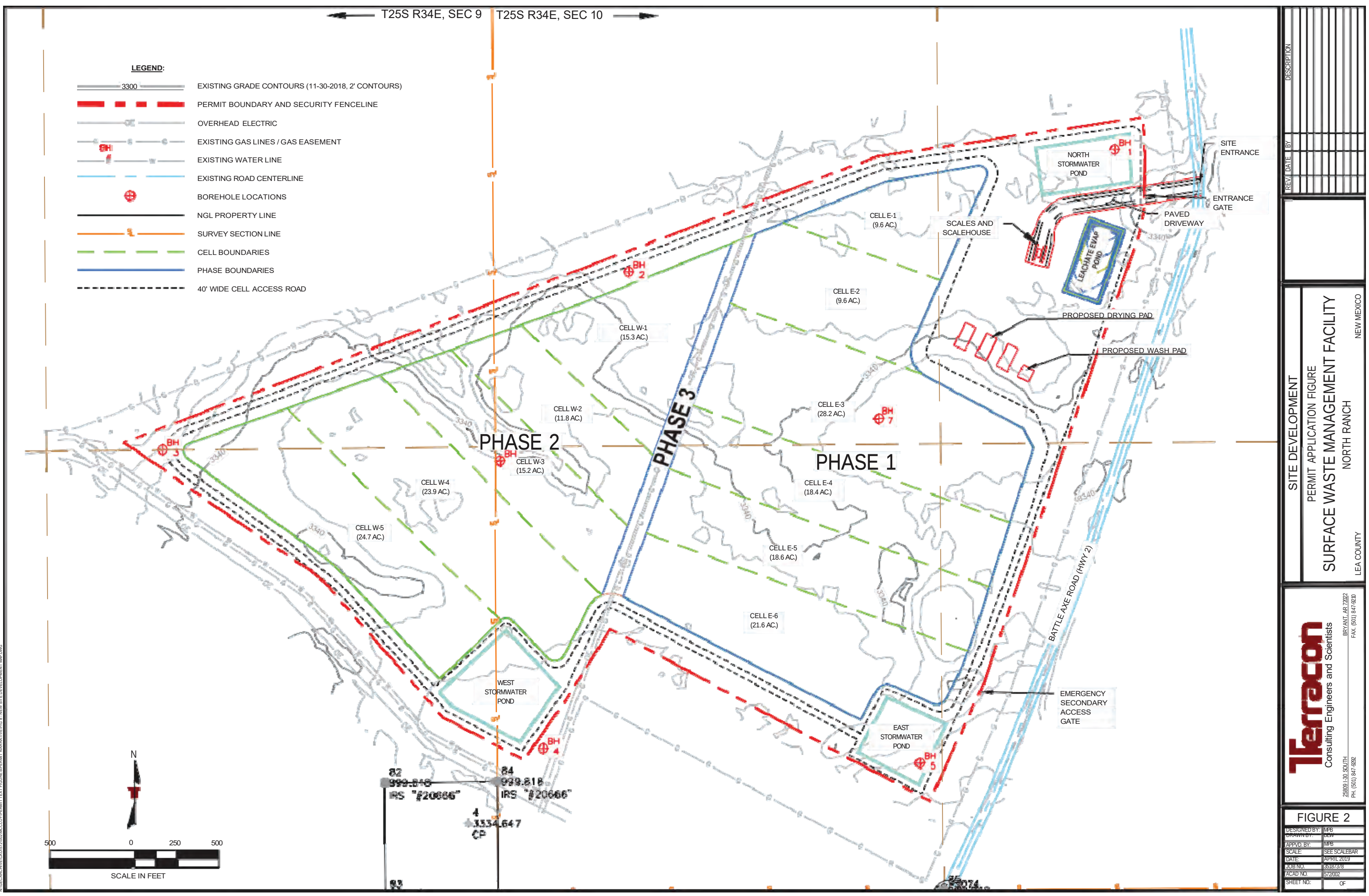
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

SITE LOCATION MAP
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. 1

DESIGNED BY:	-
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	1" = 100'
DATE:	SEPTEMBER 2019
JOB NO.	35187378
ACAD NO.	572002
SHEET NO.:	1 OF 1

N:\GEOARCHIVE\CAD\572002\MCCLOY\PERMIT TEXT FIGURES\PERMIT NARRATIVE\FIG 1 - SITE LOCATION MAP.DWG


T25S R34E, SEC 9
T25S R34E, SEC 10
LEGEND:
3300
EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
PERMIT BOUNDARY AND SECURITY FENCELINE
OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
EXISTING ROAD CENTERLINE
BOREHOLE LOCATIONS
NGL PROPERTY LINE
SURVEY SECTION LINE
CELL BOUNDARIES
PHASE BOUNDARIES
40' WIDE CELL ACCESS ROAD
NORTH STORMWATER POND
SITE ENTRANCE
ENTRANCE GATE
PAVED DRIVEWAY
SCALES AND SCALEHOUSE
LEACHATE EVAP POND
PROPOSED DRYING PAD
PROPOSED WASH PAD
CELL E-1 (9.6 AC.)
CELL E-2 (9.6 AC.)
CELL E-3 (28.2 AC.)
CELL E-4 (18.4 AC.)
CELL E-5 (18.6 AC.)
CELL E-6 (21.6 AC.)
CELL W-1 (15.3 AC.)
CELL W-2 (11.8 AC.)
CELL W-3 (15.2 AC.)
CELL W-4 (23.9 AC.)
CELL W-5 (24.7 AC.)
PHASE 1
PHASE 2
PHASE 3
BH 1
BH 2
BH 3
BH 4
BH 5
BH 7
BH
WEST STORMWATER POND
EAST STORMWATER POND
EMERGENCY SECONDARY ACCESS GATE
BATTLE AXE ROAD (HWY 2)
N
500 0 250 500
SCALE IN FEET
IRS "#20666"
IRS "#20666"
3334.647
CP
SITE DEVELOPMENT
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 2

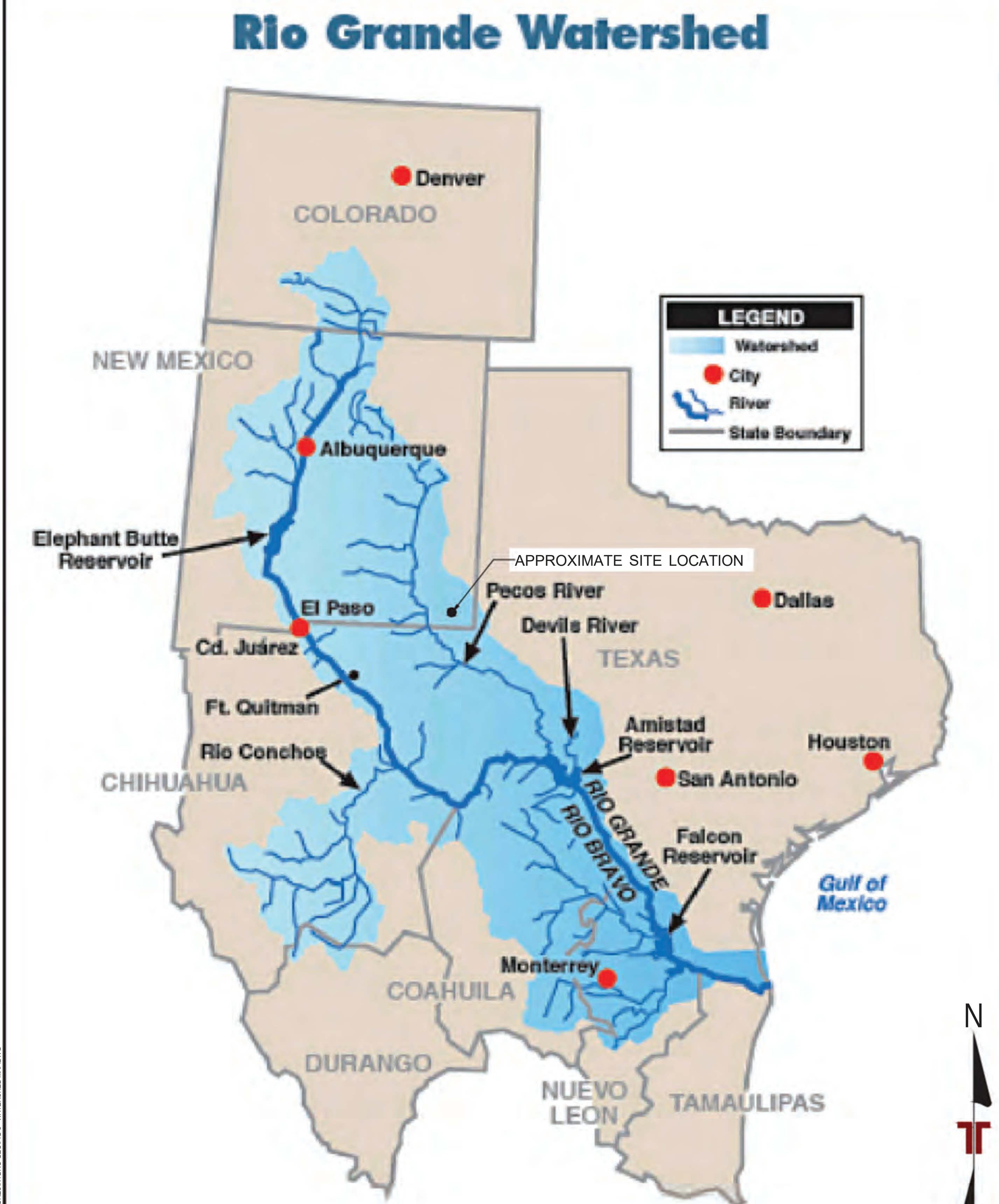


IMAGE SOURCE: TEXAS COMMISSION OF ENVIRONMENTAL QUALITY
https://www.tceq.texas.gov/assets/public/comm_exec/pubs/sfr/057_16/RGMap.jpg

Project Mngr: MPB	Project No. 35187378	Terracon Consulting Engineers and Scientists	RIO GRANDE WATERSHED	FIG. No.
Drawn By: DEW	Scale: AS SHOWN	25809 INTERSTATE 30 S BRYANT, ARKANSAS 72022	PERMIT APPLICATION FIGURE	3
Checked By: MPB	File No. 572-002	PH. (501) 847-9292 FAX. (501) 847-2910	NGL WASTE SERVICES, LLC	
Approved By: FOC	Date: SEPT. 2019		NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY	
			LEA COUNTY NEW MEXICO	

G:\GECARCHIVE\CAD\572\002\MCCLOY\PERMIT TEXT FIGURES\HYDRO GEO\FIG 3 - WATERSHED MAP.DWG

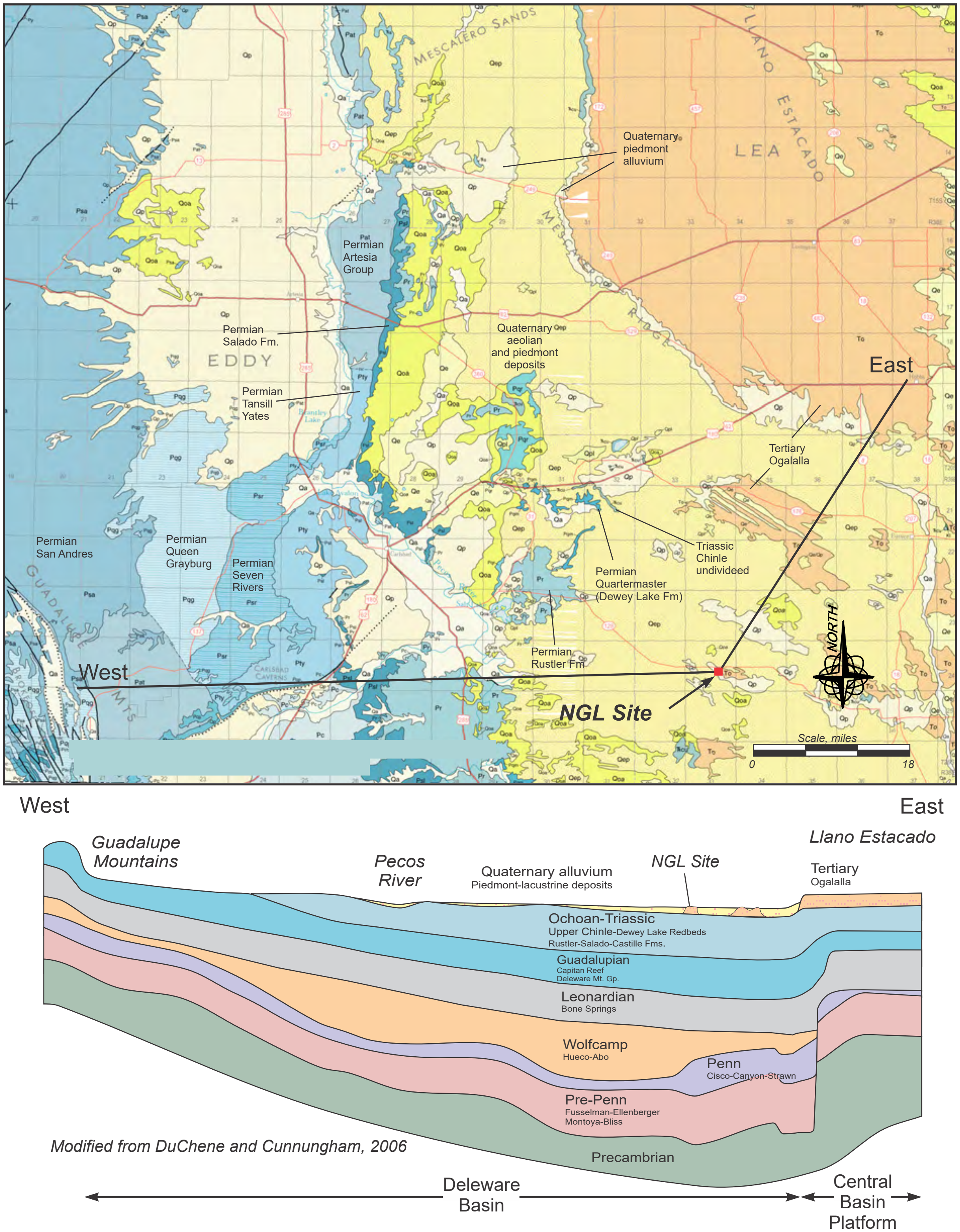
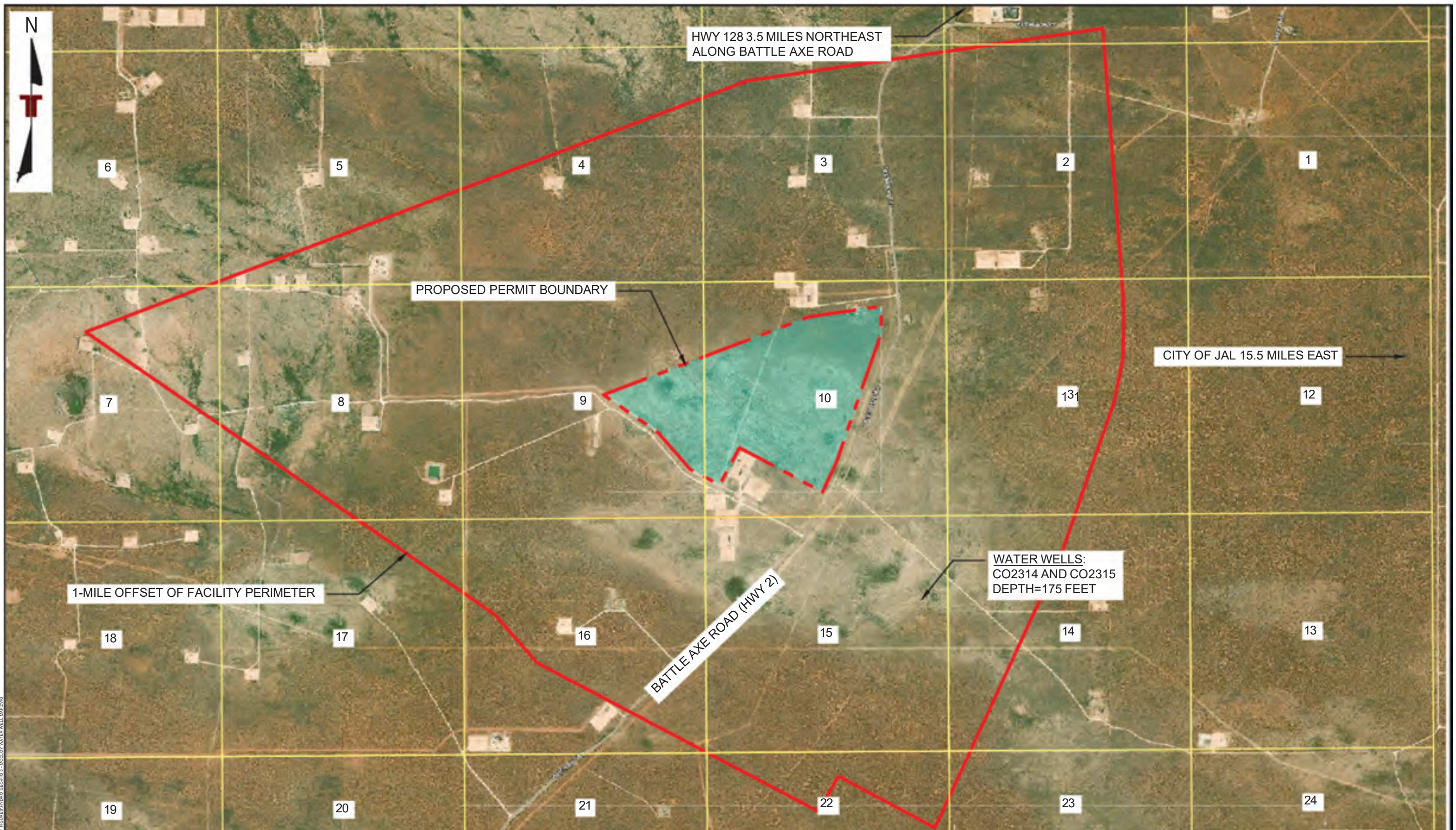


Fig 4

NGL North Ranch SWMF, Lea County, NM

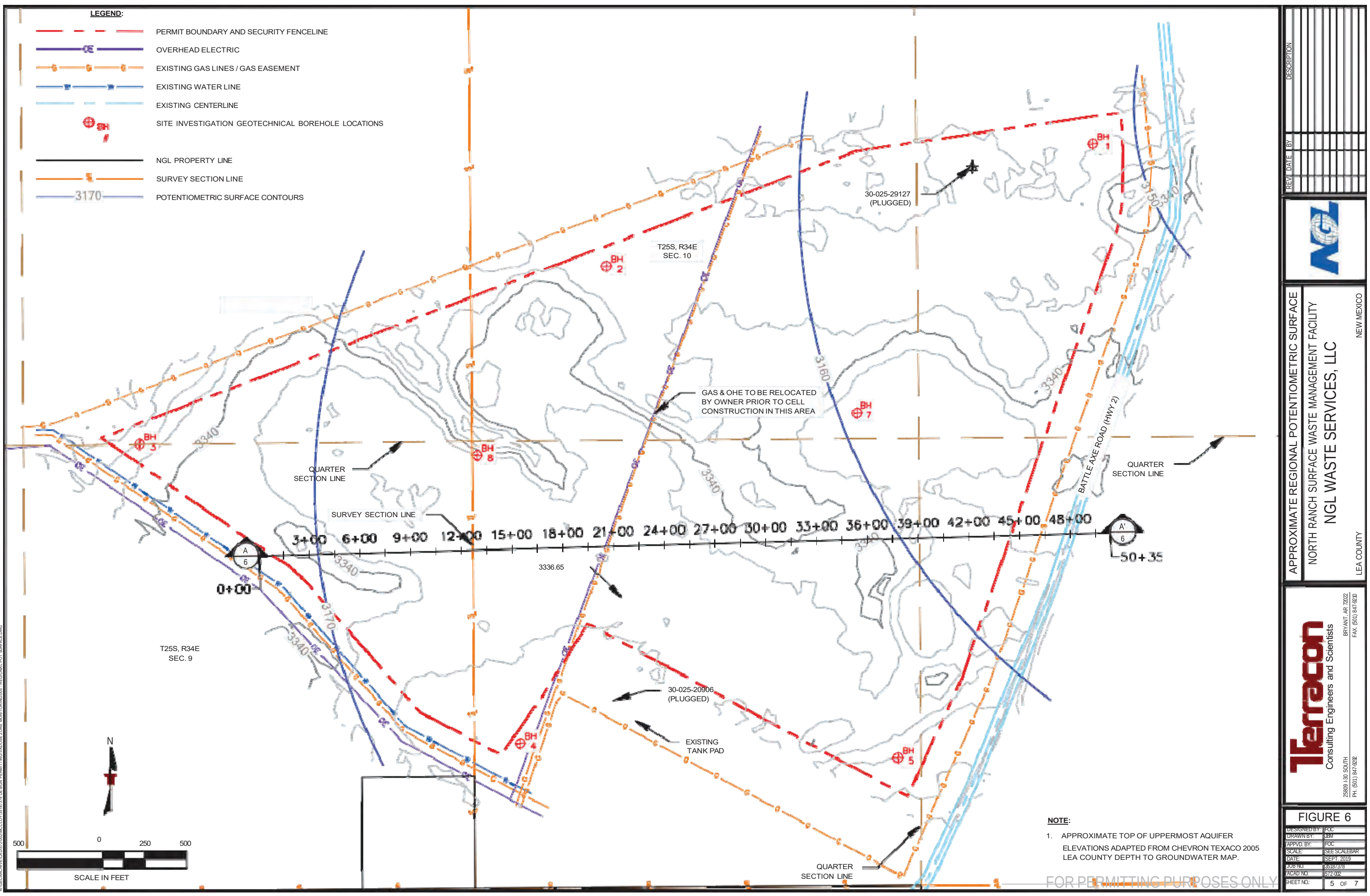
Regional Surface Geology and Generalized Stratigraphy, Southeastern New Mexico

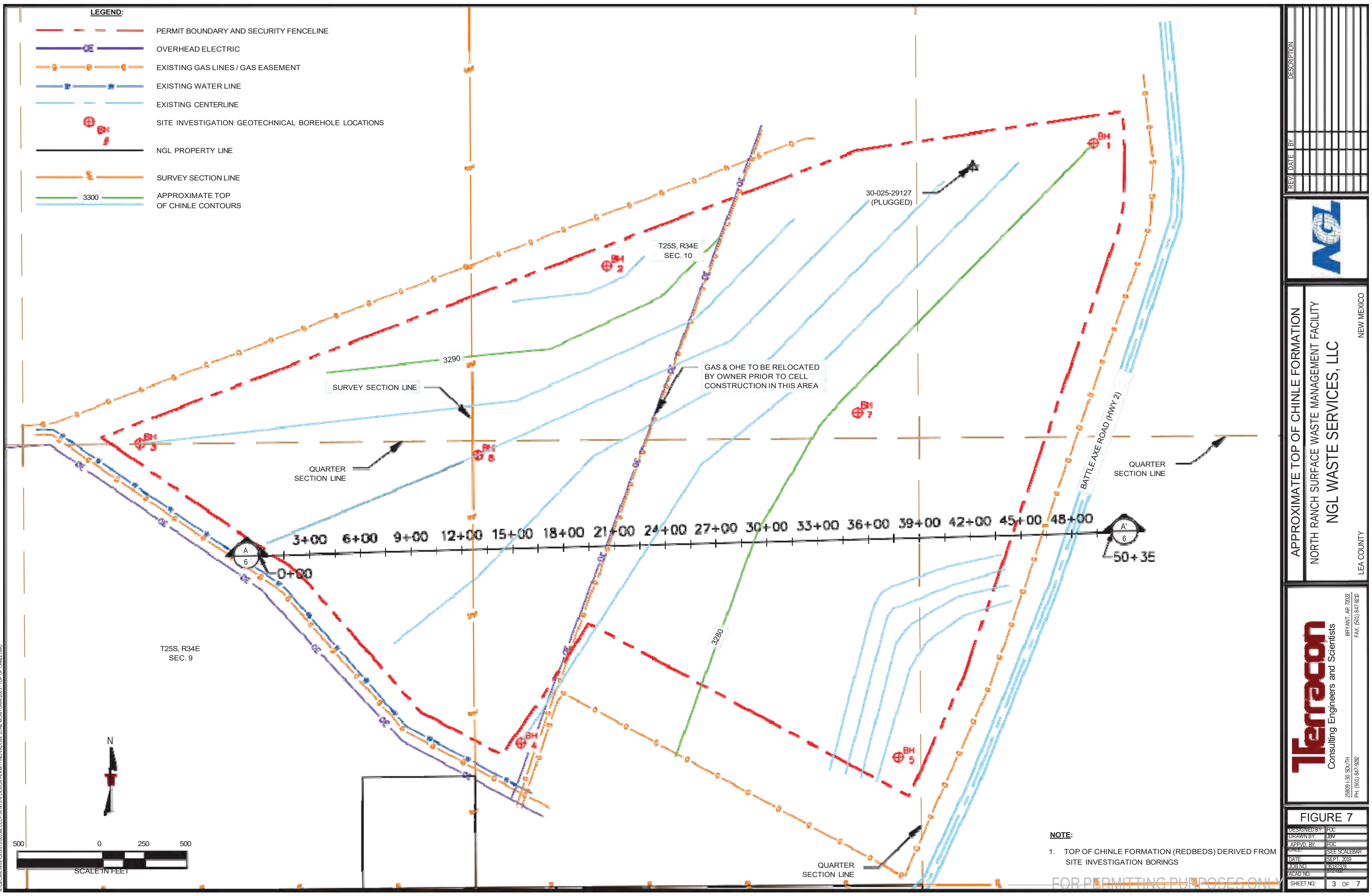
Modified from NM Bureau of Geology and Minerals, 2003
1:500,000 Geologic Map of New Mexico

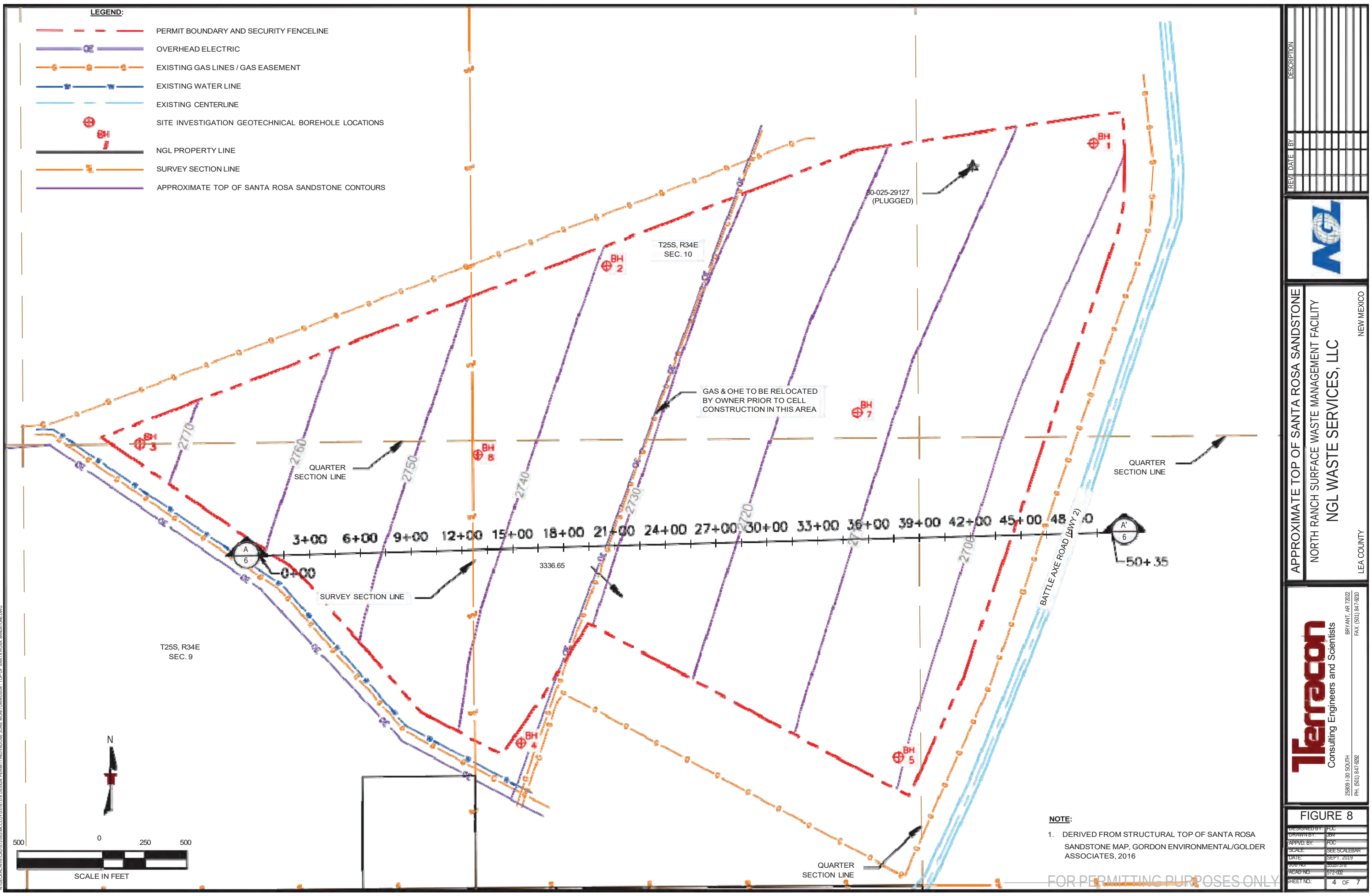


NOTE:
1. WATER WELL INFORMATION OBTAINED FROM NEW MEXICO OFFICE OF THE STATE ENGINEER POD LOCATION GIS APPLICATION.
3. SHOWN TOWNSHIP 25S RANGE 34 E, SECTIONS AS LABELED

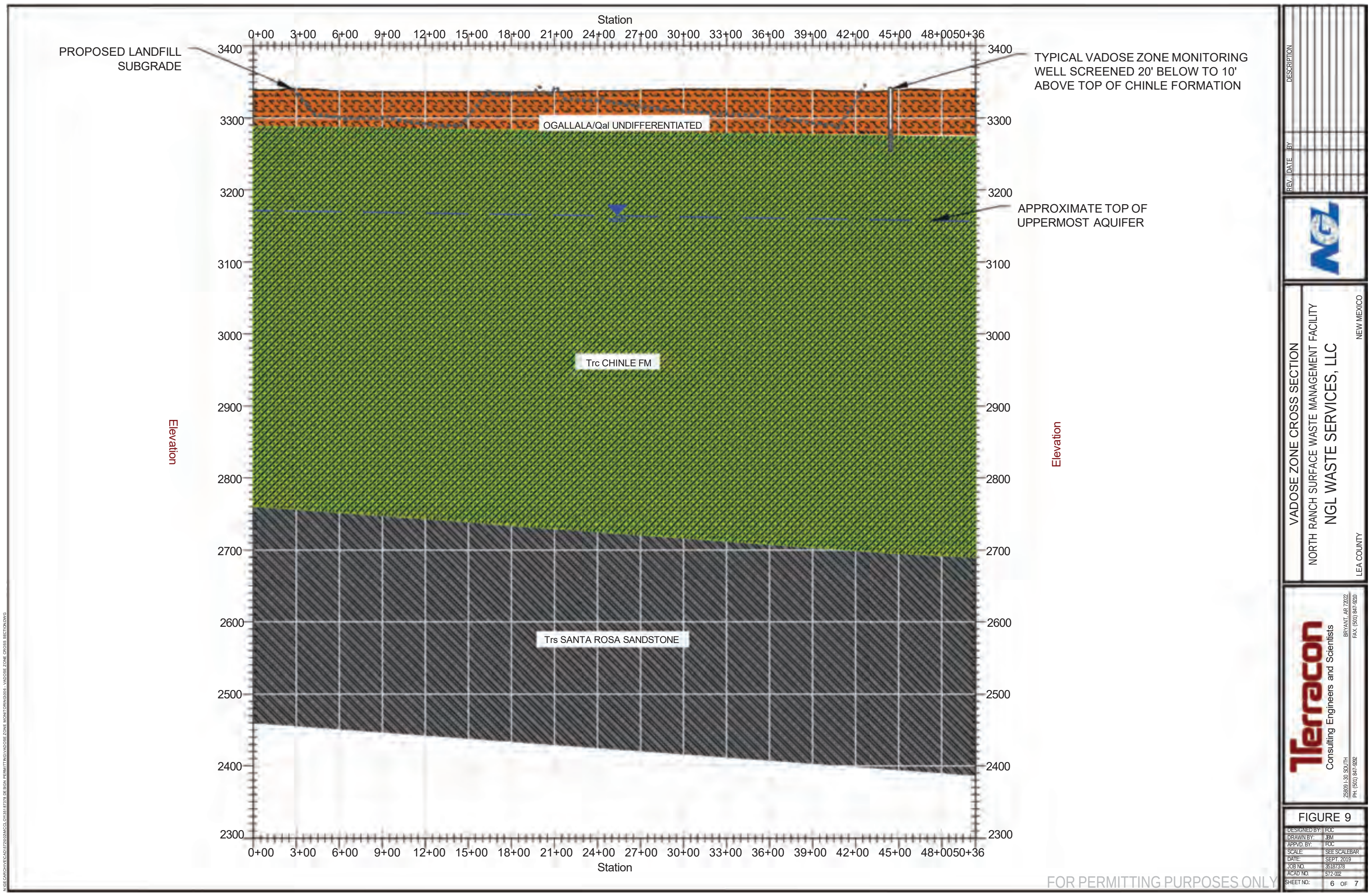
Project Mngr: MPB	Project No. 35187378	Terracon Consulting Engineers and Scientists	WATER WELLS WITHIN 1 MILE	FIG. No.
Drawn By: JBM	Scale: 1"=2000'		PERMIT DRAWING	5
Checked By: MPB	File No. 572-002	25809 I-30 SOUTH BRYANT, AR 72022	SURFACE WASTE MANAGEMENT FACILITY NORTH RANCH	
Approved By: MPB	Date: APRIL 2019	PH. (501) 847-9292 FAX. (501) 847-9210	LEA COUNTY NEW MEXICO	

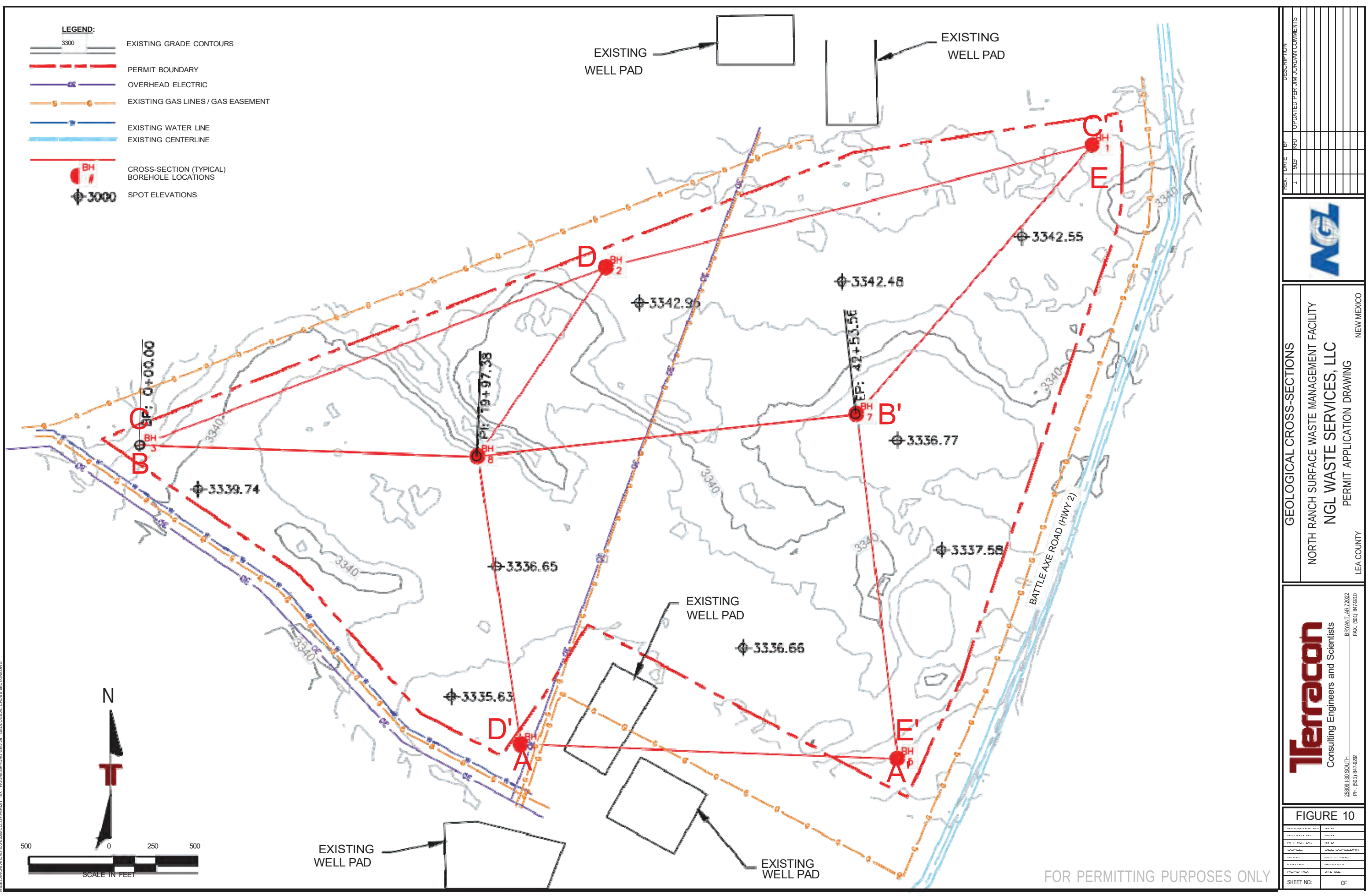

LEGEND:
PERMIT BOUNDARY AND SECURITY FENCELINE
OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
EXISTING CENTERLINE
SITE INVESTIGATION GEOTECHNICAL BOREHOLE LOCATIONS
NGL PROPERTY LINE
SURVEY SECTION LINE
POTENTIOMETRIC SURFACE CONTOURS
T25S, R34E
SEC. 10
T25S, R34E
SEC. 9
30-025-29127
(PLUGGED)
30-025-20906
(PLUGGED)
GAS & OHE TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA
QUARTER SECTION LINE
SURVEY SECTION LINE
EXISTING TANK PAD
BATTLE AXE ROAD (HWY 2)
0+00
3+00 6+00 9+00 12+00 15+00 18+00 21+00 24+00 27+00 30+00 33+00 36+00 39+00 42+00 45+00 48+00
50+35
3336.65
SCALE IN FEET
NOTE:
1. APPROXIMATE TOP OF UPPERMOST AQUIFER ELEVATIONS ADAPTED FROM CHEVRON TEXACO 2005 LEA COUNTY DEPTH TO GROUNDWATER MAP.
FOR PERMITTING PURPOSES ONLY
APPROXIMATE REGIONAL POTENTIOMETRIC SURFACE
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 6


LEGEND:
PERMIT BOUNDARY AND SECURITY FENCELINE
OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
EXISTING CENTERLINE
SITE INVESTIGATION GEOTECHNICAL BOREHOLE LOCATIONS
NGL PROPERTY LINE
SURVEY SECTION LINE
APPROXIMATE TOP OF CHINLE CONTOURS
T25S, R34E SEC. 10
T25S, R34E SEC. 9
30-025-29127 (PLUGGED)
GAS & OHE TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA
SURVEY SECTION LINE
QUARTER SECTION LINE
BATTLE AXE ROAD (HWY 2)
0+00 3+00 6+00 9+00 12+00 15+00 18+00 21+00 24+00 27+00 30+00 33+00 36+00 39+00 42+00 45+00 48+00 50+35
3290
3280
SCALE IN FEET
NOTE:
1. TOP OF CHINLE FORMATION (REDBEDS) DERIVED FROM SITE INVESTIGATION BORINGS
FOR PERMITTING PURPOSES ONLY
APPROXIMATE TOP OF CHINLE FORMATION
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 7
SHEET NO. 3 OF 7



LEGEND:
PERMIT BOUNDARY AND SECURITY FENCELINE
OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
EXISTING CENTERLINE
SITE INVESTIGATION GEOTECHNICAL BOREHOLE LOCATIONS
NGL PROPERTY LINE
SURVEY SECTION LINE
APPROXIMATE TOP OF SANTA ROSA SANDSTONE CONTOURS
T25S, R34E SEC. 10
T25S, R34E SEC. 9
30-025-29127 (PLUGGED)
GAS & OHE TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA
QUARTER SECTION LINE
SURVEY SECTION LINE
BATTLE AXE ROAD (HWY 2)
0+00
50+35
3336.65
SCALE IN FEET
NOTE:
1. DERIVED FROM STRUCTURAL TOP OF SANTA ROSA SANDSTONE MAP, GORDON ENVIRONMENTAL/GOLDER ASSOCIATES, 2016
FOR PERMITTING PURPOSES ONLY
APPROXIMATE TOP OF SANTA ROSA SANDSTONE
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 8


Station
PROPOSED LANDFILL SUBGRADE
TYPICAL VADOSE ZONE MONITORING WELL SCREENED 20' BELOW TO 10' ABOVE TOP OF CHINLE FORMATION
OGALLALA/Qal UNDIFFERENTIATED
APPROXIMATE TOP OF UPPERMOST AQUIFER
Trc CHINLE FM
Elevation
Trs SANTA ROSA SANDSTONE
FOR PERMITTING PURPOSES ONLY
VADOSE ZONE CROSS SECTION
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 9
SHEET NO. 6 OF 7

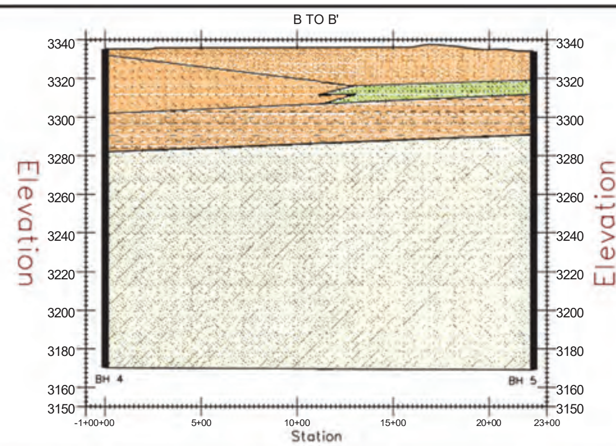

LEGEND:
EXISTING GRADE CONTOURS
PERMIT BOUNDARY
OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
EXISTING CENTERLINE
CROSS-SECTION (TYPICAL) BOREHOLE LOCATIONS
SPOT ELEVATIONS
EXISTING WELL PAD
EXISTING WELL PAD
EXISTING WELL PAD
EXISTING WELL PAD
EXISTING WELL PAD
BATTLE AXE ROAD (HWY 2)
3342.55
3342.48
3342.95
3336.77
3339.74
3336.65
3337.58
3336.66
3335.63
BP: 0+00.00
PI: 19+97.38
EP: 42+53.56
FOR PERMITTING PURPOSES ONLY
SCALE IN FEET
GEOLOGICAL CROSS-SECTIONS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 10
UPDATED PER JIM JORDAN COMMENTS

General Notes:

1. Lithologic information provided is based on field site investigation information collected by Terracon. Interpretations may change as additional information is gathered.
2. No groundwater was encountered during drilling.
3. Existing topography was performed November 30, 2018 and vertical elevations are based on the NAVD 88 NM_E.

Note:

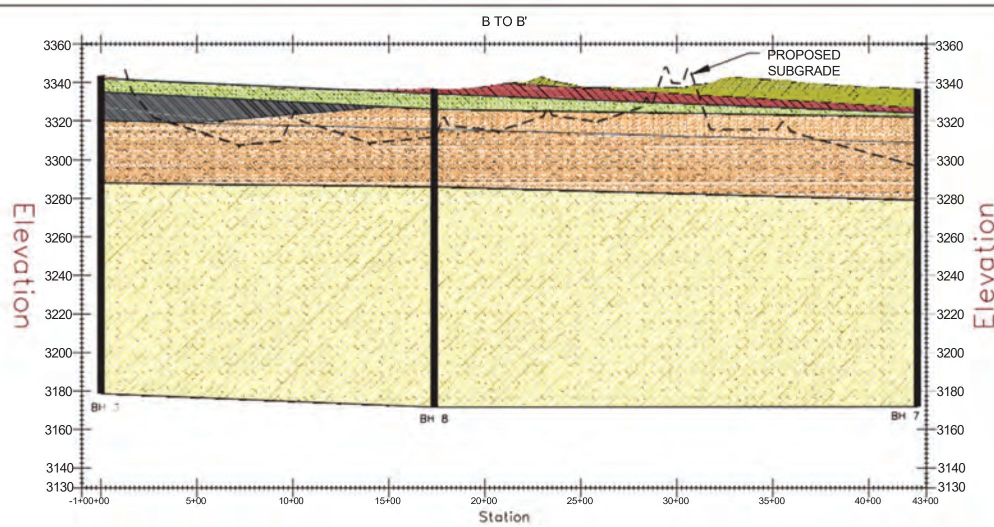
Information depicted in this lithology shown was derived from "Geotechnical Engineering Report - McCloy Ranch Landfill" dated January 18, 2019, and was prepared by Terracon Consultants, Inc.



LEGEND:

- Poorly Graded Sand with Silt
- Clayey Sand with Interbedded Caliche
- Caliche
- Silty Sand
- Sandstone
- Poorly Graded Sand
- Poorly Graded Sand with Interbedded Caliche
- Silty Sand with Interbedded Caliche
- Bore Hole (BH 8)

Horizontal Scale: 1" = 500'
Vertical Scale: 1" = 50'

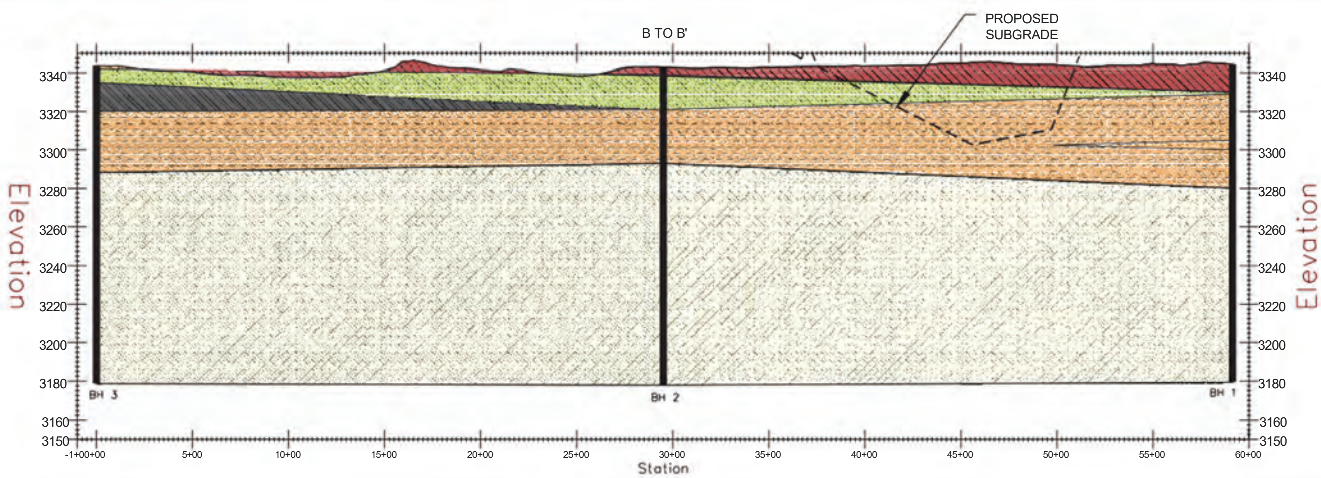


GEOLOGICAL CROSS-SECTION A - A' & B - B'
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists

FIGURE 11A

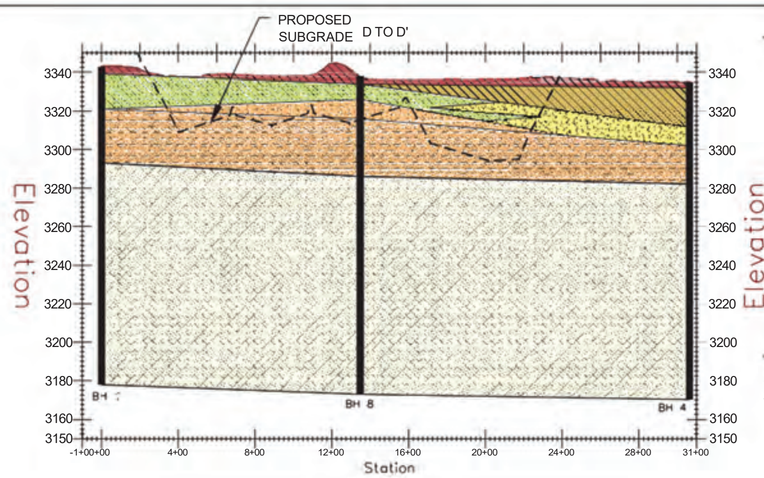
FOR PERMITTING PURPOSES ONLY



LEGEND:

- Poorly Graded Sand with Silt
- Clayey Sand with Interbedded Caliche
- Caliche
- Silty Sand
- Sandstone
- Poorly Graded Sand
- Poorly Graded Sand with Interbedded Caliche
- Silty Clayey Sand with Interbedded Caliche
- Silty Sand with Interbedded Caliche
- Bore Hole (BH 8)

Horizontal Scale: 1" = 500'
Vertical Scale: 1" = 50'



General Notes:

1. Lithologic information provided is based on field site investigation information collected by Terracon. Interpretations may change as additional information is gathered.
2. No groundwater was encountered during drilling.
3. Existing topography was performed November 30, 2018 and vertical elevations are based on the NAVD 88 NM_E.

Note:

Information depicted in this lithology shown was derived from "Geotechnical Engineering Report - McCloy Ranch Landfill" dated January 18, 2019, and was prepared by Terracon Consultants, Inc.

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

GEOLOGICAL CROSS-SECTION C - C' & D - D'
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

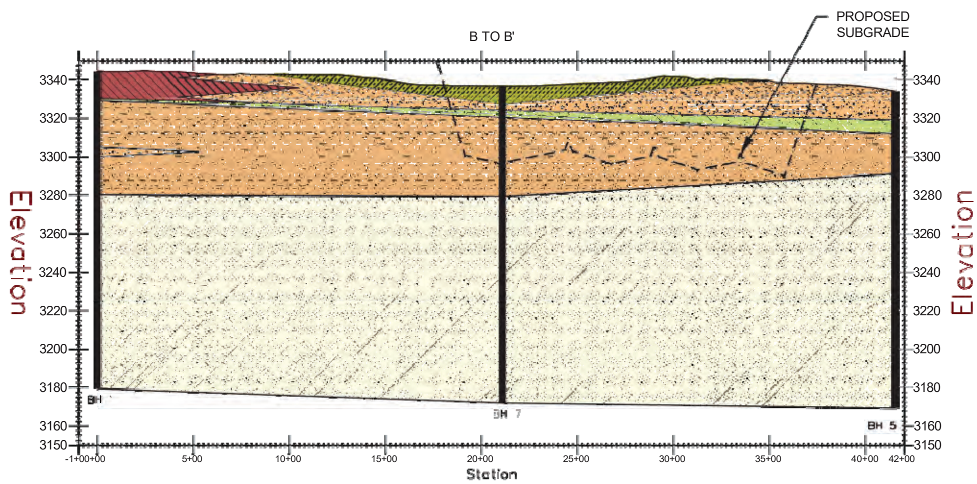
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 11B

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

General Notes:

1. Lithologic information provided is based on field site investigation information collected by Terracon. Interpretations may change as additional information is gathered.
2. No groundwater was encountered during drilling.
3. Existing topography was performed November 30, 2018 and vertical elevations are based on the NAVD 88 NM_E.



LEGEND:

- Poorly Graded Sand with Silt
- Clayey Sand with Interbedded Caliche
- Caliche
- Silty Sand
- Sandstone
- Poorly Graded Sand
- Poorly Graded Sand with Interbedded Caliche
- Silty Sand with Interbedded Caliche
- Bore Hole (BH 8)

Horizontal Scale: 1" = 500'
Vertical Scale: 1" = 50'

Note:

Information depicted in this lithology shown was derived from "Geotechnical Engineering Report - McCloy Ranch Landfill" dated January 18, 2019, and was prepared by Terracon Consultants, Inc.

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

GEOLOGICAL CROSS-SECTION E - E'

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 11C

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

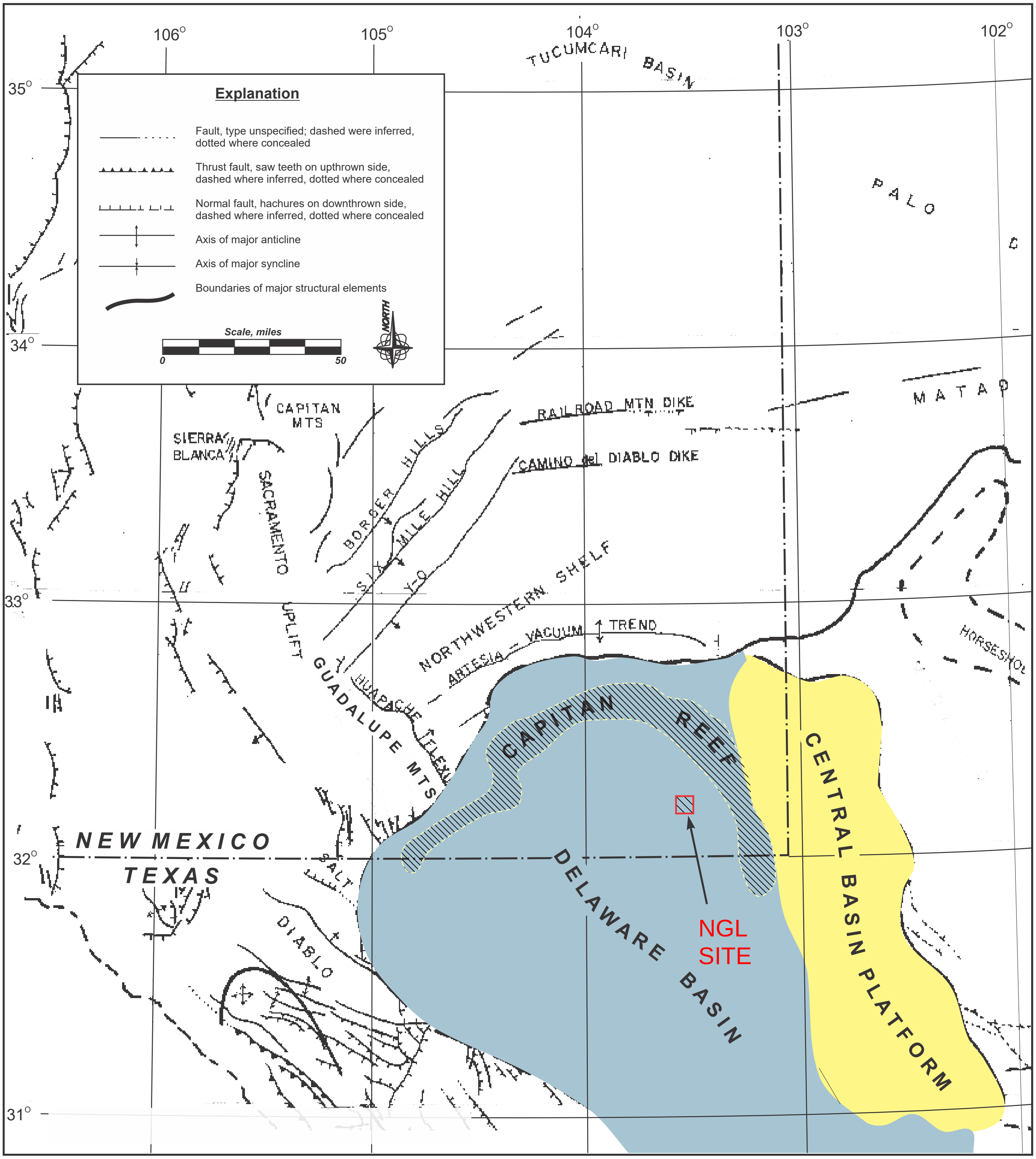


Fig 12

NGL North Ranch SWMF, Lea County, NM

Structures of the Delaware Basin,

Southeastern New Mexico and West Texas

Terracon

Major Regional Structural Features of Southeastern New Mexico
Modified from Powers, 1978

Attachment A

Geotechnical Engineering Report
(Terracon, January 2019)

Terracon GeoReport

Geotechnical Engineering Report

McCloy Ranch Landfill

Jal, Lea County, New Mexico

January 25, 2019

Terracon Project No. A4187129

Prepared for:

Trammco Environmental Solutions, LLC

Fernandina Beach, FL

Prepared by:

Terracon Consultants, Inc.

Midland, Texas

Terracon GeoReport

January 25, 2019

Trammco Environmental Solutions, LLC
P.O. Box 2283
Fernandina Beach, FL 79760

Attn: Mr. Matthew Trammell
E: matt@trammco.com

Re: Geotechnical Engineering Report
McCloy Ranch Landfill
Lea County, New Mexico
Terracon Project No. A4187129

Dear Mr. Trammell:

We have completed the Hydrogeological/Geotechnical investigations for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P35187312 dated October 17, 2018. This report presents the findings of the subsurface exploration and provides hydrological/geotechnical recommendations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

JAMES D. COSPER, II
NEW MEXICO
14477
REGISTERED PROFESSIONAL ENGINEER
1-25-19

Naga Velpuri
Staff Geotechnical Engineer

J. Dan Cosper, P.E.
Senior Associate/Office Manager

Copy: file

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	Landfill facility will be constructed on a 306-acre surface waste disposal facility within Section 9 and 10 of, T25S, R34E approximately 16 miles west of the City of Jal in Lea County, New Mexico.
Geotechnical Characterization	■ Based on the field exploration, we classified the soils we encountered into three soil stratums, first strata with depths ranging between 20 feet to 27 feet below grade surface (bgs) consisting of silty sand, silty sand with gravel, silty clayey sand, poorly graded sand with interbedded layers of caliche. The second strata was penetrated at depths ranging between 20 feet to 27 feet bgs consisting of silty sand, poorly graded sand, interbedded caliche layers classified as, silty sand, poorly graded sand. The third strata was penetrated at depths ranging between 40 feet to 65 feet bgs and consisted of fine-grain, poorly to moderately compacted sandstone. ■ Very dense/hard calcareous materials with varying degrees of cementation, or locally called “caliche” materials, which are typically classified as silty sand, poorly graded sand, were encountered in all the borings ranging from the upper approximately 2 to 65 feet of existing grades. Caliche interval thicknesses ranged from 1 inch to over 10 feet. The caliche materials are underlain by medium to finely weathered sandstone extending to boring-termination depths of 165 feet below existing grades. On-site subsurface soils are not expected to experience substantial volumetric changes (shrink/swell) with fluctuations in moisture content. Potential vertical rise (PVR) of on-site soils is estimated to be less than 1 inch. On-site soils are generally suitable for use as structural fill. ■ Caliche bears a strong resemblance to rock and is therefore difficult to excavate. Based on the conditions encountered, we believe landfill excavations in the upper 2 to 65 feet of existing grades will require a hoe ram, a heavy dozer equipped with a ripper, a rock saw or a jack hammer. Bedrock was encountered beneath caliche materials, thus rock excavation by means of ripping and blasting is expected. Recommendations regarding excavation conditions of on-site subsurface materials and definitions of rock in various conditions are included in section Excavations Conditions of this report. ■ The 2012 International Building Code (Section 1613.3.2) seismic site classification for this site is estimated to be C. ■ No groundwater was encountered in the borings within the drilling depths of 165 feet below existing grades at the time of drilling. Based on these data, we do not expect groundwater would impact the landfill development. ■ Laboratory permeability were measured on samples. Results of laboratory permeability measurements on samples collected from BH-1, and BH-4 were in a range of 1.09×10^{-6} to 6.5×10^{-5} cm/sec. Detailed permeability measurement results are presented in Geotechnical Characterization section of this report. ■ Bedrocks (sandstone) were encountered at depths of 30 to 165 feet below existing grades. Please refer to boring logs and subsurface profiles provided in the Appendices.

Topic [1]	Overview Statement [2]
Below Grade Structures	The landfill development itself is considered a below grade structure.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report
McCloy Ranch Landfill
IH-20 and FM-866
Jal, Lea County, New Mexico
Terracon Project No. A4187129
January 25, 2019

INTRODUCTION

This report presents the results of Terracon's subsurface exploration and geotechnical engineering services performed for the proposed Landfill to be located within Section 9 and 10 of, T25S, R34E approximately 16 miles west of the City of Jal in Lea County, New Mexico. The purpose of these services is to provide geologic and hydrogeologic findings and geotechnical engineering recommendations relative to:

- Subsurface soil (and rock) conditions
- Groundwater conditions
- Seismic site classification per IBC
- Site preparation and earthwork
- Excavation considerations

The geotechnical engineering scope of services for this project included the advancement of seven test borings (BH-1 to BH-5, BH-7 and BH-8) to depths approximately 165 feet below existing site grades. **Please note that boring BH-6 was mislabeled as BH-8.** Although the original scope of services consisted of a total of 14 geotechnical soil testing samples. Due to the homogeneity of soils and based on the project coordination with the client during the site exploration, a total of three samples were collected for lab testing.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from Terracon's site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located within Section 9 and 10 of, T25S, R34E approximately 16 miles west of the City of Jal in Lea County, New Mexico. See **Site Location** for site location information.
Existing Improvements	Undeveloped ranch covered with creosote and mesquite tress.
Current Ground Cover	Site covered with sparse vegetation and mesquite trees
Existing Topography	The site slopes downward towards the east.
Geology	■ Expected Geologic Conditions: o Pecos alluvium overlying Dockum Group ■ Geologic Map Details: o Unconsolidated, interlayered eolian sands and piedmont-slope deposits: ▪ Unconsolidated, interlayered eolian sands • Sands, loesse ▪ Piedmont-slope deposits • Includes deposits of higher gradient tributaries bordering major stream valleys, alluvial veneers of the piedmont slope, and alluvial fans. May locally include uppermost Pliocene deposits. ■ Underlying Upper Chinle Group, Garita Creek through Redonda Formations, undivided (Upper Triassic) ▪ Major mudstone, sandstone and minor conglometrate

PROJECT DESCRIPTION

Terracon's initial understanding of the project was provided in our proposal and was discussed in the project planning stage. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Description	One recycling and landfill facility will be constructed on a 306-acre tract of land.
Finished Floor Elevation	Elevation of deepest excavation is expected to be 65 feet below existing grade.
Below Grade Structures	Landfill

DRILLING PROCEDURES

■ FIELD SUBSURFACE BORING INVESTIGATION WORK PLAN

Seven boring locations were identified for drilling within the property. The boring program was designed to evaluate the lithology and subsurface conditions throughout the property. Terracon mobilized a sonic drilling unit to the site. However, due to drilling requirements, rock coring and/or air rotary drilling was required to advance the borings to final depth.

The drilling at this location was completed by a State of New Mexico licensed well driller. Oversight of the drilling program and the logging of the lithology was conducted by a Terracon field geologist.

■ Drilling Methodology

Soil borings were performed using sonic drilling methods to the proposed depth in accordance with ASTM D-6914/D6914M-16. The drilling rig was equipped with coring tools capable of providing a minimum borehole diameter of 6 inches with a core barrel 4 inches, 5 or 10 feet in length as drilling depth dictates. Borings BH-1, BH-5, and BH-7 were cored to a total depth of 165 feet bgs. Continuous cores were collected from the remaining borings (BH-2, BH-3, BH-4, and BH-8) to the depth of bedrock (40 to 67 feet below grade) where compressed air-rotary drilling was implemented after approval from the State of New Mexico.

■ Soil Boring Advancement

Each soil boring was advanced to a depth of 165 feet below grade. This is over 100 feet below the proposed maximum depth of the landfill, if a landfill cell were to be located in the area of the soil boring. If a potential groundwater bearing zone (moist to saturated soils) was visible in any of the core samples, the depth would be noted and the drill casing would be raised to a depth 2 feet above the potential groundwater bearing zone. The boring would be gauged every hour for 3 hours, if no measurable amount of water had accumulated as measured with a water level meter (less than 0.01 feet) drilling would continue past this zone until either another potential groundwater bearing zone was encountered or the total depth of the boring was reached.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

Subsurface conditions encountered at the boring locations are indicated on the boring logs **Exploration Results**. Stratification boundaries on the boring logs represent the approximate locations of changes in soil types; in-situ, the transition between materials may be gradual. Details for the boring locations can be found on the boring logs of this report. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

As noted in **General Comments**, the stratum characterization is based upon lithologic descriptions by a Terracon field geologist. The widely spaced exploration points across the site may result in lithologic variations.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Encountered[1]	Consistency/Density
Stratum I	20 to 27	Silty sand, silty sand with gravel, silty clayey sand, poorly graded sand; brown; with interbedded layers of caliche	Loose to medium
Stratum II	40 to 65	Silty sand, poorly graded sand, interbedded caliche layers classified as, silty sand, poorly graded sand; brown, light brown, reddish brown	Medium dense to very dense
Stratum III	>165	Sandstone, light brown, brown, tannish brown, to tan, dark reddish brown	Fine to medium, poorly to well Cemented

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ the transition between materials may be gradual.

Groundwater Conditions

Groundwater was not identified during boring advancement. In addition, each boring was allowed to recharge for a period of 24 hours to determine if groundwater was present. Prior to plugging each boring, the boring was gauged with a water level probe to evaluate the boring for the presence of groundwater. No measurable groundwater infiltration (greater than 0.01 feet) was present; therefore, the installation of monitoring wells was not required.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Laboratory Permeability Tests

Terracon conducted 3 laboratory permeability tests on cored stratum samples, the results are tabulated in the following table:

Test Number	Boring Number	Sample Depth (feet)	Permeability, K (cm/sec)
1	BH-1	0 to 65	6.56×10^{-6}
2	BH-4	0 to 20	1.09×10^{-7}
3	BH-4	20 to 52	6.56×10^{-6}

Laboratory Direct Shear Tests

Terracon conducted three laboratory direct shear tests on the samples and the results are tabulated in the following table:

Test Number	Boring Number	Sample Depth (feet)	Strain rate, (in./min.)
1	BH-1	0 to 65	0.004
2	BH-4	0 to 20	0.005
3	BH-4	20 to 52	0.005

GEOTECHNICAL OVERVIEW

On-site soils generally consist of fine to medium sandy soils and strongly cemented, calcareous interbedded caliche materials in the upper approximately 2 to 65 feet of existing grades, underlain by sandstone extending to boring termination depths of 165 feet bgs. On-site subsurface soils are not expected to experience substantial volumetric changes (shrink/swell) with fluctuations in moisture content. Potential vertical rise (PVR) of on-site soils is estimated to be less than 1 inch. On-site soils are generally suitable for use as structural fill.

The 2012 International Building Code (Section 1613.3.2) seismic site classification for this site is C.

No groundwater was encountered in any of the borings within the drilling depths at the time of drilling. Based on site exploration, we do not expect groundwater would impact the landfill development, provided expected depth of excavation (EDE) is kept at 65 feet below existing grades.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work.

Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for landfill construction.

Site Preparation

Any topsoil or vegetation within areas to receive new fill or structures foundation footprint should be stripped and grubbed and removed. Subsequently, the exposed subgrade should be proof-rolled prior to the placement of any fill or base materials. The proof-rolling should be performed with a fully loaded, tandem-axle dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 20 tons is recommended for the proof-rolling equipment. The proof-rolling should consist of several overlapping passes in mutually perpendicular directions over a given area. Any soft or pumping areas should be excavated to firm ground. Excavated areas should be backfilled with properly placed and compacted fill as discussed in Section **Fill Compaction Requirements**.

Fill Material Types

The on-site subsurface materials, which are free of vegetation, debris, and rocks greater than 4 inches in maximum dimension, are generally suitable to be used for structural fill. Cemented caliche materials that look like rock are present on the project site. Caliche materials need to be crushed into sizes less than 4 inches in maximum dimension and thoroughly mixed with soils before they can be used for structural fill. Structural fill should be clean soil with a Liquid Limit (LL) of less than 35 and a Plasticity Index (PI) less than 15.

Fill Compaction Requirements

Recommendations for compaction are presented in the following table. Terracon recommends that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Item	Description
General subgrade preparation to receive fill	Surface scarified to a minimum depth of 6 inches, moisture conditioned and compacted
Lift thickness	9 inches or less loose lift thickness
Compaction	At least 95% maximum standard Proctor dry density (ASTM D 698) in the range of ±2 percentage points of optimum moisture

Utilities

Care should be taken that utility trenches are properly backfilled. Backfilling should be accomplished with properly compacted engineered fill with loose lift thickness of generally 9 inches except for the first lift above the utility pipes that can be relaxed to 12 inches. Compaction should be accomplished with a hand-held compaction device inside utility trenches. Engineered fill should be compacted to at least 95% maximum standard Proctor dry density (ASTM D 698) in the range of ±2 percentage points of optimum moisture for the engineered fill.

Excavation Conditions and Construction Slopes

Terracon understands that EDE in the landfill is expected to be 65 feet below ground surface and construction of the proposed waste facility will involve mass excavation of subsurface materials. For this reason, we aim to determine the expected excavation conditions and rippability of the on-site subsurface materials within approximately 25 feet of existing grades. We note that actual rippability will depend heavily on the equipment and tools used as well as the skill and experience of operators, among other factors. There is no method more effective to determine material rippability than a field production test with equipment similar or identical to that planned for use in project construction.

Caliche layers were encountered from existing grade to depths of approximately 2 to 65 feet bgs. Interbedded caliche and sand layers were underlain by sandstone bedrock extending to the borings termination depths of 165 feet bgs in the borings. Caliche bears a strong resemblance to rock and is therefore difficult to excavate. Based on the conditions encountered, we believe excavation of caliche may require a hoe ram, a heavy dozer equipped with a ripper, a rock saw or a jack hammer or with rock-excavation or blasting equipment. Excavation of rock, sandstone, will likely require controlled blasting.

Soils can generally be excavated by conventional scrapers and loaders. Caliche, partially weathered rock (PWR) or heavily fractured rock typically requires loosening by ripping with large dozers pulling single tooth rippers in mass excavation or blasting in confined (trench) excavation. Relatively sound, massive, rock typically requires blasting for removal in mass or trench excavation.

All excavations must comply with the applicable Federal, State, and local safety regulations and codes, and especially with the excavation standards of the Occupational Safety and Health Administration (OSHA). According to the OSHA soil classification, the on-site materials are generally classified as Type B soils. Temporary slopes of 1H:1V and permanent slopes of 3H:1V may be used. Construction site safety, including excavation safety, is the sole responsibility of the Contractor as part of its overall responsibility for the mean, methods, and sequencing of construction operations.

These descriptions are a guide to conditions generally encountered. Excavation techniques will vary based on the weathering of the materials, fracturing and jointing in the rock, and the overall stratigraphy of the feature. Actual field conditions usually display a gradual weathering progression with poorly defined and uneven boundaries between layers of different materials.

Terracon recommends that the following definitions for rock in earthwork excavation construction be included in bid documents:

Mass Excavation: Any material occupying an original volume of more than 1 cubic yard which cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rating of not less than 80,000 pounds (Caterpillar D-8 or larger).

Trench Excavation: Any material occupying an original volume of more than 1/2 cubic yard which cannot be excavated with a backhoe having a bucket curling rate of not less than 40,000 pounds, using a rock bucket and rock teeth (a John Deere 790 or larger).

In applicable areas, Terracon recommends that soils which can be excavated with conventional equipment be removed first. Then, if necessary, heavy-duty or oversized equipment can be used to excavate cemented caliche by ripping. Blasting should only be conducted where materials cannot be excavated by other trench excavation techniques such as ripping.

Grading and Drainage

All grades must provide effective drainage away from structures during and after construction and should be maintained throughout the life of the structures. Water retained next to structures can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from structures

Exposed ground should be sloped and maintained at a minimum 5 percent away from structures for at least 10 feet beyond the perimeter of the structures. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structure a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations, for the landfill structures and buildings, are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

SEISMIC CONSIDERATIONS

Description	Value
2012 International Building Code Site Classification	C [1, 2]
Site Latitude	32.139862°
Site Longitude	- 103.465597°
S_{DS} Spectral Acceleration for a Short Period [3]	0.153g
S_{D1} Spectral Acceleration for a 1-Second Period [3]	0.052g

1. Seismic site classification in general accordance with the *2012 International Building Code*, which refers to ASCE 7-10.
2. The 2012 International Building Code (IBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 165 feet.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

GENERAL COMMENTS

As the construction project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Borings

As client requested, Terracon conducted a total of Seven (7) soil-testing borings as tabulated in the following table:

Boring Location	Number of Borings	Boring Depth (feet)[1]	Drilling Footage (feet)[1]
McCloy Ranch Landfill	7	165	1,155

[1] The borings at the proposed center were extended to auger refusal/rock depths, and then rock coring was conducted.

Boring Layout and Elevations: Location of soil borings are provided on our **Site Location and Exploration Plans**. Location is established in the field by Terracon's exploration team using a measuring wheel/tape and/or a hand-held GPS unit to establish boring location with reference to known points. The accuracy of the exploration points is usually within 10 feet of the noted location.

Subsurface Exploration Procedures: All borings will be performed using sonic drilling methods to the minimum depth of 50 feet bgs in accordance with ASTM D-6914/D6914M-16. The sonic drilling rig was equipped with coring tools capable of providing a minimum borehole diameter of 6 inches with a core barrel was be advanced into the subsurface and tocollect an undisturbed soil core. Prior to placing an additional core casing section onto the drill stem, the soil core was removed from the core barrel and the undisturbed soil core was extracted, characterized for geological lithology, and logged. The empty coring barrel was replaced inside the drill casing, and the drilling continued. This process was continued until either a boring depth of 165 feet bgs was achieved or until groundwater was encountered. Compressed air-rotary drilling and plain water was utilized to remove the cores and/or cuttings and speed up the operation further, depending on subsurface conditions.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a geotechnical engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs are prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

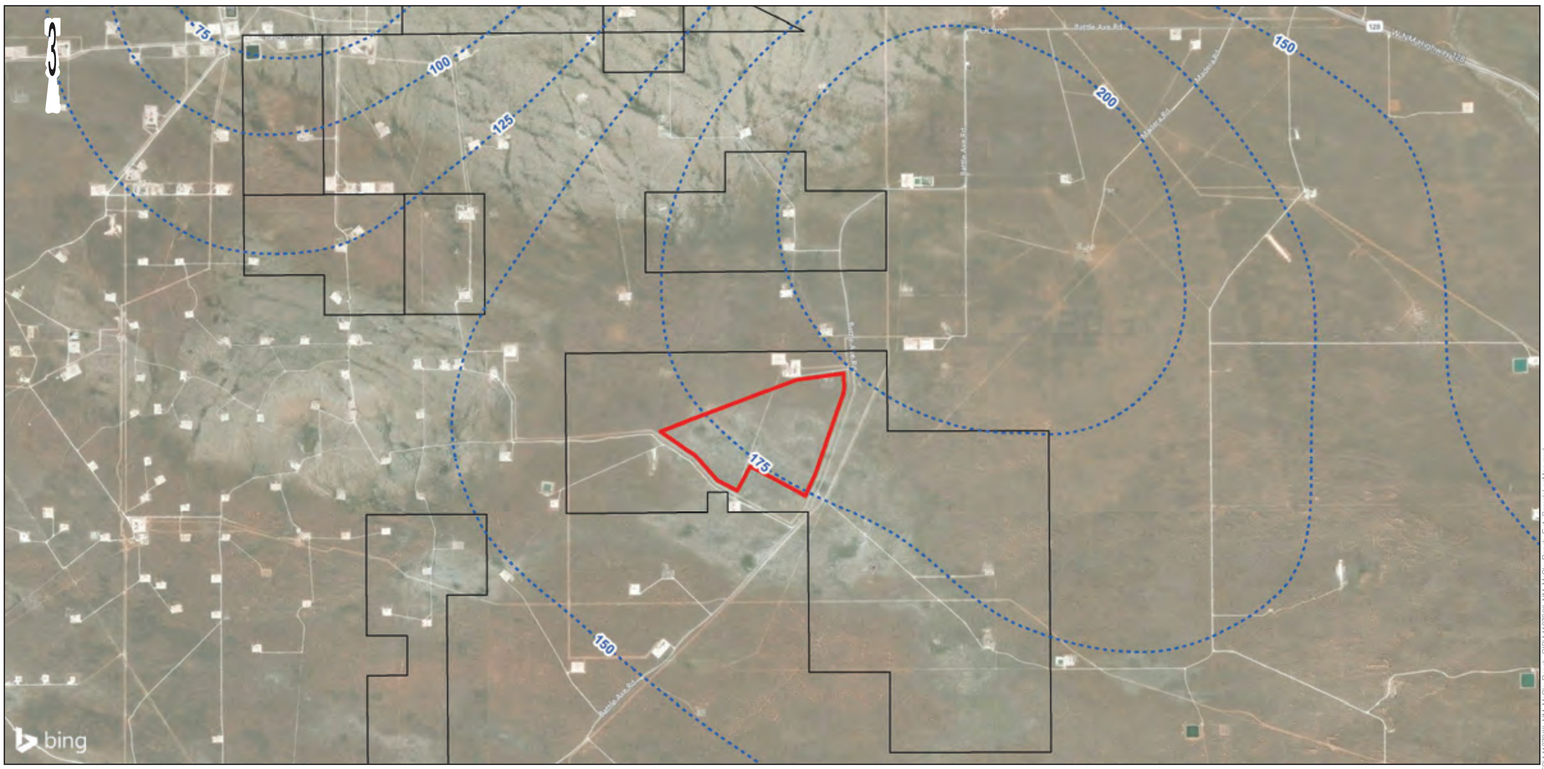
The project engineer reviews the field data and assigns various laboratory tests to better understand the engineering properties of the various soil and rock strata as necessary for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

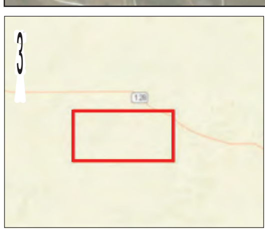
- Moisture Content (ASTM D854)
- Particle Size (ASTM D1140, D422)
- Atterburg Limits (ASTM D4318)
- Laboratory Compaction (ASTM D698)
- ASTM D5084 Standard Test Method for Permeability Tests
- Direct Shear of Soil (ASTM D3080)

The laboratory testing program often includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we describe and classify the soil samples in accordance with the Unified Soil Classification System.

Rock classification is conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification is determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS





Proposed Landfill

Proposed Landfill

Inferred Depth to Water Contour (ft. bgs)

McCloy Ranch Boundaries

Notes:
-Exhibit is for general location only, is not indended for construction purposes, and should not be used seperatedly from original report.

Miles: 0 · 0.5 · 1 · 2

Fractional Scale: 1:37,883

DATA SOURCES:
Bing Maps - Aerial Imagery, World Street Map

Project No.:	35187312
Date:	Sep 2018
Drawn By:	SW
Reviewed By:	MB

Terracon
10400 Highway 191 Midland, TX 79707
PH. (432) 684-9600 terracon.com

Proposed Landfill Map

Project Name
Client Name
Project Address
Project City, State
GPS: 32.143736°, -103.461678°

Exhibit

1

Proposed Landfill

Soil Boring (BH)

Proposed Landfill

Notes:
-Exhibit is for general location only, is not indended for construction purposes, and should not be used seperatedly from original report.

0 500 1,000 2,000 Feet

Fractional Scale: 1:7,055

DATA SOURCES:
Bing Maps - Aerial Imagery, World Street Map

Project No.:	A4187129
Date:	Jan 2019
Drawn By:	SW
Reviewed By:	DC

Terracon
10400 Highway 191 Midland, TX 79707
PH. (432) 684-9600 terracon.com

Proposed Landfill Sample Location Map

Trammco Environmental Solutions
McCloy Ranch - Proposed Landfill
Lea County, New Mexico
GPS: 32.143736°, -103.461678°

Exhibit

2

EXPLORATION RESULTS

BORING LOG NO. BH-1

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.15° Longitude: -103.4539°

Approximate Surface Elev.: 3345 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1.0	**POORLY GRADED SAND (SP)**, brown, dry, -Loose to very dense	3344+/-						
5.0	**SILTY SAND (SM)**, brown to dark reddish brown, dry, -Medium dense to very dense	3340+/-	5					
10.0	**POORLY GRADED SAND (SP)**, brown, dry, -Medium dense to very dense	3335+/-	10					
15.0	**SILTY SAND (SM)**, light brown to gray, dry, -Medium dense to very dense	3330+/-	15					
16.0	**CALICHE**, white, dry	3329+/-						
18.0	**POORLY GRADED SAND (SP)**, brown, dry, -Medium dense to very dense	3327+/-						
			20					
			25					
			30		(hand sample)			
						7	20-17-3	23
			35					
40.0	**POORLY GRADED SAND (SP)**, brown to light brown, dry, -Medium dense to very dense	3305+/-	40					
45.0	**SILTY SAND (SM)**, brown to light brown, dry, -Medium dense to very dense	3300+/-	45					
	POORLY GRADED SAND WITH SILT (SP-SM), reddish brown to light brown, dry, -Medium dense to very dense		50					
			55					
			60					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-02-2018	Boring Completed: 11-06-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-1

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC Fernandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.15° Longitude: -103.4539°

Approximate Surface Elev.: 3345 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND WITH SILT (SP-SM), reddish brown to light brown, dry, -Medium dense to very dense *(continued)*						
	65.0 — 3280+/-	65					
	SANDSTONE, brown to dark reddish brown, dry, -Moderately to highly weathered	70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-02-2018	Boring Completed: 11-06-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GP= MODELLAYER.GP= 1/17/19

BORING LOG NO. BH-1

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.15° Longitude: -103.4539° Approximate Surface Elev.: 3345 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, dry, -Moderately to highly weathered *(continued)*	125 130 135 140 145 150 155 160					
	165.0 — 3180+/-	165					
	Boring Terminated at 165 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-02-2018	Boring Completed: 11-06-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-2

PROJECT: McCloy Ranch Landfill

**CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida**

**SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico**

LOCATION See Exploration Plan

Latitude: 32.1481° Longitude: -103.4638°

Approximate Surface Elev.: 3343 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND (SP), light brownish gray to reddish brown, dry, -Loose to very dense							
	4.0	3339+/-						
	CALICHE, white to light brown, dry, -Loose to moderately compacted		5					
			10					
			15					
	22.0	3321+/-	20					
	POORLY GRADED SAND WITH SILT (SP-SM), reddish brown to light brown, dry, -Medium dense to very dense		25					
			30					
			35					
			40					
			45					
	50.0 **SANDSTONE**, light brown to dark reddish brown, dry, -Moderately to highly weathered	3293+/-	50					
			55					
			60					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-26-2018	Boring Completed: 11-28-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-2

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1481° Longitude: -103.4638° Approximate Surface Elev.: 3343 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, light brown to dark reddish brown, dry, -Moderately to highly weathered *(continued)*	65 70 75 80 85 90 95 100 105 110 115 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-26-2018	Boring Completed: 11-28-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-2

Page 3 of 3

PROJECT: McCloy Ranch Landfill	CLIENT: Trammco Environmental Solutions, LLC Fermandina Beach, Florida
SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico	

LOCATION See Exploration Plan

Latitude: 32.1481° Longitude: -103.4638°

Approximate Surface Elev.: 3343 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, light brown to dark reddish brown, dry, -Moderately to highly weathered *(continued)*		125, 130, 135, 140, 145, 150, 155, 160					
	165.0	3178+/-	165					
	Boring Terminated at 165 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Sonic/Coring	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Boring backfilled with bentonite chips upon completion.		

WATER LEVEL OBSERVATIONS	Terracon	Boring Started: 11-26-2018	Boring Completed: 11-28-2018
No groundwater encountered during drilling	10400 State Highway 191 Midland, TX	Drill Rig: CME 75	Driller: Alec
Dry after 24 hours of drilling		Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GP= MODELLAYER.GP= 1/17/19

BORING LOG NO. BH-3

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.1451° Longitude: -103.4733°

Approximate Surface Elev.: 3345 (Ft.) +/-

GRAPHIC LOG	DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), reddish brown, dry, -Loose to very dense							
	3.0		3342+/-						
		CALICHE, white, dry		5					
	10.0		3335+/-	10					
		SILTY SAND, with interbedded CALICHE (SM), light brownish gray to reddish brown, dry, -Medium dense to very dense		15					
				20					
	25.0		3320+/-	25					
		POORLY GRADED SAND WITH SILT (SP-SM), brown to light brown, dry, -Medium dense to very dense		30					
				35					
				40					
				45					
				50					
	57.0		3288+/-	55					
		SANDSTONE, light brown to dark reddish brown, dry, -Moderately to highly weathered		60					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-26-2018	Boring Completed: 11-28-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-3

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.1451° Longitude: -103.4733°

Approximate Surface Elev.: 3345 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, light brown to dark reddish brown, dry, -Moderately to highly weathered *(continued)*	65 70 75 80 85 90 95 100 105 110 115 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

10400 State Highway 191
Midland, TX

Boring Started: 11-26-2018	Boring Completed: 11-28-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GPJ MODELLAYER.GPJ 1/17/19

BORING LOG NO. BH-3

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.1451° Longitude: -103.4733°

Approximate Surface Elev.: 3345 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, light brown to dark reddish brown, dry, -Moderately to highly weathered *(continued)*		125 130 135 140 145 150 155 160					
	165.0	3180+/-	165					
	Boring Terminated at 165 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-26-2018	Boring Completed: 11-28-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-4

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC Fernandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.1399° Longitude: -103.4656°

Approximate Surface Elev.: 3332 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND with interbedded CALICHE (SC), light brownish gray to reddish brown, dry, -Loose to very dense							
			10		Grab	5	23-14-9	39
20.0	**SILTY CLAYEY SAND, with interbedded CALICHE (SC-SM)**, reddish brown to light brown, dry, -Medium dense to very dense	3312+/-	20					
30.0	**POORLY GRADED SAND (SP)**, brown, dry, -Dense	3302+/-	30					
			35		Grab	8	25-18-7	26
50.0	**SANDSTONE**, brown to dark reddish brown, dry, -Moderately to highly weathered, well cemented	3282+/-	50					
			60					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-15-2018	Boring Completed: 11-18-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-4

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: **Section 9 and 10 of, T25S, R34E**
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1399° Longitude: -103.4656° Approximate Surface Elev.: 3332 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, dry, -Moderately to highly weathered, well cemented *(continued)*	65 70 75 80 85 90 95 100 105 110 115 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-15-2018	Boring Completed: 11-18-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GP= MODELLAYER.GP= 1/17/19

BORING LOG NO. BH-4

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC Fernandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1399° Longitude: -103.4656° Approximate Surface Elev.: 3332 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, dry, -Moderately to highly weathered, well cemented *(continued)*	125 130 135 140 145 150 155 160					
	165.0 — 3167+/-	165					
	Boring Terminated at 165 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-15-2018	Boring Completed: 11-18-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-5

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.1394° Longitude: -103.4584°

Approximate Surface Elev.: 3331 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	**POORLY GRADED SAND (SP)**, light brownish gray to reddish brown, dry, -Loose to very dense	3329+/-						
12.0	**SILTY SAND (SM)**, reddish brown to light brown, dry, -Loose to very dense	3319+/-	5, 10					
19.0	**CALICHE**, white, dry	3312+/-	15					
40.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to light brown, dry, -Medium dense to very dense	3291+/-	20, 25, 30, 35, 40					
	SANDSTONE, brown to dark reddish brown, dry, -Medium dense to very dense		45, 50, 55, 60					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-09-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GPJ MODELLAYER.GPJ 1/17/19

BORING LOG NO. BH-5

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1394° Longitude: -103.4584° Approximate Surface Elev.: 3331 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, dry, -Medium dense to very dense *(continued)*	65 70 75 80 85 90 95 100 105 110 115 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-09-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-5

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1394° Longitude: -103.4584° Approximate Surface Elev.: 3331 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, dry, -Medium dense to very dense *(continued)*	125					
		130					
		135					
		140					
		145					
		150					
		155					
		160					
	165.0 3166+/-	165					
	Boring Terminated at 165 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-09-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GPJ MODELLAYER.GPJ 1/17/19

BORING LOG NO. BH-7

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.1454° Longitude: -103.4585°

Approximate Surface Elev.: 3334 (Ft.) +/-

GRAPHIC LOG	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND, with interbedded CALICHE (SP), light brownish gray to gray, dry, -Loose to very dense							
	7.0		3327+/-	5					
		SILTY SAND (SM), light brown to gray, dry, -Loose to very dense							
	10.0		3324+/-	10					
		CALICHE, white, dry							
	12.0		3322+/-						
		SILTY SAND (SM), light brown to gray, dry, -Medium dense to very dense		15, 20					
	25.0		3309+/-	25					
		POORLY GRADED SAND WITH SILT (SP-SM), reddish brown, dry, -Medium dense to very dense		30, 35, 40, 45, 50					
	55.0		3279+/-	55					
				60					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-06-2018	Boring Completed: 11-08-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-7

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1454° Longitude: -103.4585° Approximate Surface Elev.: 3334 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, dry, -Moderately to highly weathered *(continued)*	65 70 75 80 85 90 95 100 105 110 115 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-06-2018	Boring Completed: 11-08-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GP= MODELLAYER.GP= 1/17/19

BORING LOG NO. BH-7

PROJECT: McCloy Ranch Landfill	**CLIENT: Trammco Environmental Solutions, LLC** **Fermandina Beach, Florida**
SITE: Section 9 and 10 of, T25S, R34E **Jal, Lea County, New Mexico**	

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1454° Longitude: -103.4585° Approximate Surface Elev.: 3334 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, dry, -Moderately to highly weathered *(continued)*	125 130 135 140 145 150 155 160					
	165.0 — 3169+/-	165					
	Boring Terminated at 165 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-06-2018	Boring Completed: 11-08-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GPJ MODELLAYER.GPJ 1/17/19

BORING LOG NO. BH-8

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC Fernandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.1448° Longitude: -103.4665°

Approximate Surface Elev.: 3336 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	**POORLY GRADED SAND (SP)**, light brownish gray to reddish brown, -Loose to very dense, dry	3334+/-						
10.0	**CALICHE**, white	3326+/-						
20.0	**SILTY SAND (SM)**, brown to light brown, -Medium dense to very dense, dry	3316+/-						
50.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown to dark reddish brown, -Medium dense to very dense, dry	3286+/-						
	SANDSTONE, brown to dark reddish brown, -Moderately to highly weathered, dry							

Depth scale (Ft.): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-16-2018	Boring Completed: 11-16-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. BH-8

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1448° Longitude: -103.4665° Approximate Surface Elev.: 3336 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, -Moderately to highly weathered, dry *(continued)*	65 70 75 80 85 90 95 100 105 110 115 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-16-2018	Boring Completed: 11-16-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GPJ MODELLAYER.GPJ 1/17/19

BORING LOG NO. BH-8

PROJECT: McCloy Ranch Landfill

CLIENT: Trammco Environmental Solutions, LLC Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1448° Longitude: -103.4665° Approximate Surface Elev.: 3336 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to dark reddish brown, -Moderately to highly weathered, dry *(continued)*	125 130 135 140 145 150 155 160					
	165.0 3171+/-	165					
	Boring Terminated at 165 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

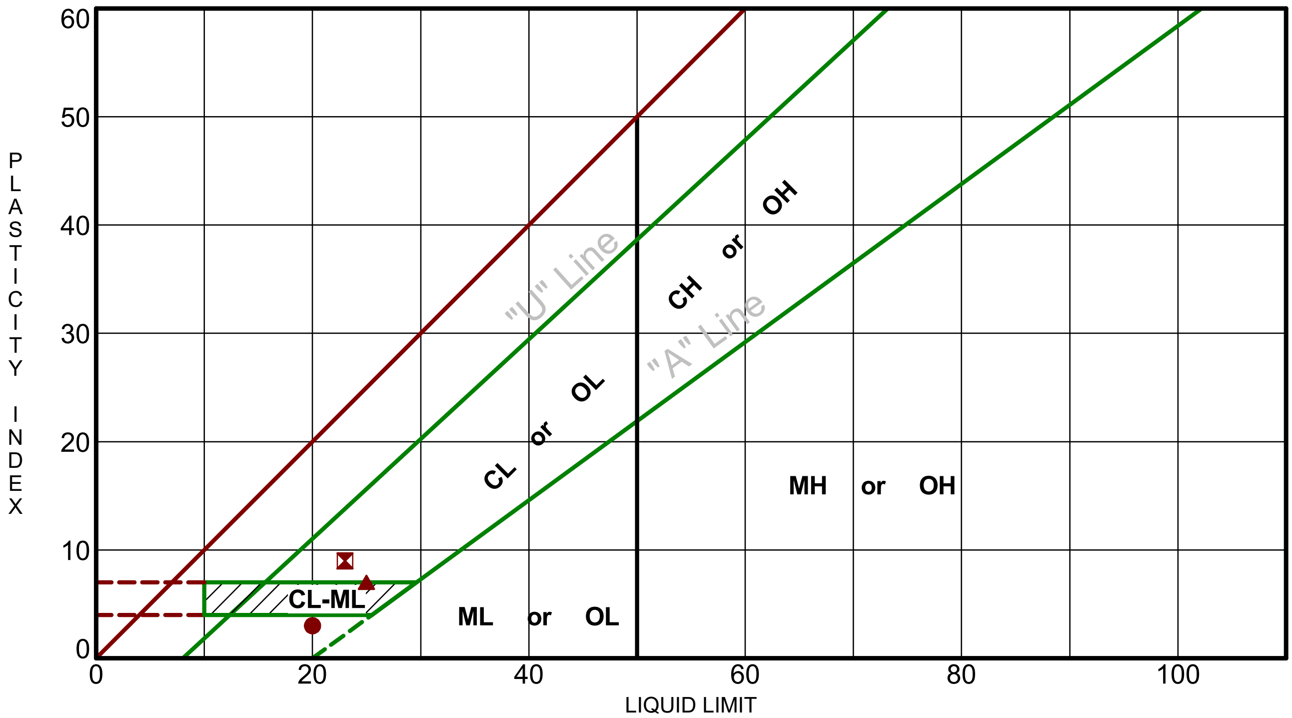
Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-16-2018	Boring Completed: 11-16-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A4187129 - MCCLOY SITE.GPJ MODELLAYER.GPJ 1/17/19

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	BH-1	0 - 65	20	17	3	23	SM	SILTY SAND with GRAVEL
⊠	BH-4	0 - 20	23	14	9	39	SC	CLAYEY SAND
▲	BH-4	20 - 52	25	18	7	26	SC-SM	SILTY, CLAYEY SAND

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS A4187129 - MCCLOY SITE.GPJ TERRACON_DATATEMPLATE.GDT 1/15/19

PROJECT: McCloy Ranch Landfill

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

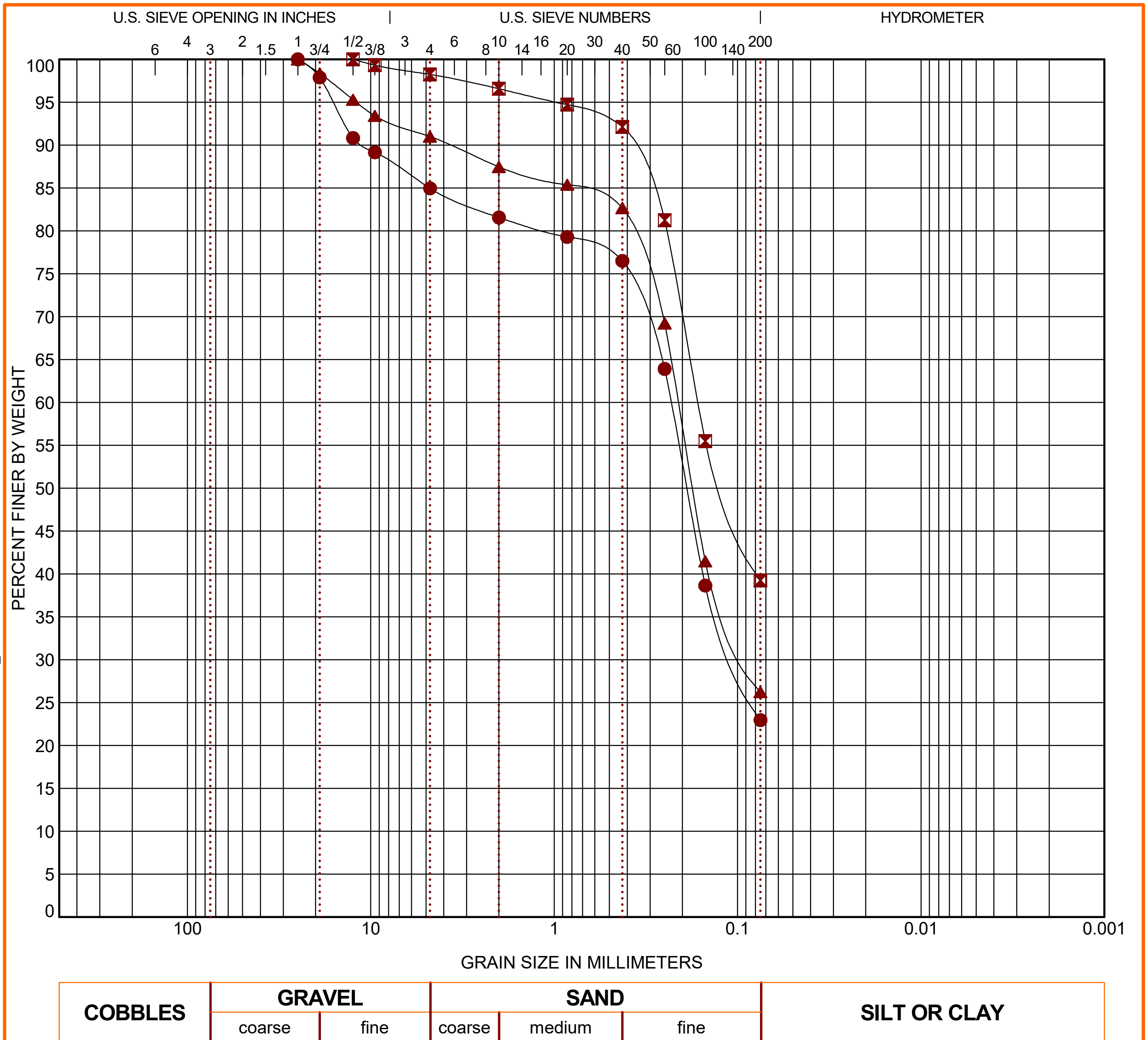
Terracon
10400 State Highway 191
Midland, TX

PROJECT NUMBER: A4187129

CLIENT: Trammco environmental Solutions, LLC
Fermandina Beach, Florida

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BH-1	0 - 65	SILTY SAND with GRAVEL (SM)	7	20	17	3		
⊠	BH-4	0 - 20	CLAYEY SAND (SC)	5	23	14	9		
▲	BH-4	20 - 52	SILTY, CLAYEY SAND (SC-SM)	8	25	18	7		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BH-1	0 - 65	25	0.231	0.102		15.0	62.0		23.0	
⊠	BH-4	0 - 20	12.5	0.164			1.8	59.0		39.2	
▲	BH-4	20 - 52	25	0.211	0.089		9.0	64.8		26.2	

PROJECT: McCloy Ranch Landfill

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

Terracon
10400 State Highway 191
Midland, TX

PROJECT NUMBER: A4187129

CLIENT: Trammco environmental Solutions, LLC
Fermandina Beach, Florida

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 A4187129 - MCCLOY SITE.GPJ TERRACON_DATATEMPLATE.GDT 1/15/19

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Beckham and McCloy Landfill

Date: 12/21/2018 Panel Number : P-1

Project No. : A4187129 Permometer Data

Boring No.:	BH-4	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	composite 1	a_a =	0.767120 cm^2			Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0-20	M_1 =	0.030180	C =	0.0004288	Annulus **Ra**	1.0	cm^3
Other Location:	McCloy Site	M_2 =	1.040953	T =	0.0658646			

Material Description : light brown clayey sand

SAMPLE DATA

Wet Wt. sample + ring or tare :			575.30	g					
Tare or ring Wt. :			0.0	g		Before Test		After Test	
Wet Wt: of Sample :			575.30	g		Tare No.:	102	Tare No.:	N/A
Diameter :	2.80	in	7.11	cm^2		Wet Wt.+tare:	115.70	Wet Wt.+tare:	578.70
Length :	2.80	in	7.11	cm		Dry Wt.+tare:	100.00	Dry Wt.+tare:	484.11
Area:	6.16	in^2	39.73	cm^2		Tare Wt:	0.00	Tare Wt:	0.00
Volume :	17.24	in^3	282.53	cm^3		Dry Wt.:	100	Dry Wt.:	484.11
Unit Wt.(wet):	**127.06**	pcf	**2.04**	$g/cm^{\wedge 3}$		Water Wt.:	15.7	Water Wt.:	94.59
Unit Wt.(dry):	**109.82**	pcf	**1.76**	$g/cm^{\wedge 3}$		% moist.:	**15.7**	% moist.:	**19.5**

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =	115.6	OMC =	13.7
		% of max =	95.0	+/- OMC =	2.00
Calculated % saturation:	98.63	Void ratio (e) =	**0.53**	Porosity (n)=	**0.35**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	• Zp (cm)	temp (deg C)	• (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/20/2018	300	15.7	1.082666	21	0.977	1.03E-07	2.93E-04	
12/20/2018	600	14.6	2.182666	21	0.977	1.08E-07	3.07E-04	
12/20/2018	900	13.5	3.282666	21	0.977	1.13E-07	3.21E-04	
12/20/2018	1200	12.6	4.182666	21	0.977	1.12E-07	3.19E-04	

SUMMARY

ka = 1.09E-07 cm/sec Acceptance criteria = 50 %

ki			Vm	
k1 =	1.03E-07	cm/sec	5.6	%
k2 =	1.08E-07	cm/sec	0.9	%
k3 =	1.13E-07	cm/sec	3.7	%
k4 =	1.12E-07	cm/sec	2.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**1.09E-07**	cm/sec	**3.10E-04**	ft/day
Void Ratio	e =	**0.53**			
Porosity	n =	**0.35**			
Bulk Density	• =	**2.04**	g/cm^3	**127.1**	pcf
Water Content	W =	**0.28**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.12E-12**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Beckham and McCloy Landfill

Date: 12/21/2018 Panel Number : P-1

Project No. : A4187129 Permometer Data

Boring No.:	BH-4	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.6 cm^3
Sample:	composite 2	a_a =	0.767120 cm^2			Pipet **Rp**	**16.8** cm^3
Depth (ft):	20.0-52.0	M_1 =	0.030180	C =	0.0004288	Annulus **Ra**	1.0 cm^3
Other Location:	McCloy Site	M_2 =	1.040953	T =	0.0658646		

Material Description : light brown silty, clayey sand

SAMPLE DATA

Wet Wt. sample + ring or tare :		566.34 g			
Tare or ring Wt. :		0.0 g		Before Test	After Test
Wet Wt: of Sample :		566.34 g	Tare No.: 103		Tare No.: N/A
Diameter :	2.80 in	7.11 cm^2	Wet Wt.+tare: 115.70		Wet Wt.+tare: 579.47
Length :	2.80 in	7.11 cm	Dry Wt.+tare: 100.00		Dry Wt.+tare: 481.39
Area:	6.16 in^2	39.73 cm^2	Tare Wt: 0.00		Tare Wt: 0.00
Volume :	17.24 in^3	282.53 cm^3	Dry Wt.: 100		Dry Wt.: 481.39
Unit Wt.(wet):	**125.08** pcf	**2.00** g/cm^3	Water Wt.: 15.7		Water Wt.: 98.08
Unit Wt.(dry):	**108.11** pcf	**1.73** g/cm^3	% moist.: **15.7**		% moist.: **20.4**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = 113.8 OMC = 13.7

% of max = 95.0 +/- OMC = 2.00

Calculated % saturation: 98.38 Void ratio (e) = **0.56** Porosity (n)= **0.36**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	• Zp (cm)	temp (deg C)	• (temp corr)	k (cm/sec)	k (ft./day)
12/20/2018	5	15.7	1.082666	21	0.977	6.20E-06	1.76E-02
12/20/2018	10	14.6	2.182666	21	0.977	6.50E-06	1.84E-02
12/20/2018	15	13.5	3.282666	21	0.977	6.80E-06	1.93E-02
12/20/2018	20	12.6	4.182666	21	0.977	6.75E-06	1.91E-02

Reset = *

SUMMARY

k_a = 6.56E-06 cm/sec Acceptance criteria = 50 %

ki			Vm	
k1 =	6.20E-06	cm/sec	5.6	%
k2 =	6.50E-06	cm/sec	0.9	%
k3 =	6.80E-06	cm/sec	3.7	%
k4 =	6.75E-06	cm/sec	2.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**6.56E-06**	cm/sec	**1.86E-02**	ft/day
Void Ratio	e =	**0.56**			
Porosity	n =	**0.36**			
Bulk Density	• =	**2.00**	g/cm^3	**125.1**	pcf
Water Content	W =	**0.27**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**6.72E-11**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Beckham and McCloy Landfill
Date: 12/21/2018 Panel Number : P-1
Project No. : A4187129 Permometer Data

Boring No.:	BH-1	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	composite	a_a =	0.767120 cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0-65	M_1 =	0.030180	C = 0.0004288	Annulus **Ra**	1.0	cm^3
Other Location:	McCloy Site	M_2 =	1.040953	T = 0.0658646			

Material Description : light brown silty sand with gravel

SAMPLE DATA

Wet Wt. sample + ring or tare :			575.26	g				
Tare or ring Wt. :			0.0	g	Before Test		After Test	
Wet Wt: of Sample :			575.26	g	Tare No.:	101	Tare No.:	N/A
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	114.70	Wet Wt.+tare:	586.52
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	100.00	Dry Wt.+tare:	492.33
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	0.00	Tare Wt:	0.00
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	100	Dry Wt.:	492.33
Unit Wt.(wet):	**127.05**	pcf	**2.04**	g/cm^3	Water Wt.:	14.7	Water Wt.:	94.19
Unit Wt.(dry):	**110.77**	pcf	**1.78**	g/cm^3	% moist.:	**14.7**	% moist.:	**19.1**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = 116.6 OMC = 12.7
% of max = 95.0 +/- OMC = 2.00
Calculated % saturation: 99.01 Void ratio (e) = **0.52** Porosity (n)= **0.34**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	• Zp (cm)	temp (deg C)	• (temp corr)	k (cm/sec)	k (ft./day)
12/20/2018	5	15.7	1.082666	21	0.977	6.20E-06	1.76E-02
12/20/2018	10	14.6	2.182666	21	0.977	6.50E-06	1.84E-02
12/20/2018	15	13.5	3.282666	21	0.977	6.80E-06	1.93E-02
12/20/2018	20	12.6	4.182666	21	0.977	6.75E-06	1.91E-02

Reset = *

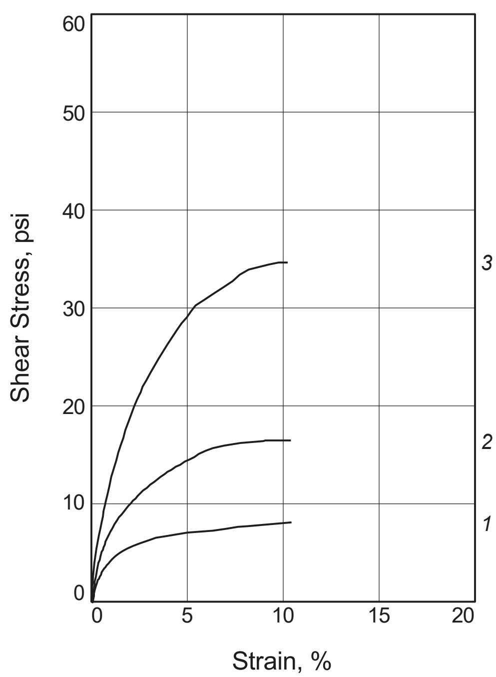
SUMMARY

ka = 6.56E-06 cm/sec Acceptance criteria = 50 %

ki		Vm	
k1 =	6.20E-06 cm/sec	5.6	%
k2 =	6.50E-06 cm/sec	0.9	%
k3 =	6.80E-06 cm/sec	3.7	%
k4 =	6.75E-06 cm/sec	2.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**6.56E-06**	cm/sec	**1.86E-02**	ft/day
Void Ratio	e =	**0.52**			
Porosity	n =	**0.34**			
Bulk Density	• =	**2.04**	g/cm^3	**127.1**	pcf
Water Content	W =	**0.26**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**6.72E-11**	cm^2	(at 20 deg C)	



Sample No.		1	2	3
Initial	Water Content, %	14.7	14.7	14.7
	Dry Density, pcf	110.8	110.8	110.8
	Saturation, %	76.1	76.1	76.1
	Void Ratio	0.5218	0.5218	0.5218
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	17.5	15.9	15.1
	Dry Density, pcf	114.3	117.8	119.5
	Saturation, %	99.7	99.5	99.2
	Void Ratio	0.4744	0.4312	0.4107
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.969	0.941	0.927
Normal Stress, psi		10.00	20.00	40.00
Fail. Stress, psi		8.08	16.43	34.65
Strain, %		10.4	9.1	10.2
Ult. Stress, psi				
Strain, %				
Strain rate, in./min.		0.004	0.004	0.004

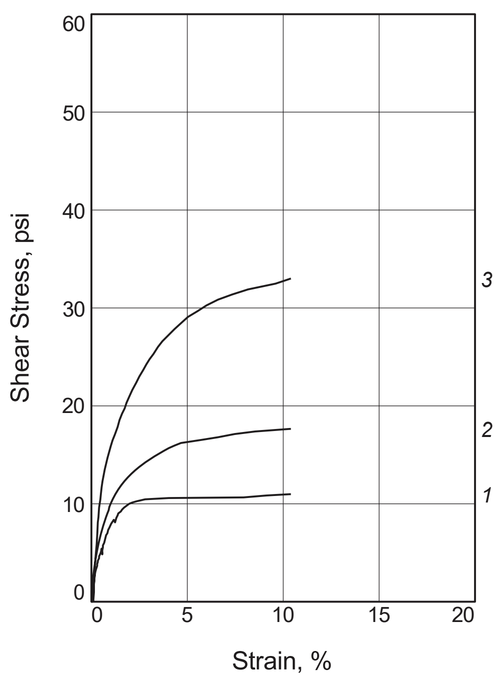
Sample Type: Remolded
Description: light brown silty sand with gravel (SM)
LL= 20 **PL=** 17 **PI=** 3
Assumed Specific Gravity= 2.7
Remarks: Compaction based on D698 efforts. Specimens remolded to 95% of maximum dry density and +2% of optimum moisture.

Client: Trammco Environmental Solutions LLC

Project: McCloy and Beckham Landfill

Source of Sample: BH-1 **Depth:** 0.0-65.0 ft
Sample Number: Composite
Proj. No.: A4187129 **Date Sampled:** N/A

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN



Sample No.		1	2	3
Initial	Water Content, %	15.7	15.7	15.7
	Dry Density, pcf	109.8	109.8	109.8
	Saturation, %	79.2	79.2	79.2
	Void Ratio	0.5350	0.5350	0.5350
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	18.2	17.9	15.8
	Dry Density, pcf	112.4	113.6	117.5
	Saturation, %	98.2	100.0	98.1
	Void Ratio	0.4994	0.4833	0.4346
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.977	0.966	0.935
Normal Stress, psi		10.00	20.00	40.00
Fail. Stress, psi		10.96	17.61	32.97
Strain, %		10.4	10.3	10.4
Ult. Stress, psi				
Strain, %				
Strain rate, in./min.		0.005	0.005	0.005

Sample Type: Remolded
Description: light brown clayey sand (SC)

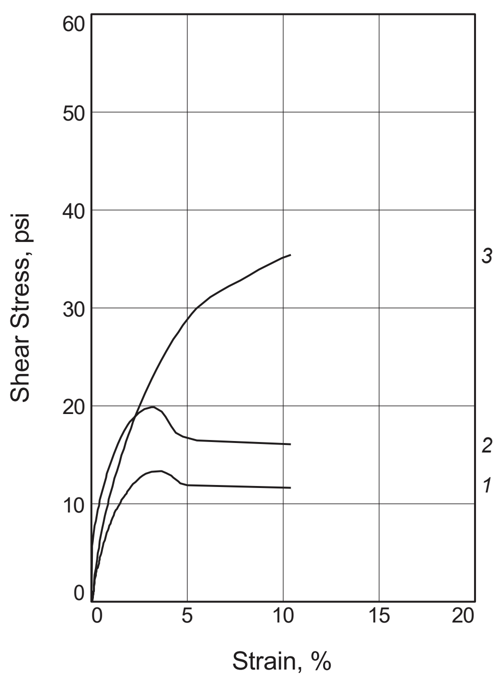
LL= 23 **PL=** 14 **PI=** 9
Assumed Specific Gravity= 2.7
Remarks: Compaction based on D698 efforts. Specimens remolded to 95% of maximum dry density and +2% of optimum moisture content.

Client: Trammco Environmental Solutions LLC

Project: McCloy and Beckham Landfill

Source of Sample: BH-4 **Depth:** 0.0-20.0 ft
Sample Number: Composite 1
Proj. No.: A4187129 **Date Sampled:** N/A

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN



Sample No.		1	2	3
Initial	Water Content, %	15.7	15.7	15.7
	Dry Density, pcf	108.1	108.1	108.1
	Saturation, %	75.7	75.7	75.7
	Void Ratio	0.5598	0.5598	0.5598
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	19.8	18.8	16.0
	Dry Density, pcf	109.4	111.4	117.4
	Saturation, %	98.6	98.7	99.1
	Void Ratio	0.5409	0.5135	0.4355
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.988	0.970	0.920
Normal Stress, psi		10.00	20.00	40.00
Fail. Stress, psi		13.35	19.85	34.50
Strain, %		3.6	3.1	9.3
Ult. Stress, psi				
Strain, %				
Strain rate, in./min.		0.005	0.005	0.005

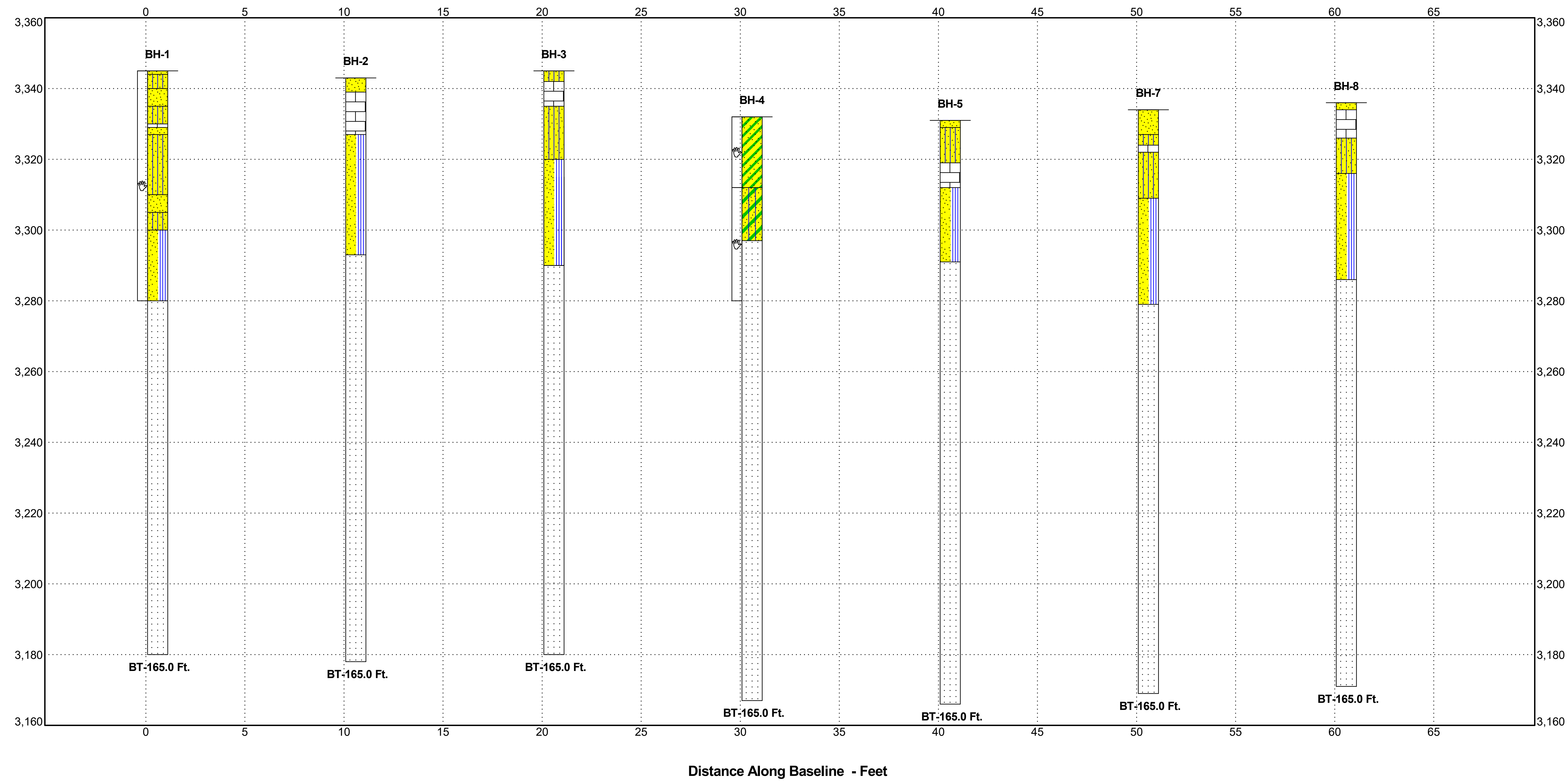
Sample Type: Remolded
Description: light brown silty, clayey sand (SC-SM)
LL= 25 **PL=** 18 **PI=** 7
Assumed Specific Gravity= 2.7
Remarks: Compaction based on D698 efforts. Specimens remolded to 95% maximum dry density and +2% of optimum moisture content.

Client: Trammco Environmental Solutions LLC

Project: McCloy and Beckham Landfill

Source of Sample: BH-4 **Depth:** 20.0-52.0 ft
Sample Number: Composite 2
Proj. No.: A4187129 **Date Sampled:** N/A

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN



Explanation

Poorly-graded Sand

Silty Sand

CALICHE - USGS Standard

Poorly-graded Sand with Silt

Sandstone

Clayey Sand

Silty Clayey Sand

BH-1 — Borehole Number

Moisture Content — %w

LL PL — Liquid and Plastic Limits

Sampling (See General Notes) — Borehole Lithology

AR BT — Borehole Termination Type

Water Level Reading at time of drilling.

Water Level Reading after drilling.

NOTES:

See Exploration Plan for orientation of soil profile.
See General Notes in Supporting Information for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: A4187129

Date: 1/15/2019

Scale: N.T.S

Terracon
10400 State Highway 191
Midland, TX

SUBSURFACE PROFILE

MCCLOY RANCH LANDFILL
SECTION 9 AND 10 OF, T25S, R34E
JAL, LEA COUNTY, NEW MEXICO

SUPPORTING INFORMATION

UNIFIED SOIL CLASSIFICATION SYSTEM

McCloy Ranch Landfill ■ Jal, Lea County, New Mexico
January 25, 2019 ■ Terracon Project No. A4187129

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu } 4 and 1 :: Cc :: 3 [E]	GW	Well-graded gravel [F]
			Cu < 4 and/or 1 > Cc > 3 [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu } 6 and 1 :: Cc :: 3 [E]	SW	Well-graded sand [I]
			Cu < 6 and/or 1 > Cc > 3 [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains } 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains } 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains } 30% plus No. 200 predominantly sand, add "sandy" to group name.

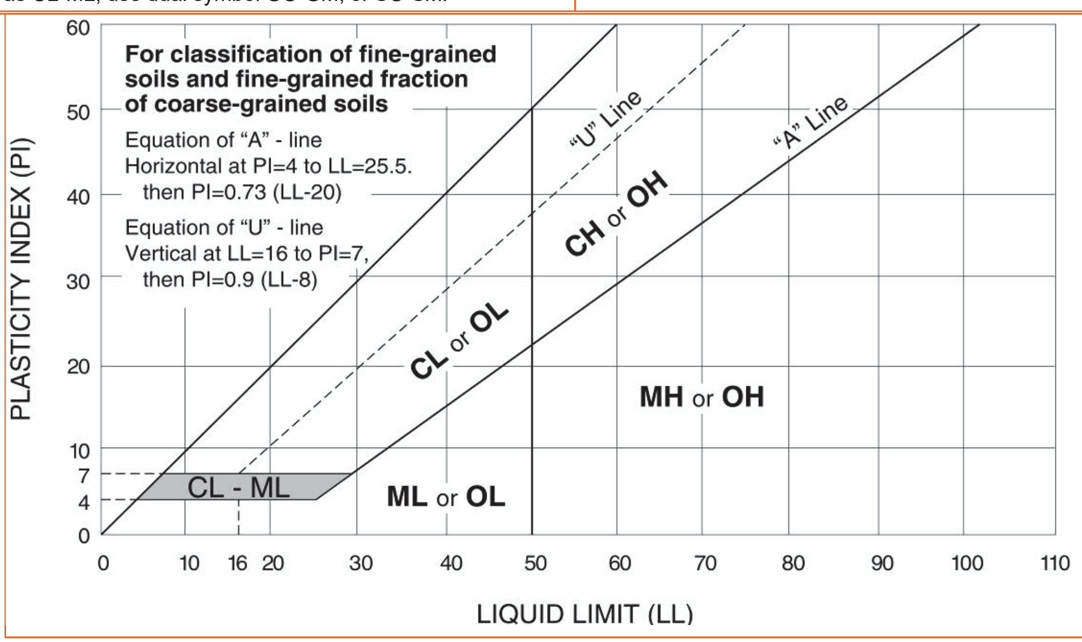
[M] If soil contains } 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI } 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

McCloy Ranch Landfill ■ Jal, Lea County, New Mexico
January 25, 2019 ■ Terracon Project No. A4187129

Terracon GeoReport

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

DESCRIPTION OF ROCK PROPERTIES

McCloy Ranch Landfill ■ Jal, Lea County, New Mexico
January 25, 2019 ■ Terracon Project No. A4187129

WEATHERING	
Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" no discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)	
Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding, and Foliation Spacing in Rock [1]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

1. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

Rock Quality Designator (RQD) [1]

RQD, as a percentage	Diagnostic description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

1. RQD (given as a percentage) = length of core in pieces 4 inches and longer / length of run

Joint Openness Descriptors

Openness	Descriptor
No Visible Separation	Tight
Less than 1/32 in.	Slightly Open
1/32 to 1/8 in.	Moderately Open
1/8 to 3/8 in.	Open
3/8 in. to 0.1 ft.	Moderately Wide
Greater than 0.1 ft.	Wide

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

Attachment B

United States Department of Agriculture Web Soil Survey Report

Soil Map-Lea County, New Mexico

Map Scale: 1:25,400 if printed on B portrait (11" x 17") sheet.

N

Meters: 0 350 700 1400 2100

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

Soil Map-Lea County, New Mexico

MAP LEGEND

Area of Interest (AOI)
Area of Interest (AOI)

Soils
Soil Map Unit Polygons
Soil Map Unit Lines
Soil Map Unit Points

Special Point Features
Blowout
Borrow Pit
Clay Spot
Closed Depression
Gravel Pit
Gravelly Spot
Landfill
Lava Flow
Marsh or swamp
Mine or 4uarry
Miscellaneous Water
Perennial Water
Rock Outcrop
Saline Spot
Sandy Spot
Severely Eroded Spot
Sinkhole
Slide or Slip
Sodic Spot
Spoil Area
Stony Spot
Very Stony Spot
Wet Spot
Other
Special Line Features

Water Features
Streams and Canals

Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background
Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 15, Sep 12, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 200 -Sep 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digiti]ed probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BE	Berino-Cacique loamy fine sands association	1 5.6	3.7%
BF	Berino-Cacique fine sandy loams association	18.3	0.3%
CLP	Caliche pit	2.6	0.0%
KD	Kermit-Palomas fine sands, 0 to 12 percent slopes	547.4	10.4%
MM	Ratliff loam	7.4	0.1%
MN	Ratliff-Wink fine sandy loams	707.6	13.4%
PU	Pyote and maljamar fine sands	2,736.8	51. %
P<	Pyote soils and dune land	222.3	4.2%
TF	Tonuco loamy fine sand, 0 to 3 percent slopes	36.0	0.7%
WF	Wink fine sand	372.4	7.1%
WK	Wink loamy fine sand	431.2	8.2%
Totals for Area of Interest		**5,277.6**	**100.0%**

Appendix J

North Ranch Surface Waste Management Facility Design and Construction Plan

Engineering Design Report

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 2019
Project No. 35187378

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

Table of Contents

Tables

Attachments

1.0 INTRODUCTION

This engineering design report (EDR) was prepared by Terracon Consultants, Inc. (Terracon) for NGL Waste Services, LLC (NGL) to support the Permit Application for the proposed North Ranch Surface Waste Management Facility (Facility) located near Jal, Lea County, New Mexico. The following sections and appendices provide backup engineering calculations and documentation for the proposed landfill configuration as presented on the permit drawings in **Appendix K** of the Permit Application (PA).

1.1 Regulatory Oversight

Due to its function the Facility will be regulated by New Mexico Administrative Code, Title 19 – Natural Resources and Wildlife, Chapter 15 – Oil and Gas, Part 36 – Surface Waste Management Facilities, or 19.15.36. The Facility is defined as a commercial landfill facility by **19.15.36.7.A(2)** and **(4)** accepting exempt oil field waste from nearby oil field development customers. In general, this EDR will focus on providing the engineering calculations and documentation to satisfy design requirements specified in **19.15.36.14.C** – **19.15.36.14.F**. In addition, NGL proposes to manage and dispose of the Facility's leachate with an evaporation pond. Therefore, this EDR will also provide engineering calculations for the proposed evaporation pond in compliance with **19.15.36.17.A** and **19.15.36.17.B**.

1.2 General Facility Description

The Facility consists of approximately (~) 303 acres of which ~205 acres will be dedicated for lined landfill disposal cells. The remaining ~98 acres consists of a ~26-acre entrance and waste acceptance area including an ~2.2-acre leachate evaporation pond; ~12.5 acres making up three stormwater retention ponds; and ~57.3 acres of ancillary space for perimeter roadways, drainage channels and landfill structural berms.

The landfill area will be subdivided in to three phases. Phase 1 will have six disposal cells ranging in size from 9.6 acres to 28.2 acres for a total disposal area of ~111 acres. Phase 2 will have five disposal cells ranging in size from 11.8 acres, to 24.7 acres for a total disposal area ~88.5 acres. Phase 1 and 2 have maximum depths below existing grade of ~50-feet. Phase 1 and 2 are separated by ~100 feet. During operation of the Phase 1 and 2 this area will be used for roadways and drainage channels. However, upon completion of Phase 1 and 2 this separation area and the valley between the Phase 1 and 2 waste slopes will be developed into Phase 3. Phase 3 will fill the valley between Phases 1 and 2 and ultimately reach the proposed final elevations.

Each of the Phase 1 and 2 disposal cells will be separated by a 4-foot tall soil divider berm. All disposal areas will be lined with a multilayered geosynthetic liner system with both leachate collection and recovery and leak detection systems. Final waste surfaces will be covered with a geosynthetic and soil based final cover system. Full descriptions of the liner and cover systems are provided in this EDR. Ultimately the proposed configuration of the landfill area will result in a total design operational capacity (waste and routine soil) of ~40,264,324 Cubic Yards (CY).

Detailed design of the Facility is presented within this EDR and attached including supporting calculations and analyses.

2.0 PROPOSED FACILITY DESIGN

2.1 Landfill Geometry

In general compliance with **19.15.36.14.C** and **19.15.36.14.D**, all landfill cells have been designed with 3H:1V side slopes. Each cell floor will be graded at a minimum of 2% laterally to a center leachate collection pipeline which is sloped at 2% towards a central leachate collection sump. The liner system and leachate collection lines will be protected with 2-feet of protective soil, see Section 2.7 for greater details regarding the liner system design. Cell depths ranging from eight (8) at the high end of the cell to 71 feet at the leachate collection sump, the maximum excavation depth below existing grade is ~48 feet. The intermediate, final waste and final cover slopes will be nominally 4H:1V and the top deck will have a minimum grade of 4%. The final cover system will include 5 feet of soil over the liner system. The landfill will have a maximum final waste grade of 3,539.1 feet above mean sea level (AMSL), and maximum final cover grade will be 3,544.1 feet AMSL. See **Permit Drawings** in **Appendix K** of the PA for visual representation of the proposed geometry.

2.2 Landfill Design Capacity

The following Table 2.1 provides the design operational capacity (waste and routine and intermediate soil cover), routine and intermediate soil cover volume assuming 15% soil to waste ratio, and waste capacity of each disposal cell, phase and overall landfill. Per-cell capacities assume an intermediate waste fill slope of 4V:1H and that fill sequencing occurs as shown on **Drawing 24** of **Appendix K** of the PA. Operational capacities were calculated using AutoDesk© Civil3D® 2019 (Civil 3D) software.

Table 2.1 Design Capacity Summary

Cell	Operational Capacity (CY)	Routine and Intermediate Soil Cover [10% of Operational Waste Capacity] (CY)	Waste Capacity [90% of Operational Capacity] (CY)
PHASE 1			
E-1	933,202	93,320	839,882
E-2	2,111,021	211,102	1,899,919
E-3	5,116,491	511,649	4,604,842
E-4	3,939,124	393,912	3,545,212
E-5	3,840,751	384,075	3,456,676
E-6	2,564,850	256,485	2,308,365
PHASE 1	**18,505,439**	**1,850,543**	**16,654,896**
PHASE 2			
W-1	1,108,726	110,873	997,853
W-2	1,322,275	132,228	1,190,048
W-3	2,075,688	207,569	1,868,119
W-4	4,148,670	414,867	3,733,803
W-5	4,679,514	467,951	4,211,563
PHASE 2	**13,334,873**	**1,333,493**	**12,001,391**
PHASE 3	**8,424,012**	**842,401**	**7,581,611**
TOTAL	**40,264,324**	**4,026,432**	**36,237,892**

2.3 Site Soil Balance

Landfill cell construction, routine operations, and closure will require large quantities of soil over the life of the landfill. The proposed Facility-wide grading plan shown in the **Permit Drawings** in **Appendix K** of the PA, which includes all grading activities for landfill cells, roads, stormwater infrastructure (channels and ponds), and the leachate evaporation pond, will generate soils for these activities. Table 2.2 below summarizes the soil balance for known operational and construction activities through buildout of the Facility. All cut and fill volumes provided in Table 2.2 are calculated using Civil 3D.

Table 2.2 Soil Balance Summary

Area	Cut (CY)	Fill (CY)
Facility Wide Grading	8,166,740	514,465
Phase 1 Base Liner Protective Cover	0	357,923
Phase 2 Base Liner Protective Cover	0	292,892
Phase 3 Base Liner Protective Cover	0	19,522
Operational Cover (Routine and Intermediate, From Table 2.1)	0	4,026,432
Final Cover System	0	1,495,694
TOTALS	**8,166,740**	**6,706,928**
FACILITY SOIL BALANCE = +1,459,812 EXCESS SOIL		

2.4 Stormwater Management System

The proposed surface-water management system for both run-on and run-off for the Facility is shown on the **Permit Drawings** in **Appendix K** of the PA. The proposed configuration of the run-off management system was modeled in AutoDesk© Storm and Sanitary Analysis® 2019 (SSA) software. The run-on management system has been sized using the USDA, NRCS, Technical Release 55 (TR-55) method. Both the SAA and TR-55 simulated the 25-year, 24-hour storm (design storm) event for the Lea County, New Mexico area.

Facility Storm Run-off Management System Design
All proposed stormwater run-off conveyance structures (channels, berms, letdowns, culverts) have been designed to handle the peak flow from the design storm. The three stormwater ponds have been designed to retain at least the total run-off volume from the design storm. The Facility also has a 2-foot earth berm at the permit boundary to retain onsite any potential storm pond over flow during greater storm events. In short, the Facility has been designed to be a non-discharging facility.

Facility Run-on Management System Design
The run-on drainage area is potentially a 5,555-acre area northwest of the Facility. It is likely that only a small portion of the potential run-on area impacts the Facility perimeter. However, to

designed to collect the peak flow from the design storm event for the entire potential run-off area.

Attachment A provides a detailed report of the SSA and TR-55 analysis, including figures and modeling results.

2.5 Erosion Loss (RUSLE)

The purpose of the erosion calculation is to determine potential soil losses due to rainfall erosion under closure conditions. Using the Revised Universal Soil Loss Equation (RUSLE), projected soil loss from rainfall is approximately 4.96 tons/acre/year (t/a/y), which is below the NRCS established criterion of 5.0 t/a/y. Detailed RUSLE calculations are provided in **Attachment B**.

2.6 Leachate Evaporation Pond Geometry and Sizing

Geometry
A proposed leachate evaporation pond (LEP) is to be located near the site entrance in the northeast portion of the Facility. In general, the LEP geometry is in compliance with **19.15.36.17.A** and **19.15.36.17.B** having 3H:1V side slopes and a floor sloped laterally at 2% towards a central leak detection sump. In addition, the LEP has a 2-3-foot-high perimeter berm to prevent external surface water intrusion. The LEP plan footprint is approximately 2.25 acres with depths varying from 3.25 feet – 13.3 feet, with a 2-foot deep leak detection sump at the lowest point.

The LEP was sized assuming a worst-case condition defined as follows:

- Assumes the Facility will only construct and operate one disposal cell at a time. In this case:
- The largest Cell (E-3, 28.2 acres) has been constructed and hasn't received waste.
- Run-off from the intermediate 4H:1V waste slope from the previous Cell (E-2) is draining into the new cell (E-3) leachate collection system.
- Little to no waste has been placed over the new cell's liner system.

Under this condition leachate generation is governed by incidental precipitation, thus two calculation methods to determine the require storage in the LEP are considered:

- 25-year, 24-hour precipitation volume incidental to the open area defined above, which totals to 37.3 acres.
- Leachate generation from the open cell (28.2 acres).

To be conservative, the LEP is sized to fully contain the greater of the volumes generated from the two sources. **Attachment C** provides a TR-55 run-off volume calculation from the 37.3-acre

area indicating that 8.5 acre-feet of storage is required to contain incidental precipitation volume. A Hydraulic Evaluation of Landfill Performance (HELP) analysis was performed to determine the leachate generation rate from the open cell. The HELP analysis indicated that ~2.8 acre-feet annually of leachate is collected over the liner and would be required to contain the leachate generation volume from the largest cell (Cell E-3) when it is open with no waste over the liner. This required capacity diminishes as waste thickness is increased over the liner system. A HELP analysis summary memo and results are provided in **Attachment D**. In either case, the LEP must also provide storage for incidental precipitation over the 2-acre pond footprint, requiring an additional 0.77 acre-feet.
Therefore, the LEP has a design storage capacity of 9.3 acre-feet. The LEP will also have three feet of freeboard above the design waterline which is not included in the design capacity. This complies with **19.15.36.17.B(12)** requiring three feet of freeboard and **19.15.36.17.B(12)** limiting the maximum size of evaporation ponds to 10 acre-feet.

2.7 Base Liner System

The Facility is proposing two base liner systems one for the landfill cells and one for the leachate evaporation pond. Details showing the bottom liner systems can be found in the **Permit Drawings** in **Appendix K** of the PA.

The typical landfill liner system will consist of (from bottom to top):

- A prepared subgrade layer on the cell floor and on the side slopes to provide a smooth surface for geosynthetic deployment;
- Low Permeability Clay Base Layer. The field geologic/hydrogeological investigation (See **Appendix I** of the PA) generally characterized the potential excavated soil as sandy with permeabilities ranging from 1.09×10^{-6} cm/sec to 6.5×10^{-5} cm/s. Thus, this soil is not favorable for a compacted clay liner. In addition, groundwater was not encountered within 100 feet of the lowest proposed landfill cell elevation. Therefore, NGL proposes to install a geosynthetic clay liner (GCL) in lieu of the prescriptive base layer (**19.15.36.14.C(1)**) two-feet of compacted clay with hydraulic conductivity of 1×10^{-7} cm/s or less. GCLs are commonly installed in landfill liner systems as an alternative to compacted clay in similar conditions, and have hydraulic conductivities as low as 1×10^{-8} – 1×10^{-10} cm/s (Daniel 1993)
- A secondary 60-mil thick textured high-density polyethylene (HDPE) geomembrane liner, in compliance with **19.15.36.14.C(2)**;
- Leak detection drainage layer. For ease of construction and to maximize potential landfill airspace, NGL proposes using a 200-mil HDPE bi-planar geonet composite (Geocomposite) leak detection drainage layer in lieu of the prescriptive (**19.15.36.14.C(3)**) two feet of compacted soil with a hydraulic

conductivity of 1x10^{-5} cm/s or greater. Drainage geocomposites consist of a biplanar geonet with geotextile filters heat bonded to both sides and are commonly installed in landfill liner leak detection systems as an alternative to a soil drainage layer due to their superior hydraulic performance obtaining hydraulic conductivities of up to 10 cm/s. The geocomposite, in conjunction with the textured geomembrane, also provides additional friction for greater slope stability;

- A primary 60-mil thick textured HDPE geomembrane liner in compliance with **19.15.36.14.C(4)**);
- Leachate collection and removal system. For ease of construction and to maximize potential landfill airspace, NGL proposes 200-mil HDPE bi-planar geocomposite leachate drainage layer in lieu of the prescriptive (**19.15.36.14.C(5)**) two-feet of compacted soil with a hydraulic conductivity of 1x10^{-2} cm/s or greater. This concept provides a high transmissivity (K up to 10 cm/s) blanket over the entire cell rather than intermittent collection laterals, giving greater leachate collection coverage;
- 2-feet of highly permeable protective cover soil, 1x10^{-2} cm/s or greater, in compliance with (**19.15.36.14.C(6)**).

The typical leachate evaporation pond liner system will consist of (from bottom to top):

- A prepared subgrade layer on the cell floor and on the side slopes to provide a smooth surface for geosynthetic deployment;
- Secondary 60-mil thick HDPE geomembrane liner, in compliance with **19.15.36.17.B(8)**.
- Leak detection drainage layer. For ease of construction, NGL proposes a 200-mil Geocomposite leak detection drainage layer in lieu of the prescriptive (**19.15.36.17.B(9)**) two-feet of compacted soil with a hydraulic conductivity of 1x10^{-5} cm/s or greater. Geocomposites are commonly installed in leak detection systems as an alternative to soil drainage layers due to their superior hydraulic performance obtaining hydraulic conductivities of up to 1-5 cm/s;
- Primary 60-mil thick textured HDPE geomembrane liner in compliance with **19.15.36.17.B(7)**).

See **Attachment D** for a HELP model demonstrating equivalent performance to the prescriptive base line system defined in **19.15.36.14.C**. The modeling was performed in two tiers as directed by the New Mexico Environmental Department guidance document; *Performance Demonstration for an Alternative Cover Design Under Section 502.A.2 of the New Mexico Solid Waste Regulations (20 NMAC 9.1) Using HELP Modeling.* Tier 1 of the modeling first demonstrates the alternative liner's equivalent performance to the prescriptive liner and compliance with maintaining no more than 12-inches over the liner under open cell conditions. Tier 2 of the modeling demonstrates the alternative liner's performance under four operational conditions: open, partially filled, completely filled and closed with no established vegetation, and completely filled and closed with established vegetation. Tier 2 demonstrates that in all conditions no liquids will percolate through the liner and into the subsurface, thus protective of groundwater.

See **Attachment E** for liner design calculations of the following:

- E1 - Foundation and Waste Settlement and resulting tensile stresses on the base liner and final cover systems
- E2 - Tensile Stress due to equipment loading
- E3 - Anchor trench pullout
- E4 - Geocomposite performance under overburden compression

2.8 Leachate and Leak Detection Collection and Recovery System

Landfill

The leachate and leak detection collection and recovery systems follow identical flow paths. Leachate generated from each landfill cell and leaks (if any) through the primary liner will flow through the associated lateral geocomposite drainage layer sloped at a minimum of 2% and directed towards a leachate and leak detection collection sump. The leachate collection system incorporates a perforated six-inch HDPE SDR-11 collection pipe embedded in a gravel trench one foot deep, generally along the cell centerline, with flow towards and terminating in the leachate collection sump.

The leachate collection sumps have a top dimension of 35 feet by 35 feet and are two feet deep with 3H:1V side slopes. The leak detection sumps sit directly below the leachate collection sumps and are a continuation of the leachate sump geometry another two feet deeper. The leachate sump and leak detection sump are separated by the 60-mil HDPE primary geomembrane. Each sump is equipped with an 18-inch HDPE SDR-17 leachate pump side-slope riser pipe, a 6-inch HDPE SDR-11 collection line cleanout riser, and a 12-inch HDPE SDR-17 leak detection witness riser. The riser pipes will be embedded into a side-slope trench for protection of the pipes and the liner system. The risers will daylight at the top of landfill cell slope and be protected by a concrete headwall and capped with blind flanges. The 18-inch riser will be equipped with a submersible pump that will transfer the liquids collected in the sump via a flexible hose to a 4-inch force main/carrier pipe. The force 4-inch main/carrier pipe will transfer the liquids to the on-site leachate evaporation pond. A typical pump cycle stroke that the operator may use is ON at 6-inches, OFF at 20-inches, HIGH ALARM at 22-inchs, and HIGH-HIGH ALARM at 24-inchs. The operator may alter this pump stroke as needed by operations. The HIGH ALARM typically will illuminate a beacon and/or sound an audible alarm until the level drops. The HIGH-HIGH ALARM will be equipped with an auto dialer that will notify the site manager so that the liquid level can be managed and reduced.

Leachate Evaporation Pond

The leak detection collection and recovery system for the leachate evaporation pond will collect leaks (if any) through the primary liner. Liquids collected will flow through the associated lateral geocomposite drainage layer sloped at a minimum of 2% and directly towards a leachate and leak detection collection sump.

The leak detection collection sump has a top dimension of 20-feet by 20-feet and is 2-feet deep with 3H:1V side slopes. The sump is equipped with a 12-inch HDPE SDR-17 leak detection witness riser.

Details I-O of the Permit Drawings in **Appendix K** of the PA depict the general configuration of the leachate and leak detection systems for both the landfill cells and the leachate evaporation pond.

See **Attachment E** for pipe design calculations of the following:

- Leachate Pipe Size and Perforation Design
- Drainage Rock sizing and Bedding Strain
- Pipe Ring Deflection
- HDPE pipe wall buckling under waste compression
- HDPE pipe wall crushing under waste compression

2.9 Final Cover System

Final waste slopes will be no steeper than 4H:1V. A final cover system will be installed over the final waste surface which will include surface-water control berms that will be constructed on the final cover system with approximately 25 ft. of vertical spacing between benches. While the interior of the berms will be 4H:1V, the exterior bench slope will be 3H:1V. The berms will be directed to rip-rap lined let-down structures built into the final cover system. The typical final cover system for the landfill will consist of (from top to bottom):

- A soil erosion/vegetation layer composed of at least 12-inches of vegetated soil, permeability of 1x10-5 cm/s or less. A 70% coverage of at least two native grasses shall be maintained in accor- dance with the post closure provisions of 19.15.36.18.C.2.b. The seed list shall conform to the most recent list from NMDOT Revegetation Zone 5 – Southern Desertic Basins, Plains, and Mountains.
- A compacted soil infiltration barrier layer composed of at least 36-inches of soil with a permeability of 1x10-5 cm/s or less.
- A compacted soil intermediate cover layer composed of at least 12-inches of soil with a permeability of 1x10-5 cm/s or less.

See **Attachment D** for a HELP model demonstrating equivalent performance to the prescriptive base line system defined in **19.15.36.14.C**. The modeling was performed in two tiers as directed by the New Mexico Environmental Department guidance document; *Performance Demonstration for an Alternative Cover Design Under Section 502.A.2 of the New Mexico Solid Waste Regulations (20 NMAC 9.1) Using HELP Modeling.* Tier 1 of the modeling first demonstrates the alternative liner's equivalent performance to the prescriptive liner and compliance with maintaining no more than 12-inches over the liner under open cell conditions. Tier 2 of the modeling demonstrates the alternative liner's performance under four operational conditions: open, partially filled, completely filled and closed with no established vegetation, and completely filled and closed with established vegetation. Tier 2 demonstrates that in all conditions no liquids will percolate through the liner and into the subsurface, thus protective of groundwater. All HELP model simulations assumed that native soils can achieve a compacted hydraulic conductivity of at least $1x10^{-5}$ cm/s based on the permeability testing results of onsite soils presented in **Attachment A of Appendix I** of the Permit Narrative. When approaching a closure selected stockpiles or borrow areas to be used for closure material will be sampled and tested. If testing results in a permeability greater than $1x10^{-5}$ cm/s the alternative cap thickness shall be adjusted accordingly at that time to maintain equivalent performance.

2.10 Slope Stability Analysis

Terracon has performed a comprehensive slope stability analysis of the cell excavation side slopes, base liner configuration, final waste slopes, and final cover system configuration as defined in previous sections. This analysis was performed using Geo-Slope International SLOPE-W® software. In summary, the 3H:1V excavation slope is stable upon placement of the base liner system with a minimum factor of safety of 1.6 in the Phase 2 critical slope. The 4H:1V waste fill slopes and final cover system are stable with a minimum factor of safety of 2.3 on the Phase 2 critical slope. Please see **Attachment G** for a comprehensive slope stability report and summary of modeling results.

3.0 19.15.36 DESIGN COMPLIANCE SUMMARY

The New Mexico design criteria for surface waste management landfills are contained in **19.15.36.14** and the design criteria for leachate evaporation ponds are contained in **19.15.36.17**. The following discussion lists the design criteria contained in these regulations and how the proposed Facility design complies.

Landfill Base Liner Design Requirements:
19.15.36.14.C Landfill Design Specification

As discussed in Sections 2.7 – 2.9, the proposed landfill has been designed with the required components.

19.15.36.14.C(1) Base Layer

As discussed in Section 2.7, due to the absence of suitable clayey materials onsite, and the groundwater setting, NGL proposes an alternative base layer consisting of a reinforced geosynthetic clay liner. Typical GCLs specified for landfill liner systems have hydraulic conductivities less than $1x10^{-9}$ cm/s (EPA 2001).

19.15.36.14.C(2) Lower Geomembrane

As discussed in Section 2.7, the lower membrane shall consist of 60-mil HDPE, in compliance with this regulation.

19.15.36.14.C(3) Leak Detection System

As discussed in Sections 2.6 - 2.8 NGL proposes to install an alternative leak detection system comprised of a 200-mil HDPE geocomposite blanket drainage collection system in lieu of soil and piping as prescribed. HDPE has high chemical resistance to oil field wastes and the leak detection system is sloped at 2% in the lateral direction compliant with this regulation.

19.15.36.14.C(4) Upper Geomembrane

As discussed in Sections 2.7 the upper membrane shall consist of 60-mil HDPE, in compliance with this regulation.

19.15.36.14.C(5) Leachate Collection and Removal System

As discussed in Sections 2.6 - 2.8 NGL proposes to install an alternative leachate collection and removal system comprised of a 200-mil HDPE Geocomposite blanket drainage collection system in lieu of soil and piping as prescribed.

In compliance with this regulation, HDPE is the material proposed for geomembrane and piping, which has high chemical resistance and is proven to withstand attack from oil field wastes. The leachate collection and removal systems are sloped at 2% in the lateral direction. The central collection trench pipe is a perforated 6-inch HDPE pipe, which will be protected by a drainage rock backfill and equipped with a solid cleanout riser embedded into a side slope riser trench. The leachate is collected in a centralized sump and conveyed to a leachate evaporation pond outside of landfill perimeter within a 4-inch double-walled HDPE force main.

19.15.36.14.C(6) Liner Protection Layer

As discussed Section 2.7 the liner system will be overlain with two-feet of protective soil cover with a saturated hydraulic conductivity of $1x10^{-2}$ cm/s or greater, in compliance with this regulation.

Landfill Final Cover System Design Requirements:
19.15.36.14.C(8) Final Cover System

As discussed in Section 2.6, 2.7, and 2.9, the final waste slopes shall not exceed 4H:1V or be less than 4% in compliance with this regulation. The final cover system shall include an alternative final cover system as defined in **Section 2.**

19.15.36.14.C(9) Alternative materials

NGL is proposing the use of reinforced GCL as the base foundation layer in place of two feet of compacted clay and 200-mil HDPE geocomposite in place of high permeability soils for drainage. **Attachment E** provides a demonstration of geocomposite hydraulic performance under these conditions.

19.15.36.14.C(10) External Piping

All leachate and leak detection riser piping will be installed along the side slopes of the cells in compliance with this regulation. Liner penetrations are not proposed.

19.15.36.14.D(1) Liner Specifications and Requirements - Geomembranes

(a) In compliance with this regulation, all geomembranes are specified as 60-mil textured HDPE. HDPE geomembranes have published permeabilities as low as $1x10^{-15}$ cm/s (Webber 2005) and have high chemical resistance with proven resistance to hydrocarbons, salts, acidic and alkaline solutions. HDPE also has a high UV resistance when exposed to sunlight.

(b) As provided in **Attachment E,** the membrane is designed to withstand projected stresses and settling from overlying waste and equipment operations.

(c) As designed, the base liner system maintains a minimum 2% lateral slope to promote positive drainage and to facilitate leachate collection and leak detection.

19.15.36.14.D(2) Liner Specifications and Requirements – Additional Geomembrane Requirements

(a) HDPE geomembranes have published and field proven high chemical resistance with resistance to chemical attack from oil field waste and resulting leachate.

(b) The base liner system has a maximum slope of 3H:1V which has been shown to be stable in the slope stability analysis in **Attachment G,** which considers the soil-geosynthetic and geosynthetic-geosynthetic interface friction angles.

(c) In general, all HDPE liner systems will be installed in compliance with this regulation as specified in the Construction Quality Assurance Plan provided in **Attachment H**.

19.15.36.14.E Requirements for Soil Components

(1) The prepared subgrade for the base liner system will be compacted to at least 90%standard Proctor (ASTM D-698), see **Attachment H**.

(2) All soil surfaces to receive geosynthetics will be prepared in compliance with this regulation, See **Attachment H.**

(3) As previously discussed, NGL proposes to replace the compacted clay foundation layer with a reinforced GCL, thus this regulation is not applicable.

19.15.36.14.F Soil Material Requirements for the Leachate Collection and Recovery System and Leak Detection System

(1) As previously discussed, NGL proposes to replace the prescribed soil drainage materials with a 200-mil HDPE geocomposite designed to ensure that the liner's hydraulic head never exceeds one foot, thus this regulation is not applicable.

19.15.36.14.G Landfill Gas Control System

NGL is not required to, nor is proposing to install a landfill gas control system for this landfill at this time.

Leachate Evaporation Pond (LEP) Construction Standards:
19.15.36.17.A Engineering Design Plan

This EDR includes design information for the LEP and its liner system, which is certified by Michael Bradford, P.E. The overall PA for the Facility incorporates and integrates the LEP operation and maintenance procedures (**Appendices D** and **E** of the PA), closure planning (**Appendix G** of the PA), and hydrologic information (**Appendix I** of the PA). Thus, the overall PA demonstrates compliance with this regulation.

19.15.36.17.B Construction Standards

(1) The LEP has been designed as prescribed in the Regulations, thus protective of fresh water, public health, and the environment.

(2) The proposed LEP is designed with a primary and secondary 60-mil HDPE geomembrane with a leak detection layer between them.

(3) In compliance with this regulation, the primary and secondary liners are specified as 60-mil textured HDPE. HDPE geomembranes have published permeabilities as low as $1x10^{-15}$ cm/s (Webber 2005) and have high chemical resistance with proven resistance to hydrocarbons, salts, acidic and alkaline solutions. HDPE with carbon black also has a high UV resistance when exposed to sunlight.

(4) NGL is proposing to use 200-mil HDPE geocomposite in place of high permeability soils for drainage. **Attachment E** provides a demonstration of geocomposite hydraulic performance under these conditions.

(5) As discussed in Section 2.6 and **Attachment H,** the pond has been designed and will be constructed in compliance with this regulation.

(6) The discharge point of the leachate force main into the pond will be reinforced to protect the liner system from excessive hydrostatic force. No liner penetrations are proposed.

(7) As discussed in Section 2.7 the primary liner shall consist of 60-mil HDPE, in compliance with this regulation.

(8) As discussed in Section 2.7 the secondary liner shall consist of 60-mil HDPE, in compliance with this regulation.

(9) As discussed in Sections 2.6 - 2.8 NGL proposes to install an alternative leak detection system comprised of a 200-mil HDPE geocomposite blanket drainage collection system in lieu of soil and piping as prescribed. HDPE has high chemical resistance to oil field wastes and the leak detection system is sloped at 2% in the lateral direction, compliant with this regulation. Discharge from this pond is not proposed.

(10) Not applicable

(11) The LEP has been designed with 3-feet of freeboard under the worst-case leachate generation condition, See **Attachment C.**

(12) The LEP has a leachate storage capacity of approximately 9.3 acre-feet, in compliance with this regulation which limits the capacity of evaporation ponds to 10 acre-feet.

4.0 REFERENCES

Daniel, D.E. and Estornell P. (1991) “Hydraulic Conductivity of Three Geosynthetic Clay Liners” *Journal of Civil Engineering* 118(10) 2605.

U.S. EPA. 2001. **Geosynthetic Clay Liners Used in Municipal Solid Waste Landfills**. EPA530-F-97-002. Solid Waste and Emergency Response. December.

Weber, C.T., and Zornberg, J.G. (2005). Leakage through Liners under High Hydraulic Heads." Geosynthetics Research and Development in Progress, Eighteenth Geosynthetic Research Institute Conference (GRI-18), Austin, Texas, January 26

Attachment A
Run-on and Run-off Surface Water Management Report

CALCULATIONS BY: Michael P. Bradford, P.E. – Senior Project Manager
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

I. RUN-OFF SURFACE WATER MODELING

MODELING METHOD

Autodesk Storm and Sanitary Analysis 2019 (SSA)

ANALYSIS

A detailed engineering analysis was performed on the components that comprise the stormwater management system for surface water run-off within the facility boundaries. The components analyzed for this permit modification include:

1. Stormwater Let-down Structures
2. Slope Integrated diversion channels
3. Perimeter Ditches
4. Stormwater Ponds

As required by ***NMAC 19.15.36***, the hydrologic analysis was performed utilizing a 25-year, 24-hour rainfall event. SSA was utilized to perform the engineering analysis to assure compliance with the above regulations. The analysis was performed for the post development conditions of the Facility. This is considered to be a conservative approach for the design capacity of the stormwater pond and other conveyance features.

SSA was utilized to illustrate the capacity of the stormwater let-down structures, slope integrated berms, and perimeter ditches. These results were generated to assure that the conveyance parameters of stormwater design elements are adequate.

PARAMETERS USED IN THE ANALYSES

The following are the lists of parameters that were considered for stormwater management:

Based on ***NMAC 19.15.36,*** a 25-year, 24-hour rainfall event was considered for design of the proposed landfill permit area. The proposed disposal area was first segregated into 69 sub-basins, 99 nodes, and 102 links, then the areas were determined. It was concluded that the Landfill would fall into the Type II rainfall distribution as published by the Nation Resource Conservation Service (NRCS). The 25-year, 24-hour rainfall data for Lea

County was available within the SSA. The EPA SWMM hydrology method was used due to its flexibility, such as allowances for existing soil moisture and evaporation.

For each element in the design, the following parameters, if applicable, were input or calculated using the SSA software and dialogue box selections, typical values or site design information:

- Run-off Curve Number
  - Data gathered from NRCS Web Soil Survey and TR-55 Tables
    - Ratliff-Wink Fine Sandy Loams and Kermit-Palomas Fine Sands.
      - Hydraulic Soil Group B.
    - CN = 86 from Table 2-2a of the TR-55 Manual for "Newly Graded, Pervious Areas, No Vegetation"
- Area (Ac);
  - Automatically calculated based on site design
- Impervious Area (%);
  - 0% assumed globally this site is not expected to have significant areas of pavement
- Drying Time (days);
  - 2 days assumed globally
- Average Slope (%);
  - 1% for side slope berms
  - 1.5% min for perimeter channels
  - 4 horizontal to 1 vertical for waste side slopes
  - 4% waste top deck
  - 0.5% for entrance/admin/staging area
- Equivalent Width (ft)
  - Critical flow path as determined by site design
- Pervious Area Manning's Roughness, taken from SSA databases;
  - 0.22 for Landfill – "poor grass cover, moderately rough surface"
  - 0.15 for Entrance/Admin/Staging area – "Gravel"
  - 0.35 for Let-down Structures, "rip-rap"
- Link Invert Information (elevation)
  - Taken from site design
- Link Cross Section
  - V-ditch for all side slope diversion channels
  - Trapezoidal ditch for all let-down structures and perimeter ditches
  - Circular for all culverts

SUMMARY OF RESULTS

Stormwater Let-down Structures

Four (4) stormwater let-down structures are planned for the final landfill configuration, beginning with let-down structure 1 in the northeast landfill face of the finished landfill and distributed clockwise around the landfill to let-down structure 4 on the northwest face of the landfill. Each of these let-down structures has been designed with a 10-foot bottom width, 2' depth, 3:1 side slopes, and 25% flowline slope. The flow capacity of these let-down structures is approximately 850 cubic feet per second (cfs). The SSA calculated maximum peak flow values from a 25-year, 24-hour rainfall event for lower most design segments of the let-down structures range from 150 CFS to 280 cfs. The SSA generated output tables for the stormwater analysis can be found in **Exhibit A.2, also see Figures depicting links, junctions, basins, and storage nodes for visual reference in Exhibit A.1**.

Slope Integrated Berms

The landfill slope integrated berms were designed assuming that the berms would collect and transfer the entire area of each let-down sub-basin run-off volume. With this assumption, the maximum flow to be carried in a slope integrated berm is ~24 cubic feet per second (cfs). Each let-down has at least seven slope integrated berms with contributing drainage areas varying in size. The slope integrated berms will be sloped at 1 percent and have a depth of 1.5-feet, providing a maximum flow capacity of approximately ~42 cfs. The side slopes of the berms will be 4:1 (using the 4:1 final cover system of the landfill for the interior side) and 3H:1V on the exterior slope.

Perimeter Ditches

The perimeter channels along the west, south, and north sides have been designed with a 10-foot bottom width, 3-foot depth, 4:1 side slopes, and a flowline slope of 1.5% minimum. The perimeter channel along the east side has been designed with a 6-foot bottom width, 3-foot depth and 4:1 side slopes.

- West Ditch (Link 9 and Link 28)
  - Design Capacity ~415 cfs
  - Peak Flow during design storm ~304 cfs
- South Ditch – 1 (Link 48)
  - Design Capacity ~585 cfs
  - Peak Flow during design storm ~14 cfs
- South Ditch – 2 (Link 51)
  - Design Capacity ~400 cfs
  - Peak Flow during design storm ~34 cfs
- East Ditch (Link 18 and Link 50)
  - Design Capacity ~310 cfs
  - Peak Flow during design storm ~297 cfs
- Northeast Ditch (Link 26 and Link 49)

- Design Capacity ~395 cfs
- Peak Flow during design storm ~196 cfs

- Northwest Ditch (Link 27)
  - Design Capacity ~714 cfs
  - Peak Flow during design storm ~553 cfs

See **Exhibit A.1** for results

Culverts

Each of the perimeter ditches must transition through a culvert below the main access/haul roads prior to entering one of the three retention ponds. Culverts are size to flow approximately half full at peak discharge. To minimize entrance losses and surcharging, the culverts will be installed with approximately half of the pipe installed below the flow line of the channel. The following is a summary of the culverts proposed:

- Northeast Culvert (Link 99)
  - 3 barrel, 36-inch concrete pipe
  - Design Flow = 223 cfs
  - Peak Flow during design storm = 164 cfs
- Northwest Culvert (Link 100)
  - 3 barrel, 36-inch concrete pipe
  - Design Flow = 222 cfs
  - Peak Flow during design storm = 195 cfs
- East Culvert (Link 40)
  - 2 barrel, 48-inch concrete pipe
  - Design Flow = 375 cfs
  - Peak Flow during design storm = 297 cfs
- Southeast Culvert (Link 39)
  - 2 barrel, 36-inch concrete pipe
  - Design Flow = 204 cfs
  - Peak Flow during design storm = 34 cfs
- Southwest Culvert (Link 38)
  - 2 barrel, 24-inch concrete pipe
  - Design Flow = 55 cfs
  - Peak Flow during design storm = 13 cfs
- West Culvert (Link 37)
  - 2 barrel, 48-inch concrete pipe
  - Design Flow = 350 cfs
  - Peak Flow during design storm = 304 cfs

Stormwater culvert sizing is presented in **Exhibit A.1, also see Figures depicting links, junctions, basins, and storage nodes for visual reference**.

Stormwater/Sedimentation Ponds

The facility will be required to hold the run-off from a 25-year, 24-hour storm. As shown in **Exhibit A.2,** the three proposed ponds will provide sufficient capacity to retain the entire run-off volume from their associated contributing basins from the 25-year, 24-hour storm event. Each pond has been size to be 10-feet deep with 3:1 side slopes in order to maximize borrow soil generation. These ponds will each have a minimum of 3' freeboard, and some additional capacity in the case that the pond is retaining some liquids already at the time of the design storm event.

II. RUN-ON SURFACE WATER MODELING

MODELING METHOD

USDA, NRCS, Technical Release 55 (TR-55) via Microsoft Excel Spreadsheet

ANALYSIS

A detailed engineering analysis was performed on the stormwater run-on management system. The run-on area is assumed to flow perpendicularly to the Northwest permit boundary. Thus a stormwater run-on diversion channel is proposed along the north boundary that will intercept run-on flow and divert it around the north east and southwest permit boundary corners. Once the flow has passed these corners, the diversion channel will daylight and allow the collected stormwater run-on to dissipate to native ground. The components analyzed for this permit modification include:

1. Run-on Control Diversion Ditch

As required by ***NMAC 19.15.36***, the hydrologic analysis was performed utilizing a 25-year, 24-hour rainfall event. TR-55 manual was utilized to perform the engineering analysis to assure compliance with the above regulations. The analysis was performed for the undeveloped current conditions of the assumed run-on area. This is considered to be a conservative approach for the design capacity of the stormwater pond and other conveyance features.

TR-55 modeled through Microsoft Excel spreadsheet was utilized to illustrate the capacity of the run-on control ditch. These results were generated to assure that the conveyance parameters of stormwater design elements are adequate.

PARAMETERS USED IN THE ANALYSIS

Stormwater Run-on Drainage Basin

The assumed stormwater run-on contributing drainage basin is bound by the Northwest permit boundary and the Highway 128 North of the site. The stormwater run-on contributing drainage basin is approximately 5,555 acres in size. See Figure 1A for a map of the approximated run-on drainage area.

Overland Gradient

It is determined based on USGS Quadrangle Maps and site-specific topographic survey of this facility that the natural surface water gradient is Northwest to Southeast at 0.9%.

Run-off Curve Number

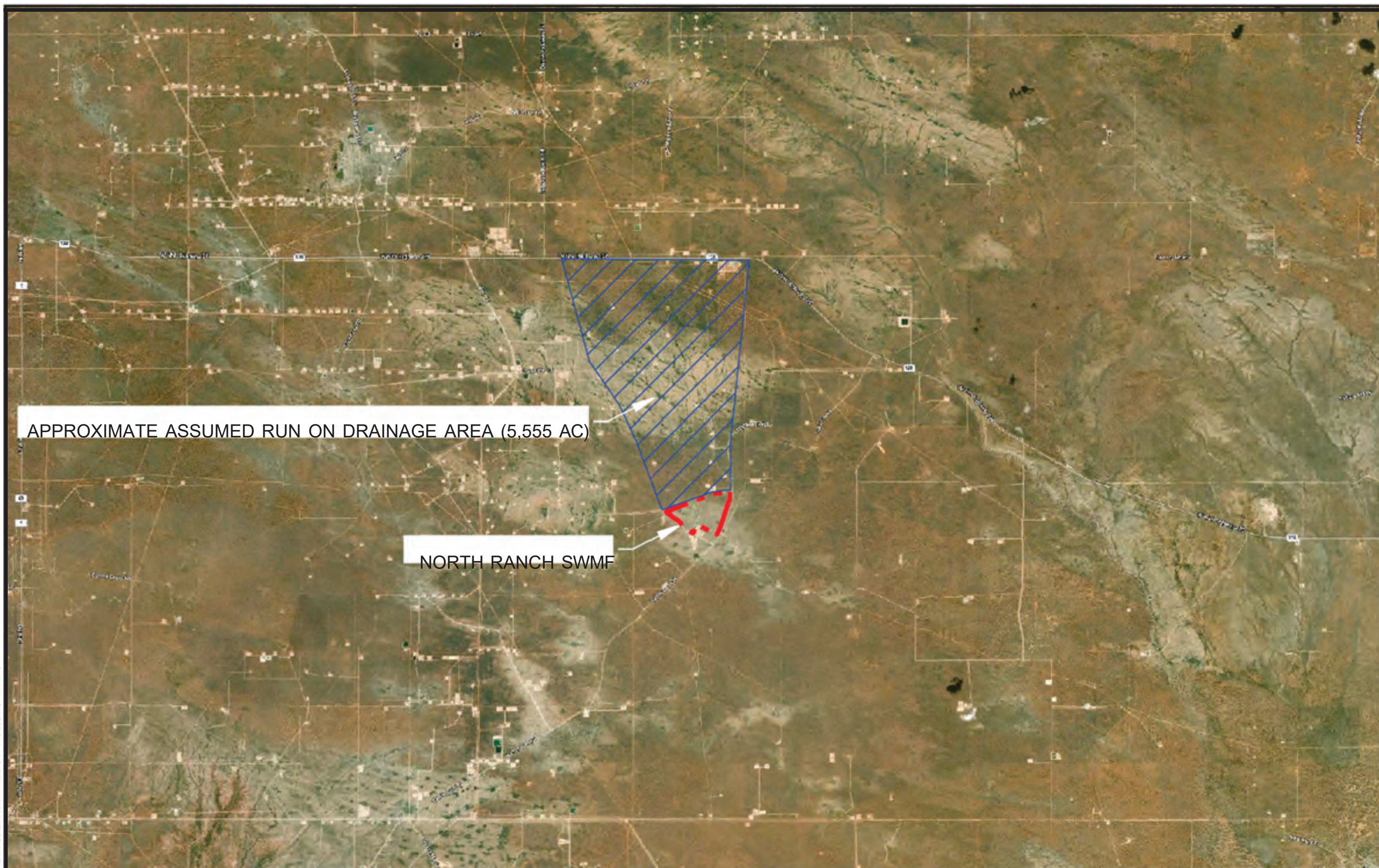
A composite curve number (CN) was generated using the approximate assumed run-on drainage area, and hydraulic soil group, CN information, and approximate areas as calculated using the NRCS web soil survey. Using this information, a composite CN of 42 was calculated for the assumed run-on control area.

SUMMARY OF RESULTS

The TR-55 calculation summarized in **Exhibit A.3** demonstrates that a run-on diversion channel with a 7-foot bottom width, 2 feet deep, with 3:1 side slopes will control the peak discharge from a 25-year, 24-hour storm event from the run-on drainage basin.

In general, a channel with these dimensions, with a traverse slope of 0.1% will have a design capacity of 67cfs. The peak flow from the run-on drainage basin is 132 cfs. However, this flow is split and diverted north and south, thus each channel must have a design capacity of 66 cfs. The proposed run-on diversion ditch will also provide an additional 0.3-feet of freeboard.

Figure A-1
Approximate Run-on Drainage Basin Map



N:\GECARCHIVE\CAD\35187378\PERMIT TEXT FIGURES\STORMWATER\FIG 1 - SITE LOCATION MAP.DWG

REV.	DATE	BY	DESCRIPTION

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APPROXIMATE RUN-ON DRAINAGE BASIN MAP
PERMIT APPLICATION FIGURE
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIG. A-1

DESIGNED BY:	-
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	1" = 100'
DATE:	SEPTEMBER 2019
JOB NO.	35187378
ACAD NO.	572/002
SHEET NO.:	1 OF 1

PROJECT: North Ranch Surface Waste Management Permit Application– Run-on and Run-off Surface Water Management

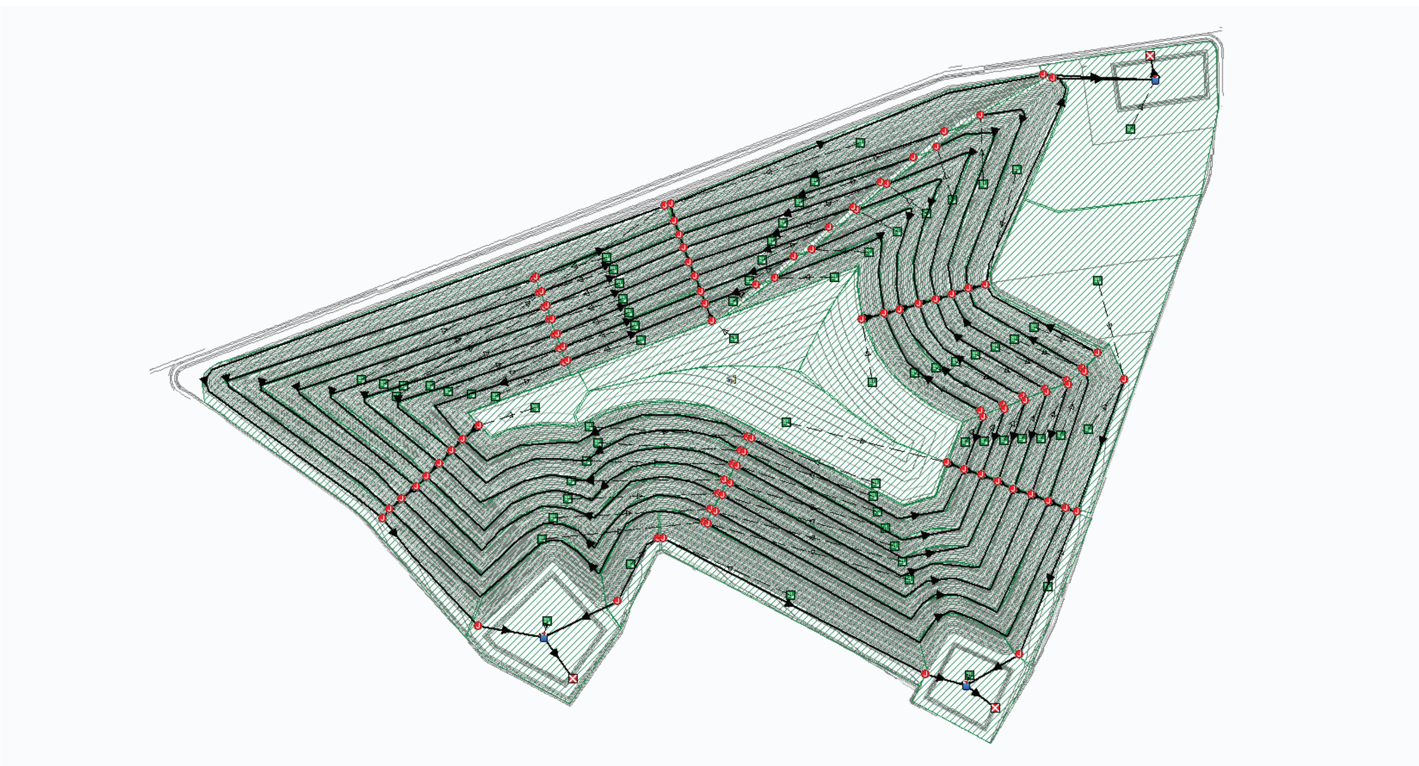
PAGE: A of 7

JOB NO.: 35187378 DATE: September 2019 COMP. BY: MPB CHECKED BY: FOC

Exhibit A.1
Run-off Design Figures

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

03-19-2019

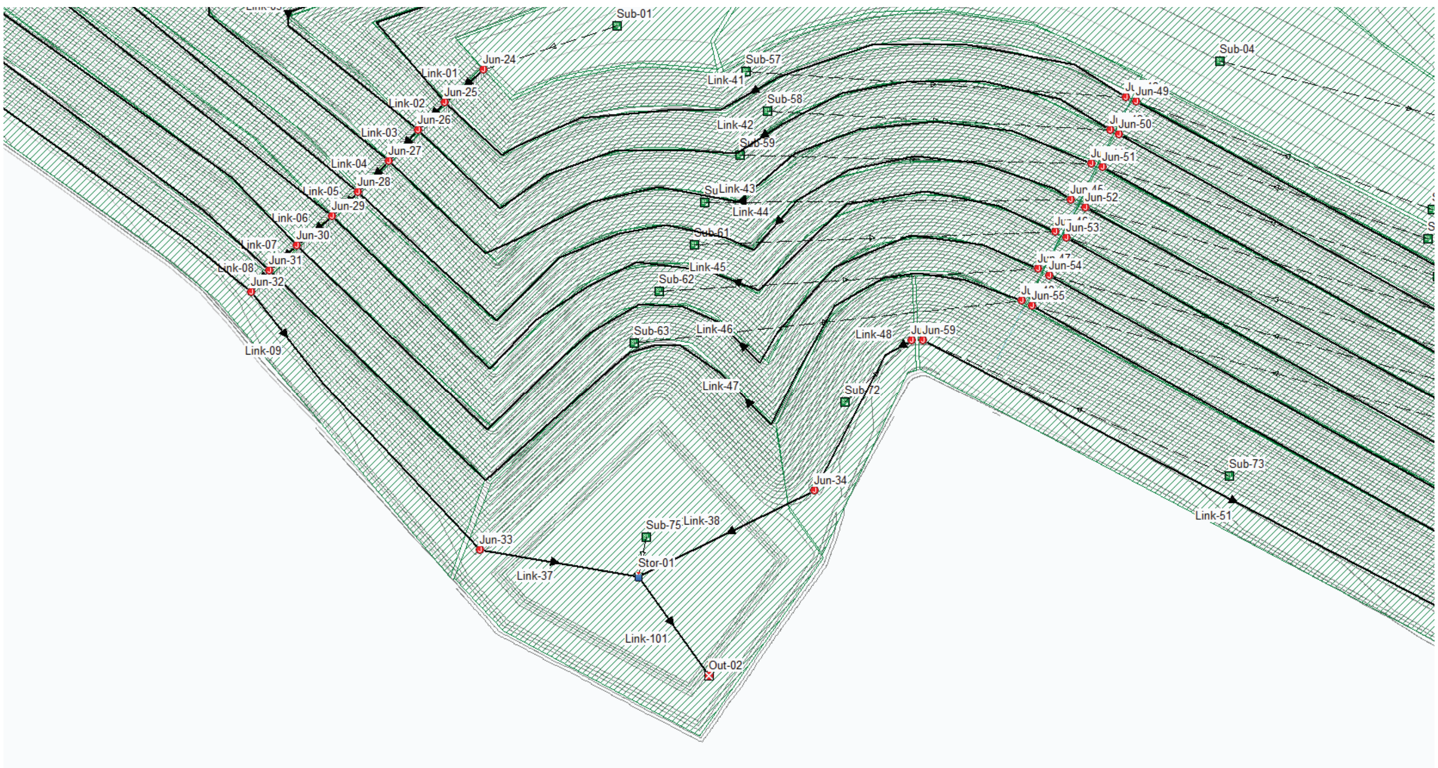


Autodesk Storm and Sanitary Analysis

FIGURE 1 - WHOLE SITE

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

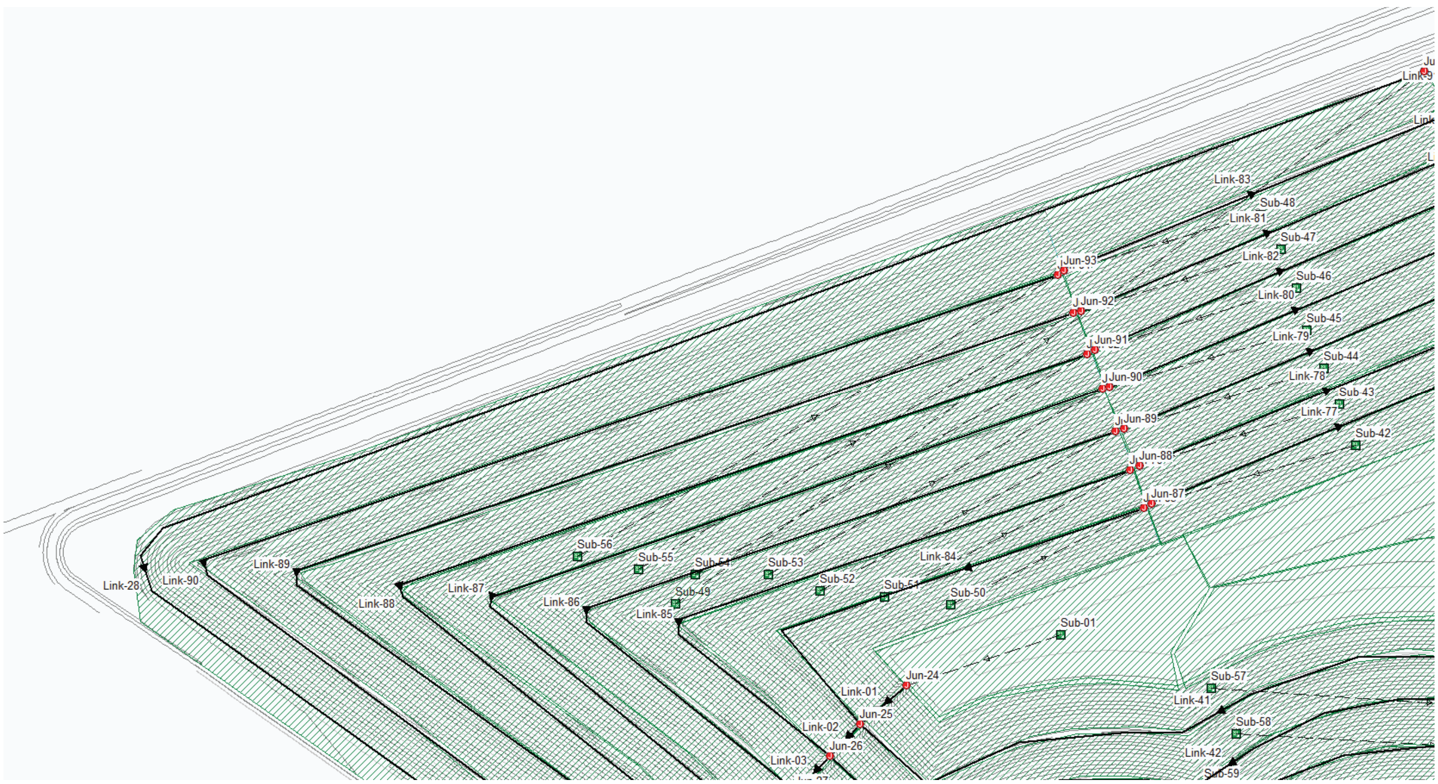
03-19-2019



Autodesk Storm and Sanitary Analysis

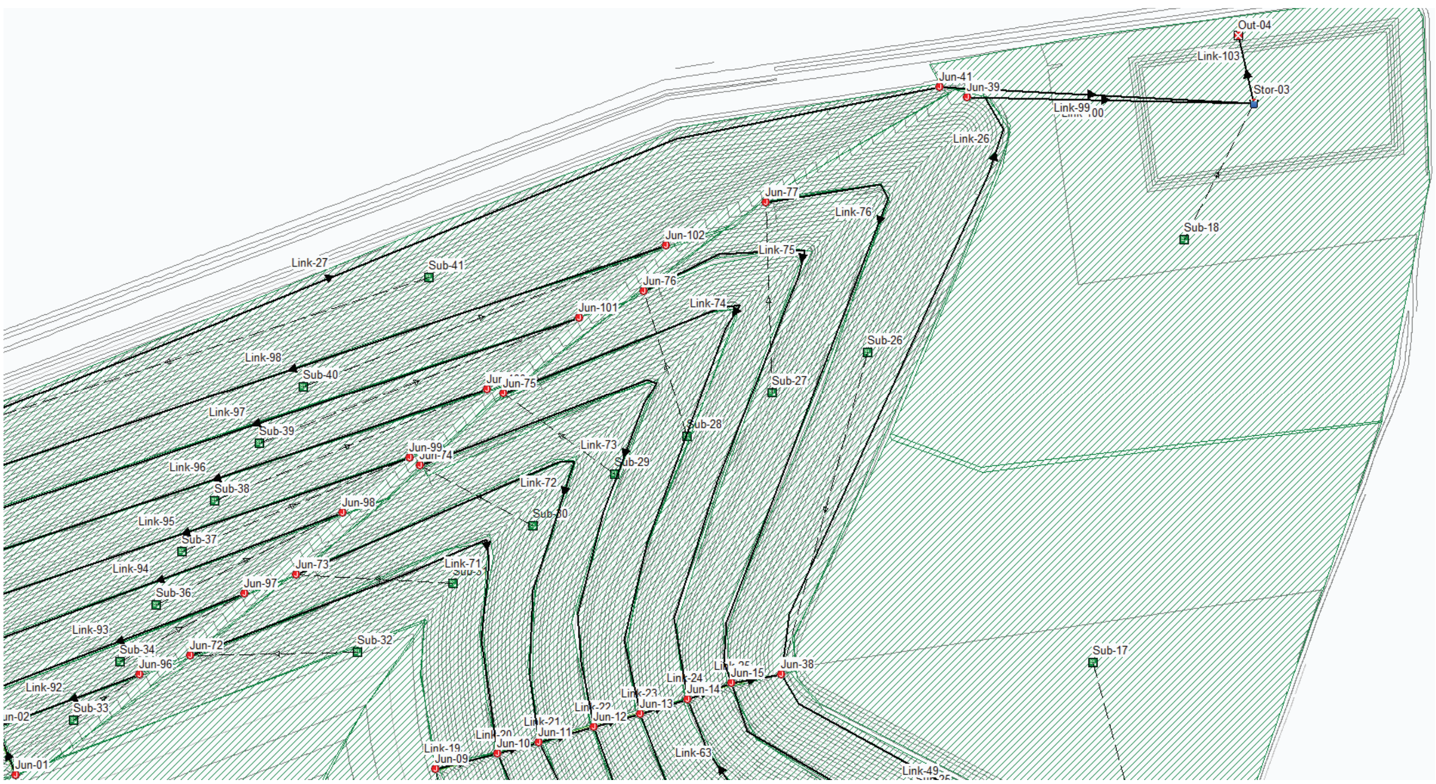
FIGURE 2 - SE END PH 2

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY 03-19-2019



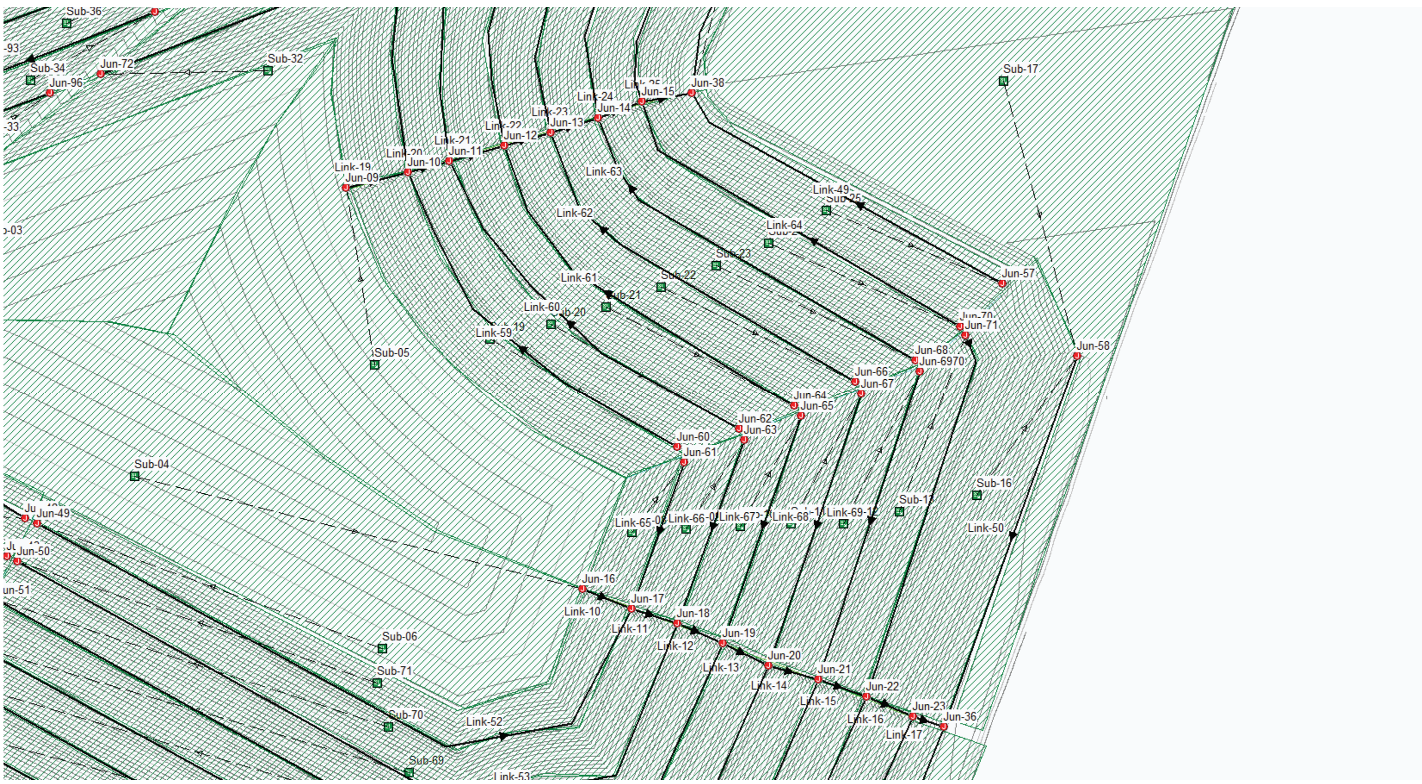
Autodesk Storm and Sanitary Analysis FIGURE 3 - NE END PH 2

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY 03-19-2019



Autodesk Storm and Sanitary Analysis FIGURE 4 - NE END PH1

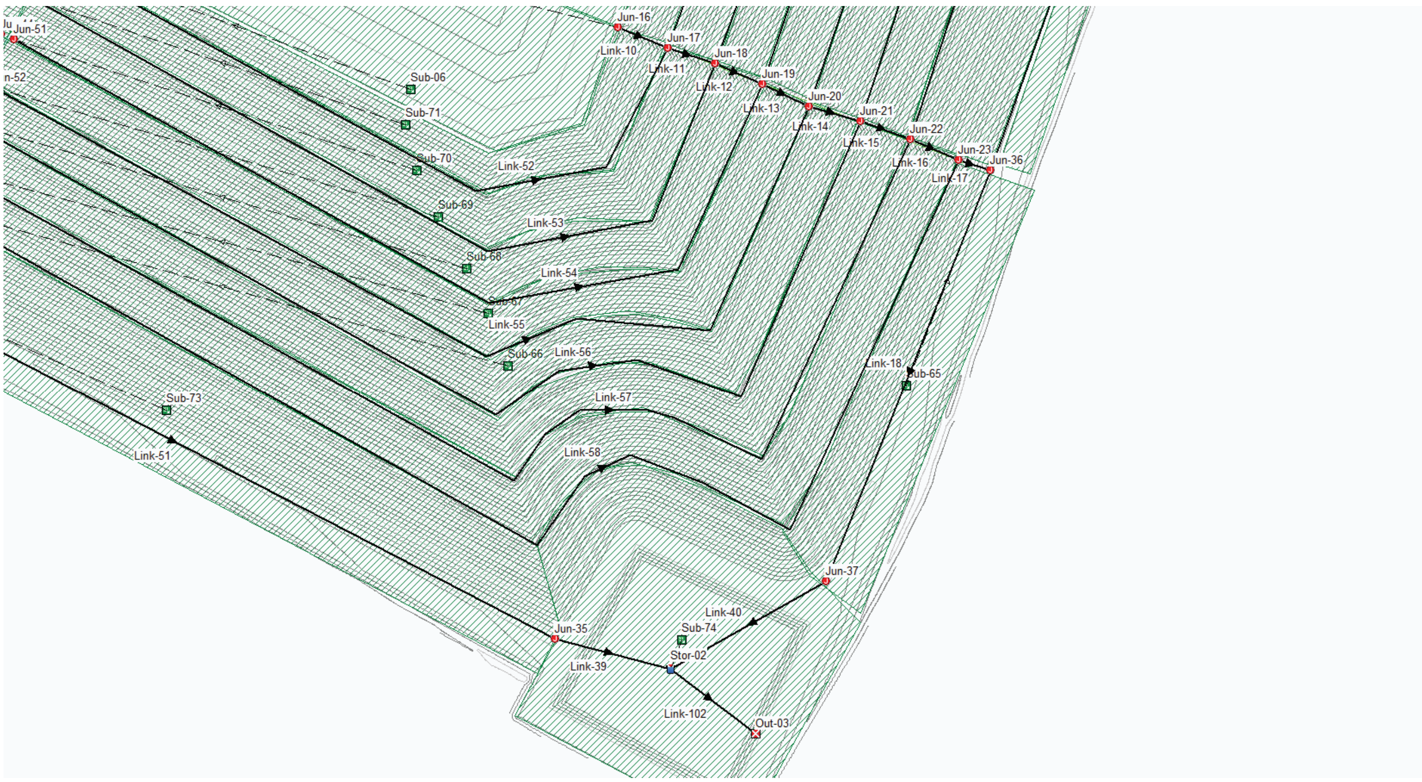
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY 03-19-2019



Autodesk Storm and Sanitary Analysis FIGURE 5 - EAST PH1

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

03-19-2019



Autodesk Storm and Sanitary Analysis

FIGURE 6 - SE PH1

Terracon

PROJECT: North Ranch Surface Waste Management Permit Application– Run-on and Run-off Surface Water Management

PAGE: A of 7

JOB NO.: 35187378 DATE: September 2019 COMP. BY: MPB CHECKED BY: FOC

Exhibit A.2
Run-off Design Results
Storm and Sanitary Analysis Results

SN	Element ID	Description	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Pipe Width (inches)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	Lengthening Factor	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged (min)	Max Flow Depth (ft)	Reported Condition
1	Link-100		64	Stor-03	576.94	3342.70	0.00	3333.20	0.00	9.50	1.6500	CIRCULAR	36.000	36.00	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	194.92	0 12:09	11.90	0.81	222.53	0.88	0.73	0.00	2.14	Calculated
2	Link-37		64	Stor-01	375.70	3330.40	0.00	3323.00	0.00	7.40	1.9700	CIRCULAR	48.000	48.00	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	303.60	0 12:11	15.68	0.40	349.43	0.87	0.72	0.00	2.85	Calculated
3	Link-38		64	Stor-01	459.60	3332.00	0.00	3323.00	0.00	9.00	1.9600	CIRCULAR	20.040	20.04	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	13.25	0 12:02	7.30	1.05	33.74	0.39	0.44	0.00	0.70	Calculated
4	Link-39		64	Stor-02	233.95	3328.30	0.00	3321.00	0.00	7.30	3.1200	CIRCULAR	20.040	20.04	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	33.74	0 12:09	10.84	0.36	42.60	0.79	0.67	0.00	1.12	Calculated
5	Link-40		64	Stor-02	348.09	3328.90	0.50	3321.00	0.00	7.90	2.2700	CIRCULAR	48.000	48.00	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	297.37	0 12:08	16.57	0.35	375.09	0.79	0.67	0.00	2.63	Calculated
6	Link-99		64	Stor-03	632.04	3343.60	0.00	3333.20	0.00	10.40	1.6500	CIRCULAR	36.000	36.00	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	163.61	0 12:11	11.54	0.91	222.45	0.74	0.64	0.00	1.90	Calculated

SN	Element ID	Description	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Channel Type	Channel Height	Channel Width	Left Overbank Manning's Roughness	Channel Manning's Roughness	Right Overbank Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate	Lengthening Factor	Peak Flow	Time of Peak Flow Occurrence	Max Flow Velocity	Travel Time	Design Flow Capacity	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged	Max Flow Depth	Reported Condition
					(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(ft)	(ft)							(cfs)			(cfs)	(days hh:mm)	(ft/sec)	(min)	(cfs)			(min)	(ft)	
1	Link-01		64	64	120.88	3527.50	0.00	3495.50	0.00	32.00	26.4700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	12.86	0 12:00	6.75	0.30	880.17	0.01	0.09	0.00	0.18	Calculated
2	Link-02		64	64	88.42	3495.50	0.00	3471.70	0.00	23.80	26.9200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	34.62	0 12:05	9.75	0.15	887.52	0.04	0.16	0.00	0.32	Calculated
3	Link-03		64	64	99.97	3471.70	0.00	3447.80	0.00	23.90	23.9100	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	69.88	0 12:07	12.02	0.14	836.43	0.08	0.25	0.00	0.50	Calculated
4	Link-04		64	64	102.50	3447.80	0.00	3423.90	0.00	23.90	23.3200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	101.11	0 12:07	13.52	0.13	826.04	0.12	0.31	0.00	0.62	Calculated
5	Link-05		64	64	83.29	3423.90	0.00	3401.60	0.00	22.30	26.7700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	134.26	0 12:07	15.55	0.09	885.16	0.15	0.36	0.00	0.69	Calculated
6	Link-06		64	64	106.97	3401.60	0.00	3375.90	0.00	25.70	24.0300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	167.57	0 12:08	16.11	0.11	838.50	0.20	0.42	0.00	0.81	Calculated
7	Link-07		64	64	87.17	3375.90	0.00	3353.30	0.00	22.60	25.9300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	238.39	0 12:08	18.50	0.08	871.04	0.27	0.50	0.00	0.98	Calculated
8	Link-08		64	64	65.76	3353.30	0.00	3334.90	0.00	18.40	27.9800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	279.75	0 12:09	19.96	0.05	904.89	0.31	0.53	0.00	1.06	Calculated
9	Link-09		64	64	808.14	3334.90	0.00	3330.40	0.00	4.50	0.5600	Trapezoidal	3.000	34.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	303.85	0 12:11	5.94	2.27	415.80	0.73	0.86	0.00	2.57	Calculated
10	Link-10		64	64	105.66	3527.50	0.00	3498.00	0.00	29.50	27.9200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	69.95	0 12:00	12.64	0.14	903.90	0.08	0.24	0.00	0.48	Calculated
11	Link-101		Stor-01	Out-02	40.00	3333.00	10.00	3330.00	0.00	3.00	7.5000	Trapezoidal	3.000	58.00	0.0000	0.0320	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	0.00	0 00:00	0.00		3436.82	0.00	0.00	0.00	0.00	Calculated
12	Link-102		Stor-02	Out-03	207.25	3331.00	10.00	3328.00	0.00	3.00	1.4500	Trapezoidal	3.000	58.00	0.0000	0.0320	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	0.00	0 00:00	0.00		1509.87	0.00	0.00	0.00	0.00	Calculated
13	Link-103		Stor-03	Out-04	139.10	3343.20	10.00	3340.20	0.00	3.00	2.1600	Trapezoidal	4.000	72.00	0.0000	0.0320	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	0.00	0 00:00	0.00		3226.20	0.00	0.00	0.00	0.00	Calculated
14	Link-11		64	64	97.41	3498.00	0.00	3473.00	0.00	25.00	25.6600	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	80.38	0 12:00	12.91	0.13	866.63	0.09	0.27	0.00	0.53	Calculated
15	Link-12		64	64	100.65	3473.00	0.00	3448.00	0.00	25.00	24.8400	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	94.85	0 12:01	13.51	0.12	852.57	0.11	0.30	0.00	0.59	Calculated
16	Link-13		64	64	100.50	3448.00	0.00	3423.00	0.00	25.00	24.8800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	112.58	0 12:02	14.31	0.12	853.21	0.13	0.33	0.00	0.64	Calculated
17	Link-14		64	64	105.53	3423.00	0.00	3398.00	0.00	25.00	23.6900	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	133.13	0 12:03	14.88	0.12	832.62	0.16	0.37	0.00	0.73	Calculated
18	Link-15		64	64	102.02	3398.00	0.00	3373.00	0.00	25.00	24.5000	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	155.39	0 12:04	15.83	0.11	846.83	0.18	0.40	0.00	0.79	Calculated
19	Link-16		64	64	102.31	3373.00	0.00	3348.00	0.00	25.00	24.4400	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	179.79	0 12:07	16.58	0.10	845.62	0.21	0.43	0.00	0.86	Calculated
20	Link-17		64	64	65.85	3348.00	0.00	3333.30	0.50	14.70	22.3200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	200.85	0 12:07	16.65	0.07	808.25	0.25	0.47	0.00	0.93	Calculated
21	Link-18		64	64	864.47	3332.80	0.00	3328.40	0.00	4.40	0.5100	Trapezoidal	3.000	30.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	297.54	0 12:08	5.83	2.47	308.70	0.96	0.98	0.00	2.92	Calculated
22	Link-19		64	64	128.77	3527.50	0.00	3492.95	0.00	34.55	26.8300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	38.96	0 12:00	10.19	0.21	886.10	0.04	0.17	0.00	0.35	Calculated
23	Link-20		64	64	86.14	3492.95	0.00	3468.80	0.00	24.15	28.0400	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	60.14	0 12:02	12.02	0.12	905.78	0.07	0.22	0.00	0.43	Calculated
24	Link-21		64	64	115.25	3468.80	0.00	3444.60	0.00	24.20	21.0000	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	79.62	0 12:02	12.04	0.16	783.89	0.10	0.28	0.00	0.56	Calculated
25	Link-22		64	64	95.83	3444.60	0.00	3420.40	0.00	24.20	25.2500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	100.53	0 12:03	13.85	0.12	859.65	0.12	0.31	0.00	0.61	Calculated
26	Link-23		64	64	100.32	3420.40	0.00	3396.20	0.00	24.20	24.1200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	122.61	0 12:03	14.57	0.11	840.20	0.15	0.35	0.00	0.69	Calculated
27	Link-24		64	64	94.59	3396.20	0.00	3372.70	0.00	23.50	24.8400	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	144.28	0 12:03	15.52	0.10	852.66	0.17	0.38	0.00	0.75	Calculated
28	Link-25		64	64	101.09	3372.70	0.00	3349.20	0.00	23.50	23.2500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	167.57	0 12:04	15.94	0.11	824.80	0.20	0.42	0.00	0.84	Calculated
29	Link-26		64	64	1297.91	3349.20	0.00	3342.70	0.00	6.50	0.5000	Trapezoidal	3.000	34.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	195.17	0 12:08	5.36	4.04	394.32	0.49	0.71	0.00	2.11	Calculated
30	Link-27		64	64	2239.31	3354.40	0.00	3343.60	0.00	10.80	0.4800	Trapezoidal	4.000	42.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	163.94	0 12:10	5.37	6.95	716.40	0.23	0.48	0.00	1.90	Calculated
31	Link-28		64	64	4070.59	3354.40	0.00	3334.90	0.00	19.50	0.4800	Trapezoidal	3.000	34.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	34.06	0 12:17	3.39	20.01	385.66	0.09	0.28	0.00	0.83	Calculated
32	Link-29		64	64	104.08	3527.50	0.00	3497.50	0.00	30.00	28.8200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	28.28	0 12:06	9.26	0.19	918.42	0.03	0.14	0.00	0.28	Calculated
33	Link-30		64	64	73.45	3497.50	0.00	3476.90	0.00	20.60	28.0500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	38.91	0 12:06	10.30	0.12	905.95	0.04	0.17	0.00	0.34	Calculated
34	Link-31		64	64	90.85	3476.90	0.00	3456.30	0.00	20.60	22.6700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	51.28	0 12:04	10.61	0.14	814.59	0.06	0.21	0.00	0.43	Calculated
35	Link-32		64	64	86.06	3456.30	0.00	3435.70	0.00	20.60	23.9400	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	67.05	0 12:04	11.86	0.12	836.95	0.08	0.25	0.00	0.49	Calculated
36	Link-33		64	64	86.06	3435.70	0.00	3416.40	0.00	19.30	22.4300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	83.47	0 12:03	12.51	0.11	810.11	0.10	0.28	0.00	0.57	Calculated
37	Link-34		64	64	78.65	3416.40	0.00	3394.00	0.00	22.40	28.4800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	101.47	0 12:04	14.46	0.09	912.94	0.11	0.30	0.00	0.59	Calculated
38	Link-35		64	64	81.77	3394.00	0.00	3374.60	0.00	19.40	23.7300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	121.43	0 12:04	14.45	0.09	833.24	0.15	0.35	0.00	0.69	Calculated
39	Link-41		64	64	1723.57	3514.90	0.00	3495.50	0.00	19.40	1.1300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	14.28	0 12:08	4.59	6.26	42.51	0.34	0.65	0.00	0.97	Calculated
40	Link-42		64	64	1797.17	3492.00	0.00	3471.70	0.00	20.30	1.1300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	15.92	0 12:08	4.67	6.41	42.59	0.37	0.68	0.00	1.01	Calculated
41	Link-43		64	64	1836.80	3468.70	0.00	3447.80	0.00	20.90	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	17.50	0 12:08	4.73	6.47	42.74	0.41	0.70	0.00	1.05	Calculated
42	Link-44		64	64	1967.89	3446.00	0.00	3423.90	0.00	22.10	1.1200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	17.77	0 12:08	4.75	6.90	42.46	0.42	0.71	0.00	1.06	Calculated
43	Link-45		64	64	2033.88	3424.30	0.00	3401.60	0.00	22.70	1.1200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	16.40	0 12:08	4.72	7.18	42.33	0.39	0.68	0.00	1.02	Calculated
44	Link-46		64	64	2205.75	3400.20	0.00	3375.90	0.00	24.30	1.1000	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	20.60	0 12:09	4.83	7.61	42.06	0.49	0.75	0.00	1.12	Calculated
45	Link-47		64	64	2345.80	3379.00	0.00	3353.30	0.00	25.70	1.1000	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	19.44	0 12:09	4.81	8.13	41.94	0.46	0.73	0.00	1.09	Calculated
46	Link-48		64	64	429.05	3336.70	0.00	3332.00	0.00	4.70	1.1000	Trapezoidal	3.000	34.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	13.36	0 12:01	2.89	2.47	583.20	0.02	0.13	0.00	0.40	Calculated
47	Link-49		64	64	741.37	3352.90	0.00	3349.20	0.00	3.70	0.5000	Trapezoidal	3.000	34.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.92	0 12:04	2.37	5.21	393.64	0.03	0.15	0.00	0.44	Calculated
48	Link-50		64	64	792.86	3336.75	0.00	3332.80	0.00	3.95	0.5000	Trapezoidal	3.000	30.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	84.55	0 12:07	4.26	3.10	305.41	0.28	0.55	0.00	1.64	Calculated
49	Link-51		64	64	1661.72	3336.70	0.00	3328.30	0.00	8.40	0.5100	Trapezoidal	3.000	34.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	33.76	0 12:09	3.37	8.22	396.17	0.09	0.27	0.00	0.81	Calculated
50	Link-52		64	64	1455.37	3514.90	0.00	3498.00	0.00	16.90	1.1600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.62	0 12:07	4.39	5.53	43.18	0.25	0.58	0.00	0.87	Calculated
51	Link-53		64	64	1667.38	3492.00	0.00	3473.00	0.00	19.00	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	15.17	0 12:08	4.61	6.03	42.77	0.35	0.66	0.00	1.00	Calculated
52	Link-54		64	64	1830.27	3468.70	0.00	3448.00	0.00	20.70	1.1300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	16.97	0 12:08	4.71	6.48	42.61	0.40	0.69	0.00	1.04	Calculated
53	Link-55		64	64	2025.36	3446.00	0.00	3423.00	0.00	23.00	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	18.10	0 12:08	4.79	7.05	42.70	0.42	0.71	0.00	1.06	Calculated
54	Link-56		64	64	2275.01	3424.30	0.00	3398.00	0.00	26.30	1.1600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	19.33	0 12:09	4.89	7.75	43.08	0.45	0.72	0.00	1.08	Calculated
55	Link-57		64	64	2512.72	3400.20	0.00	3373.00	0.00	27.20	1.0800	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	20.76	0 12:09	4.82	8.69	41.69	0.50	0.75	0.00	1.11	Calculated
56	Link-58		64	64	2758.84	3379.00	0.00	3348.00	0.00	31.00	1.1200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	23.37	0 12:10	4.96	9.27	42.48	0.55	0.78	0.00	1.15	Calculated
57	Link-59		64	64	801.43	3503.10	0.00	3492.95	0.00	10.15	1.2700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.35	0 12:03	3.95	3.38	45.10	0.23	0.57	0.00	0.85	Calculated
58	Link-60		64	64	813.64	3479.00	0.00	3468.80	0.00	10.20	1.2500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	9.00	0 12:03	3.88	3.50	44.87	0.20	0.55	0.00	0.81	Calculated
59	Link-61		64	64	812.50	3454.90	0.00	3444.60	0.00	10.30	1.2700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	9.37	0 12:03	3.91	3.46	45.12	0.21	0.55	0.00	0.82	Calculated
60	Link-62		64	64	820.78	3430.70	0.00	3420.40	0.00	10.30	1.2500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	9.48	0 12:03	3.91	3.50	44.89	0.21	0.56	0.00	0.82	Calculated
61	Link-63		64	64	827.27	3406.60	0.00	3396.20	0.00	10.40	1.2600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	9.28	0 12:03	3.91	3.53	44.93	0.21	0.55	0.00	0.81	Calculated
62	Link-64		64	64	807.16	3382.90	0.00	3372.70	0.00	10.20	1.2600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	9.29	0 12:03	3.90	3.45	45.05	0.21	0.55	0.00	0.81	Calculated
63	Link-65		64	64	312.43	3503.10	0.00	3498.00	0.00	5.10	1.6300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	3.39	0 12:01	2.94	1.77	51.20	0.07	0.36	0.00	0.54	Calculated
64	Link-66		64	64	393.21	3479.00	0.00	3473.00	0.00	6.00	1.5300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	4.51	0 12:01	3.12	2.10	49.50	0.09	0.41	0.00	0.61	Calculated
65	Link-67		64	64	484.40	3454.90	0.00	3448.00	0.00	6.90	1.4200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.31	0 12:01	3.30	2.45	47.82	0.11	0.44	0.00	0.65	Calculated
66	Link-68		64	64	577.71	3430.70	0.00	3423.00	0.00	7.70	1.3300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.66	0 12:02	3.49	2.76	46.26	0.14	0.48	0.00	0.72	Calculated
67	Link-69		64	64	653.38	3406.60	0.00	3398.00	0.00	8.60	1.3200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.30	0 12:02	3.63	3.00	45.97	0.16	0.50	0.00	0.74	Calculated
68	Link-70		64	64	765.64	3382.90	0.00	3373.00	0.00	9.90	1.2900	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.47	0 12:02	3.83	3.33	45.57	0.19	0.53	0.00	0.78	Calculated
69	Link-71		64	64	1072.75	3505.80	0.00	3492.95	0.00	12.85	1.2000	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	13.05	0 12:04	4.27	4.19	43.86	0.30	0.63	0.00	0.94	Calculated
70	Link-72		64	64	1185.76	3482.30	0.00	3468.80	0.00	13.50	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	11.08	0 12:04	4.21	4.69	42.76	0.26	0.60	0.00	0.89	Calculated
71	Link-73		64	64	1233.29	3458.90	0.00	3444.60	0.00	14.30	1.1600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	11.89	0 12:07	4.30	4.78	43.15	0.28	0.61	0.00	0.91	Calculated
72	Link-74		64	64	1380.13	3435.40	0.00	3420.40	0.00	15.00	1.0900	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	13.40	0 12:07	4.36	5.28	41.77	0.32	0.64	0.00	0.96	Calculated
73	Link-75		64	64	1293.75	3411.10	0.00	3396.20	0.00	14.90	1.1500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	12.82	0 12:07	4.37	4.93	43.00	0.30	0.63	0.00	0.94	Calculated
74	Link-76		64	64	1303.59	3387.60	0.00	3372.70	0.00	14.90	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	14.58	0 12:07	4.42	4.92	42.84	0.34	0.66	0.00	0.99	Calculated
75	Link-77		64	64	836.21	3508.00	0.00	3497.50	0.00	10.50	1.2600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.85	0 12:03	3.90	3.57	44.90	0.20	0.54	0.00	0.80	Calculated
76	Link-78		64	64	834.19	3487.40	0.00	3476.90	0.00	10.50	1.2600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.42	0 12:03	3.88	3.58	44.96	0.19	0.53	0.00	0.78	Calculated
77	Link-79		64	64	835.49	3466.70	0.00	3456.30	0.00	10.40	1.2400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.01	0 12:03	3.84	3.63	44.71	0.18	0.52	0.00	0.77	Calculated
78	Link-80		64	64	831.84	3446.10	0.00	3435.70	0.00	10.40	1.2500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.54	0 12:03	3.87	3.58	44.80	0.19	0.53	0.00	0.79	Calculated
79	Link-81		64	64	835.12	3404.50	0.00	3394.00	0.00	10.50	1.2600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.26	0 12:03	3.87	3.60	44.93	0.18	0.53	0.00	0.78	Calculated
80	Link-82		64	64	833.23	3426.80	0.00	3416.40	0.00	10.40	1.2500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.09	0 12:03	3.85	3.61	44.77	0.18	0.52	0.00	0.77	Calculated
81	Link-83		64	64	837.57	3385.00	0.00	3374.60	0.00	10.40	1.2400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.43	0 12:03	3.81	3.66	44.65	0.17	0.51	0.00	0.75	Calculated
82	Link-84		64	64	1019.14	3508.00	0.00	3495.50	0.00	12.50	1.2300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	9.17	0 12:03	4.08	4.16	44.38	0.21	0.55	0.00	0.81	Calculated

83	Link-85	64	64	1376.77	3487.40	0.00	3471.70	0.00	15.70	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	19.97	0	12:07	4.62	4.97	42.79	0.47	0.74	0.00	1.11	Calculated
84	Link-86	64	64	1693.36	3466.70	0.00	3447.80	0.00	18.90	1.1200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	14.07	0	12:08	4.56	6.19	42.33	0.33	0.65	0.00	0.97	Calculated
85	Link-87	64	64	2022.22	3446.10	0.00	3423.90	0.00	22.20	1.1000	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	15.83	0	12:08	4.68	7.20	41.98	0.38	0.68	0.00	1.01	Calculated
86	Link-88	64	64	2326.22	3426.80	0.00	3401.60	0.00	25.20	1.0800	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	17.31	0	12:09	4.74	8.18	41.71	0.42	0.70	0.00	1.04	Calculated
87	Link-89	64	64	2678.46	3404.50	0.00	3375.90	0.00	28.60	1.0700	Triangular	2.000	16.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	52.54	0	12:10	5.29	8.44	89.17	0.59	0.81	0.00	1.60	Calculated
88	Link-90	64	64	2987.76	3385.00	0.00	3353.30	0.00	31.70	1.0600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	22.85	0	12:11	4.84	10.29	41.27	0.55	0.77	0.00	1.15	Calculated
89	Link-91	64	64	99.73	3374.60	0.00	3354.40	0.00	20.20	20.2500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	141.21	0	12:04	14.39	0.12	769.89	0.18	0.40	0.00	0.79	Calculated
90	Link-92	64	64	305.54	3501.20	0.00	3497.50	0.00	3.70	1.2100	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	3.21	0	12:01	2.61	1.95	44.10	0.07	0.37	0.00	0.56	Calculated
91	Link-93	64	64	559.36	3482.80	0.00	3476.90	0.00	5.90	1.0500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	4.66	0	12:02	3.11	3.00	41.15	0.11	0.44	0.00	0.65	Calculated
92	Link-94	64	64	810.33	3464.35	0.00	3456.30	0.00	8.05	0.9900	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.92	0	12:03	3.58	3.77	39.94	0.20	0.54	0.00	0.80	Calculated
93	Link-95	64	64	970.22	3445.90	0.00	3435.70	0.00	10.20	1.0500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.94	0	12:03	3.80	4.26	41.09	0.19	0.54	0.00	0.79	Calculated
94	Link-96	Jun-100	64	1169.17	3428.70	0.00	3416.40	0.00	12.30	1.0500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.03	0	12:04	4.06	4.80	41.10	0.24	0.59	0.00	0.87	Calculated
95	Link-97	Jun-101	64	1387.08	3408.80	0.00	3394.00	0.00	14.80	1.0700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	12.25	0	12:07	4.30	5.38	41.39	0.30	0.62	0.00	0.93	Calculated
96	Link-98	Jun-102	64	1602.60	3391.40	0.00	3374.60	0.00	16.80	1.0500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	13.50	0	12:08	4.41	6.06	41.03	0.33	0.65	0.00	0.97	Calculated

SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation (ft)	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)
1	Out-02	809866.45	415888.87		3330.00	NORMAL	NO		0.00	0.00	0.00	3330.00
2	Out-03	812235.52	415724.82		3328.00	NORMAL	NO		0.00	0.00	0.00	3328.00
3	Out-04	813106.52	419384.56		3340.20	NORMAL	NO		0.00	0.00	0.00	3340.20

SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation (ft)	Max (Rim) Elevation (ft)	Max (Rim) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft²)	Evaporation Loss	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Peak Outflow (cfs)	Peak Exfiltration Flow Rate (cfm)	Maximum HGL Elevation Attained (ft)	Maximum HGL Depth Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Maximum HGL Occurrence (days hh:mm)	Total Exfiltration Volume (1000-ft³)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)	Total Retention Time (seconds)
1	Stor-01	809701.38	416120.10		3323.00	3333.00	10.00	0.00	-3323.00	0.00	0.00	336.93	32.25	0.00	0.00	3326.59	3.59	3324.58	1.58	1 00:00	0.00	0.00	0.00	0.00
2	Stor-02	812070.74	415850.52		3321.00	3331.00	10.00	0.00	-3321.00	0.00	0.00	351.60	24.20	0.00	0.00	3326.36	5.36	3323.37	2.37	1 00:00	0.00	0.00	0.00	0.00
3	Stor-03	813137.03	419248.84		3333.20	3343.20	10.00	0.00	-3333.20	0.00	0.00	405.50	65.95	0.00	0.00	3339.65	6.45	3336.06	2.86	1 00:00	0.00	0.00	0.00	0.00

SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation	Ground/Rim (Max) Elevation	Ground/Rim (Max) Offset	Initial Water Elevation	Initial Water Depth	Surcharge Elevation	Surcharge Depth	Ponded Area	Minimum Pipe Cover	Peak Inflow	Peak Lateral Inflow	Maximum HGL Elevation Attained	Maximum HGL Depth Attained	Maximum Surcharge Depth Attained	Minimum Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Maximum HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
					(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft²)	(inches)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-inches)	(minutes)
1	64	810645.90	417896.29		3527.50	3529.50	2.00	0.00	-3527.50	0.00	-3529.50	0.00	0.00	28.35	28.35	3527.78	0.28	0.00	1.72	3527.53	0.03	0 12:06	0 00:00	0.00	0.00
2	64	810607.24	417992.93		3497.50	3499.50	2.00	0.00	-3497.50	0.00	-3499.50	0.00	0.00	38.92	0.00	3498.32	0.82	0.00	1.18	3497.63	0.13	0 12:03	0 00:00	0.00	0.00
3	64	810583.39	418062.39		3476.90	3478.90	2.00	0.00	-3476.90	0.00	-3478.90	0.00	0.00	51.27	0.00	3477.70	0.80	0.00	1.20	3477.03	0.13	0 12:03	0 00:00	0.00	0.00
4	64	810549.41	418146.65		3456.30	3458.30	2.00	0.00	-3456.30	0.00	-3458.30	0.00	0.00	67.05	0.00	3457.12	0.82	0.00	1.18	3456.43	0.13	0 12:03	0 00:00	0.00	0.00
5	64	810518.16	418226.83		3435.70	3437.70	2.00	0.00	-3435.70	0.00	-3437.70	0.00	0.00	83.49	0.00	3436.51	0.81	0.00	1.19	3435.83	0.13	0 12:03	0 00:00	0.00	0.00
6	64	810486.90	418307.02		3416.40	3418.40	2.00	0.00	-3416.40	0.00	-3418.40	0.00	0.00	101.46	0.00	3417.28	0.88	0.00	1.12	3416.55	0.15	0 12:04	0 00:00	0.00	0.00
7	64	810462.44	418381.76		3394.00	3396.00	2.00	0.00	-3394.00	0.00	-3396.00	0.00	0.00	121.43	0.00	3394.95	0.95	0.00	1.05	3394.16	0.16	0 12:07	0 00:00	0.00	0.00
8	64	810432.54	418457.87		3374.60	3376.60	2.00	0.00	-3374.60	0.00	-3376.60	0.00	0.00	141.24	0.00	3375.59	0.99	0.00	1.01	3374.76	0.16	0 12:08	0 00:00	0.00	0.00
9	64	811490.32	417908.37		3527.50	3529.50	2.00	0.00	-3527.50	0.00	-3529.50	0.00	0.00	39.17	39.17	3527.85	0.35	0.00	1.65	3527.53	0.03	0 12:00	0 00:00	0.00	0.00
10	64	811615.35	417939.17		3492.95	3494.95	2.00	0.00	-3492.95	0.00	-3494.95	0.00	0.00	60.12	0.00	3493.90	0.95	0.00	1.05	3493.11	0.16	0 12:04	0 00:00	0.00	0.00
11	Jun-100	811594.50	418673.95		3428.70	3429.70	1.00	0.00	-3428.70	0.00	-3429.70	0.00	0.00	11.20	11.20	3429.62	0.92	0.00	0.58	3428.85	0.15	0 12:00	0 00:00	0.00	0.00
12	Jun-101	811779.40	418817.18		3408.80	3409.80	1.00	0.00	-3408.80	0.00	-3409.80	0.00	0.00	13.55	13.55	3409.79	0.99	0.00	0.51	3408.96	0.16	0 12:00	0 00:00	0.00	0.00
13	Jun-102	811953.88	418961.71		3391.40	3392.40	1.00	0.00	-3391.40	0.00	-3392.40	0.00	0.00	14.87	14.87	3392.43	1.03	0.00	0.47	3391.57	0.17	0 12:00	0 00:00	0.00	0.00
14	64	811698.70	417960.92		3468.80	3470.80	2.00	0.00	-3468.80	0.00	-3470.80	0.00	0.00	79.64	0.00	3469.70	0.90	0.00	1.10	3468.95	0.15	0 12:04	0 00:00	0.00	0.00
15	64	811809.23	417993.53		3444.60	3446.60	2.00	0.00	-3444.60	0.00	-3446.60	0.00	0.00	100.55	0.00	3445.53	0.93	0.00	1.07	3444.75	0.15	0 12:07	0 00:00	0.00	0.00
16	64	811901.65	418018.90		3420.40	3422.40	2.00	0.00	-3420.40	0.00	-3422.40	0.00	0.00	122.61	0.00	3421.38	0.98	0.00	1.02	3420.56	0.16	0 12:07	0 00:00	0.00	0.00
17	64	811997.69	418047.89		3396.20	3399.20	3.00	0.00	-3396.20	0.00	-3399.20	0.00	12.00	144.31	0.00	3397.15	0.95	0.00	2.05	3396.36	0.16	0 12:07	0 00:00	0.00	0.00
18	64	812086.48	418080.51		3372.70	3374.70	2.00	0.00	-3372.70	0.00	-3374.70	0.00	0.00	167.57	0.00	3373.70	1.00	0.00	1.00	3372.87	0.17	0 12:07	0 00:00	0.00	0.00
19	64	811966.88	417102.01		3527.50	3529.50	2.00	0.00	-3527.50	0.00	-3529.50	0.00	0.00	70.26	70.26	3527.98	0.48	0.00	1.52	3527.54	0.04	0 12:00	0 00:00	0.00	0.00
20	64	812064.73	417062.14		3498.00	3500.00	2.00	0.00	-3498.00	0.00	-3500.00	0.00	0.00	80.32	0.00	3498.89	0.89	0.00	1.11	3498.15	0.15	0 12:07	0 00:00	0.00	0.00
21	64	812157.15	417031.34		3473.00	3475.00	2.00	0.00	-3473.00	0.00	-3475.00	0.00	0.00	94.75	0.00	3474.02	1.02	0.00	0.98	3473.17	0.17	0 12:08	0 00:00	0.00	0.00
22	64	812249.56	416991.48		3448.00	3450.00	2.00	0.00	-3448.00	0.00	-3450.00	0.00	0.00	112.57	0.00	3449.06	1.06	0.00	0.94	3448.18	0.18	0 12:08	0 00:00	0.00	0.00
23	64	812340.16	416947.99		3423.00	3425.00	2.00	0.00	-3423.00	0.00	-3425.00	0.00	0.00	133.16	0.00	3424.09	1.09	0.00	0.91	3423.18	0.18	0 12:08	0 00:00	0.00	0.00
24	64	812441.64	416918.99		3398.00	3400.00	2.00	0.00	-3398.00	0.00	-3400.00	0.00	0.00	155.38	0.00	3399.11	1.11	0.00	0.89	3398.19	0.19	0 12:09	0 00:00	0.00	0.00
25	64	812537.67	416884.56		3373.00	3375.00	2.00	0.00	-3373.00	0.00	-3375.00	0.00	0.00	179.68	0.00	3374.15	1.15	0.00	0.85	3373.20	0.20	0 12:09	0 00:00	0.00	0.00
26	64	812631.90	416844.70		3348.00	3351.00	3.00	0.00	-3348.00	0.00	-3351.00	0.00	12.00	200.90	0.00	3349.20	1.20	0.00	1.80	3348.21	0.21	0 12:10	0 00:00	0.00	0.00
27	64	809339.43	417308.58		3527.50	3529.50	2.00	0.00	-3527.50	0.00	-3529.50	0.00	0.00	12.87	12.87	3527.68	0.18	0.00	1.82	3527.52	0.02	0 12:00	0 00:00	0.00	0.00
28	64	809247.01	417230.66		3495.50	3497.50	2.00	0.00	-3495.50	0.00	-3497.50	0.00	0.00	34.63	0.00	3496.50	1.00	0.00	1.00	3495.67	0.17	0 12:08	0 00:00	0.00	0.00
29	64	809185.40	417167.24		3471.70	3473.70	2.00	0.00	-3471.70	0.00	-3473.70	0.00	0.00	69.86	0.00	3472.83	1.13	0.00	0.87	3471.89	0.19	0 12:07	0 00:00	0.00	0.00
30	64	809116.54	417094.76		3447.80	3449.80	2.00	0.00	-3447.80	0.00	-3449.80	0.00	0.00	101.07	0.00	3448.87	1.07	0.00	0.93	3447.98	0.18	0 12:08	0 00:00	0.00	0.00
31	64	809044.06	417022.28		3423.90	3425.90	2.00	0.00	-3423.90	0.00	-3425.90	0.00	0.00	134.30	0.00	3424.98	1.08	0.00	0.92	3424.08	0.18	0 12:08	0 00:00	0.00	0.00
32	64	808984.27	416964.29		3401.60	3403.60	2.00	0.00	-3401.60	0.00	-3403.60	0.00	0.00	167.59	0.00	3402.68	1.08	0.00	0.92	3401.78	0.18	0 12:09	0 00:00	0.00	0.00
33	64	808900.91	416897.25		3375.90	3377.90	2.00	0.00	-3375.90	0.00	-3377.90	0.00	0.00	238.43	0.00	3377.54	1.64	0.00	0.36	3376.22	0.32	0 12:10	0 00:00	0.00	0.00
34	64	808837.49	416837.45		3353.30	3355.30	2.00	0.00	-3353.30	0.00	-3355.30	0.00	0.00	279.72	0.00	3354.50	1.20	0.00	0.80	3353.51	0.21	0 12:11	0 00:00	0.00	0.00
35	64	808795.12	416787.17		3334.90	3337.90	3.00	0.00	-3334.90	0.00	-3337.90	0.00	0.00	305.84	0.00	3337.49	2.59	0.00	0.41	3335.20	0.30	0 12:09	0 00:00	0.00	0.00
36	64	809331.04	416183.29		3330.40	3333.40	3.00	0.00	-3330.40	0.00	-3333.40	0.00	0.00	303.85	0.00	3333.29	2.89	0.00	1.11	3330.73	0.33	0 12:11	0 00:00	0.00	0.00
37	64	810113.85	416322.82		3332.00	3334.50	2.50	0.00	-3332.00	0.00	-3334.50	0.00	0.00	13.36	0.00	3332.73	0.73	0.00	2.27	3332.08	0.08	0 12:01	0 00:00	0.00	0.00
38	64	811844.39	415909.67		3328.30	3330.80	2.50	0.00	-3328.30	0.00	-3330.80	0.00	0.00	33.76	0.00	3329.42	1.12	0.00	1.88	3328.43	0.13	0 12:09	0 00:00	0.00	0.00
39	64	812694.57	416824.47		3332.80	3335.80	3.00	0.00	-3332.80	0.00	-3335.80	0.00	0.00	298.48	16.89	3335.76	2.96	0.00	0.04	3333.43	0.63	0 12:07	0 00:00	0.00	0.00
40	64	812373.83	416021.70		3328.40	3331.40	3.00	0.00	-3328.40	0.00	-3331.40	0.00	0.00	297.54	0.00	3331.59	3.19	0.00	1.31	3329.20	0.80	0 12:08	0 00:00	0.00	0.00
41	64	812185.97	418098.40		3349.20	3352.20	3.00	0.00	-3349.20	0.00	-3352.20	0.00	0.00	199.97	22.60	3351.36	2.16	0.00	0.84	3349.41	0.21	0 12:03	0 00:00	0.00	0.00
42	64	812560.18	419259.53		3342.70	3345.70	3.00	0.00	-3342.70	0.00	-3345.70	0.00	0.00	195.17	0.00	3344.88	2.18	0.00	0.82	3342.92	0.22	0 12:08	0 00:00	0.00	0.00
43	64	810383.10	418542.24		3354.40	3356.40	2.00	0.00	-3354.40	0.00	-3356.40	0.00	0.00	47.25	47.25	3355.43	1.03	0.00	1.97	3354.51	0.11	0 12:06	0 00:00	0.00	0.00
44	64	812505.82	419281.27		3343.60	3346.60	3.00	0.00	-3343.60	0.00	-3346.60	0.00	0.00	163.94	0.00	3345.57	1.97	0.00	2.03	3343.82	0.22	0 12:10	0 00:00	0.00	0.00
45	64	810845.21	417243.24		3514.90	3516.40	1.50	0.00	-3514.90	0.00	-3516.40	0.00	0.00	15.68	15.68	3515.93	1.03	0.00	0.47	3515.07	0.17	0 12:00	0 00:00	0.00	0.00
46	64	810808.77	417166.45		3492.00	3493.00	1.00	0.00	-3492.00	0.00	-3493.00	0.00	0.00	17.32	17.32	3493.07	1.07	0.00	0.43	3492.18	0.18	0 12:00	0 00:00	0.00	0.00
47	64	810763.22	417088.36		3468.70	3481.70	13.00	0.00	-3468.70	0.00	-3481.70	0.00	138.00	18.87	18.87	3469.80	1.10	0.00	11.90	3468.88	0.18	0 12:00	0 00:00	0.00	0.00
48	64	810716.36	417003.76		3446.00	3447.00	1.00	0.00	-3446.00	0.00	-3447.00	0.00	0.00	19.22	19.22	3447.11	1.11	0.00	0.39	3446.18	0.18	0 12:00	0 00:00	0.00	0.00
49	64	810678.62	416928.28		3424.30	3425.30	1.00	0.00	-3424.30	0.00	-3425.30	0.00	0.00	17.96	17.96	3425.39	1.09	0.00	0.41	3424.48	0.18	0 12:00	0 00:00	0.00	0.00
50	64	810639.57	416841.08		3400.20	3401.20	1.00	0.00	-3400.20	0.00	-3401.20	0.00	0.00	22.12	22.12	3401.38	1.18	0.00	0.32	3400.40	0.20	0 12:00	0 00:00	0.00	0.00
51	64	810601.40	416766.88		3379.00	3380.00	1.00	0.00	-3379.00	0.00	-3380.00	0.00	0.00	21.18	21.18	3380.16	1.16	0.00	0.34	3379.19	0.19	0 12:00	0 00:00	0.00	0.00
52	64	810868.64	417232.83		3514.90	3515.90	1.00	0.00	-3514.90	0.00	-3515.90	0.00	0.00	11.88	11.88	3515.82	0.92	0.00	0.58	3515.05	0.15	0 12:00	0 00:00	0.00	0.00
53	64	810828.29	417157.34		3492.00	3493.00	1.00	0.00	-3492.00	0.00	-3493.00	0.00	0.00	16.53	16.53	3493.05	1.05	0.00	0.45	3492.17	0.17	0 12:00	0 00:00	0.00	0.00
54	64	810789.25	417079.25		3468.70	3469.70	1.00	0.00	-3468.70	0.00	-3469.70	0.00	0.00	18.36	18.36	3469.79	1.09	0.00	0.41	3468.88	0.18	0 12:00	0 00:00	0.00	0.00
55	64	810748.90	416985.54		3446.00	3447.00	1.00	0.00	-3446.00	0.00	-3447.00	0.00	0.00	19.58	19.58	3447.12	1.12	0.00	0.38	3446.19	0.19	0 12:00	0 00:00	0.00	0.00
56	64	810705.95	416915.26		3424.30	3425.30	1.00	0.00	-3424.30	0.00	-3425.30	0.00	0.00	20.95	20.95	3425.44	1.14	0.00	0.36	3424.49	0.19	0 12:00	0 00:00	0.00	0.00
57	64	810664.30	416826.76		3400.20	3401.20	1.00	0.00	-3400.20	0.00	-3401.20	0.00	0.00	22.61	22.61	3401.39	1.19	0.00	0.31	3400.40	0.20	0 12:00	0 00:00	0.00	0.00
58	64	810624.83	416755.17		3379.00	3380.00	1.00	0.00	-3379.00	0.00	-3380.00	0.00	0.00	25.29	25.29	3380.23	1.23	0.00	0.27	3379.21	0.21	0 12:00	0 00:00	0.00	0.00
59	64	810342.27	416673.93		3336.70	3339.20	2.50	0.00	-3336.70	0.00	-3339.20	0.00	0.00	13.82	13.82	3337.11	0.41	0.00	2.59	3336.73	0.03	0 12:00	0 00:00	0.00	0.00
60	64	812811.29	417716.54		3352.90	3355.90	3.00	0.00	-3352.90	0.00	-3355.90	0.00	0.00	12.03	12.03	3353.37	0.47	0.00	2.53	3352.94	0.04	0 12:00	0 00:00	0.00	0.00
61	64	812962.28	417570.76		3336.75	3339.75	3.00	0.00	-3336.75	0.00	-3339.75	0.00	0.00	83.59	83.59	3338.40	1.65	0.00	1.35	3336.93	0.18	0 12:06	0 00:00	0.00	0.00
62	64	810369.35	416674.89		3336.70	3339.20	2.50	0.00	-3336.70	0.00	-3339.20	0.00	0.00	35.39	35.39	3337.57	0.87	0.00	2.13	3336.78	0.08	0 12:06	0 00:00	0.00	0.00
63	64	812156.81	417387.65		3503.10	3504.10	1.00	0.00	-3503.10	0.00	-3504.10	0.00	0.00	11.06	11.06	3503.99	0.89	0.00	0.61	3503.24	0.14	0 12:00	0 00:00	0.00	0.00
64	64	812170.02	417356.30		3503.10	3504.10	1.00	0.00	-3503.10	0.00	-3504.10	0.00	0.00	3.46	3.46	3503.65	0.55	0.00	0.95	3503.19	0.09	0 12:00	0 00:00	0.00	0.00
65	64	812281.98	417422.69		3479.00	3480.00	1.00	0.00	-3479.00	0.00	-3480.00	0.00	0.00	9.66	9.66	3479.84	0.84	0.00	0.66	3479.13	0.13	0 12:00	0 00:00	0.00	0.00
66	64	812292.39	417400.56		3479.00	3480.00	1.00	0.00	-3479.00	0.00	-3480.00	0.00	0.00	4.65	4.65	3479.62	0.62	0.00	0.88	3479.10	0.10	0 12:00	0 00:00	0.00	0.00
67	64	812392.64	417470.86		3454.90	3455.90	1.00	0.00	-3454.90	0.00	-3455.90	0.00	0.00	10.05	10.05	3455.75	0.85	0.00	0.65	3455.04	0.14	0 12:00	0 00:00	0.00	0.00

68	64	812405.66	417450.03	3454.90	3455.90	1.00	0.00	-3454.90	0.00	-3455.90	0.00	0.00	5.52	5.52	3455.57	0.67	0.00	0.83	3455.00	0.10	0 12:00	0 00:00	0.00	0.00
69	64	812515.01	417517.73	3430.70	3431.70	1.00	0.00	-3430.70	0.00	-3431.70	0.00	0.00	10.17	10.17	3431.56	0.86	0.00	0.64	3430.84	0.14	0 12:00	0 00:00	0.00	0.00
70	64	812528.03	417494.29	3430.70	3431.70	1.00	0.00	-3430.70	0.00	-3431.70	0.00	0.00	7.00	7.00	3431.44	0.74	0.00	0.76	3430.82	0.12	0 12:00	0 00:00	0.00	0.00
71	64	812636.08	417561.99	3406.60	3407.60	1.00	0.00	-3406.60	0.00	-3407.60	0.00	0.00	9.97	9.97	3407.45	0.85	0.00	0.65	3406.74	0.14	0 12:00	0 00:00	0.00	0.00
72	64	812645.19	417539.86	3406.60	3407.60	1.00	0.00	-3406.60	0.00	-3407.60	0.00	0.00	7.74	7.74	3407.37	0.77	0.00	0.73	3406.72	0.12	0 12:00	0 00:00	0.00	0.00
73	64	812727.21	417629.68	3382.90	3383.90	1.00	0.00	-3382.90	0.00	-3383.90	0.00	0.00	9.96	9.96	3383.75	0.85	0.00	0.65	3383.04	0.14	0 12:00	0 00:00	0.00	0.00
74	64	812737.62	417611.46	3382.90	3383.90	1.00	0.00	-3382.90	0.00	-3383.90	0.00	0.00	9.05	9.05	3383.72	0.82	0.00	0.68	3383.03	0.13	0 12:00	0 00:00	0.00	0.00
75	64	810997.81	418136.69	3505.80	3506.80	1.00	0.00	-3505.80	0.00	-3506.80	0.00	0.00	14.21	14.21	3506.78	0.98	0.00	0.52	3505.96	0.16	0 12:00	0 00:00	0.00	0.00
76	64	811209.58	418299.86	3482.30	3483.30	1.00	0.00	-3482.30	0.00	-3483.30	0.00	0.00	12.30	12.30	3483.24	0.94	0.00	0.56	3482.45	0.15	0 12:00	0 00:00	0.00	0.00
77	64	811459.54	418518.58	3458.90	3459.90	1.00	0.00	-3458.90	0.00	-3459.90	0.00	0.00	13.18	13.18	3459.86	0.96	0.00	0.54	3459.05	0.15	0 12:00	0 00:00	0.00	0.00
78	64	811627.92	418664.39	3435.40	3436.40	1.00	0.00	-3435.40	0.00	-3436.40	0.00	0.00	14.70	14.70	3436.41	1.01	0.00	0.49	3435.56	0.16	0 12:00	0 00:00	0.00	0.00
79	64	811909.13	418870.95	3411.10	3412.10	1.00	0.00	-3411.10	0.00	-3412.10	0.00	0.00	14.11	14.11	3412.09	0.99	0.00	0.51	3411.26	0.16	0 12:00	0 00:00	0.00	0.00
80	64	812155.61	419049.74	3387.60	3388.60	1.00	0.00	-3387.60	0.00	-3388.60	0.00	0.00	15.86	15.86	3388.63	1.03	0.00	0.47	3387.77	0.17	0 12:00	0 00:00	0.00	0.00
81	64	809790.19	417741.30	3487.40	3488.40	1.00	0.00	-3487.40	0.00	-3488.40	0.00	0.00	20.95	20.95	3488.55	1.15	0.00	0.35	3487.59	0.19	0 12:00	0 00:00	0.00	0.00
82	64	809760.89	417818.93	3466.70	3467.70	1.00	0.00	-3466.70	0.00	-3467.70	0.00	0.00	15.45	15.45	3467.73	1.03	0.00	0.47	3466.87	0.17	0 12:00	0 00:00	0.00	0.00
83	64	809734.67	417906.40	3446.10	3447.10	1.00	0.00	-3446.10	0.00	-3447.10	0.00	0.00	17.39	17.39	3447.18	1.08	0.00	0.42	3446.28	0.18	0 12:00	0 00:00	0.00	0.00
84	64	809704.50	417974.92	3426.80	3427.80	1.00	0.00	-3426.80	0.00	-3427.80	0.00	0.00	19.11	19.11	3427.92	1.12	0.00	0.38	3426.99	0.19	0 12:00	0 00:00	0.00	0.00
85	64	809675.21	418057.68	3404.50	3405.50	1.00	0.00	-3404.50	0.00	-3405.50	0.00	0.00	57.89	57.89	3406.20	1.70	0.00	0.30	3404.82	0.32	0 12:06	0 00:00	0.00	0.00
86	64	809645.18	418134.57	3385.00	3386.00	1.00	0.00	-3385.00	0.00	-3386.00	0.00	0.00	25.15	25.15	3386.25	1.25	0.00	0.25	3385.21	0.21	0 12:00	0 00:00	0.00	0.00
87	64	809817.99	417665.11	3508.00	3509.00	1.00	0.00	-3508.00	0.00	-3509.00	0.00	0.00	10.06	10.06	3508.86	0.86	0.00	0.64	3508.14	0.14	0 12:00	0 00:00	0.00	0.00
88	64	809834.37	417673.68	3508.00	3509.00	1.00	0.00	-3508.00	0.00	-3509.00	0.00	0.00	9.53	9.53	3508.84	0.84	0.00	0.66	3508.13	0.13	0 12:00	0 00:00	0.00	0.00
89	64	809809.96	417749.85	3487.40	3488.40	1.00	0.00	-3487.40	0.00	-3488.40	0.00	0.00	9.08	9.08	3488.22	0.82	0.00	0.68	3487.53	0.13	0 12:00	0 00:00	0.00	0.00
90	64	809778.72	417824.06	3466.70	3467.70	1.00	0.00	-3466.70	0.00	-3467.70	0.00	0.00	8.64	8.64	3467.51	0.81	0.00	0.69	3466.83	0.13	0 12:00	0 00:00	0.00	0.00
91	64	809749.42	417909.01	3446.10	3447.10	1.00	0.00	-3446.10	0.00	-3447.10	0.00	0.00	9.20	9.20	3446.93	0.83	0.00	0.67	3446.23	0.13	0 12:00	0 00:00	0.00	0.00
92	64	809719.15	417983.22	3426.80	3427.80	1.00	0.00	-3426.80	0.00	-3427.80	0.00	0.00	8.73	8.73	3427.61	0.81	0.00	0.69	3426.93	0.13	0 12:00	0 00:00	0.00	0.00
93	64	809690.83	418062.31	3404.50	3405.50	1.00	0.00	-3404.50	0.00	-3405.50	0.00	0.00	8.91	8.91	3405.32	0.82	0.00	0.68	3404.63	0.13	0 12:00	0 00:00	0.00	0.00
94	64	809656.66	418142.38	3385.00	3386.00	1.00	0.00	-3385.00	0.00	-3386.00	0.00	0.00	8.04	8.04	3385.79	0.79	0.00	0.71	3385.12	0.12	0 12:00	0 00:00	0.00	0.00
95	64	810415.50	418556.13	3354.40	3357.40	3.00	0.00	-3354.40	0.00	-3357.40	0.00	0.00	172.72	31.69	3356.42	2.02	0.00	1.98	3354.60	0.20	0 12:04	0 00:00	0.00	0.00
96	64	810893.99	418098.44	3501.20	3502.20	1.00	0.00	-3501.20	0.00	-3502.20	0.00	0.00	3.29	3.29	3501.77	0.57	0.00	0.93	3501.29	0.09	0 12:00	0 00:00	0.00	0.00
97	64	811106.23	418261.20	3482.80	3483.80	1.00	0.00	-3482.80	0.00	-3483.80	0.00	0.00	4.94	4.94	3483.48	0.68	0.00	0.82	3482.91	0.11	0 12:00	0 00:00	0.00	0.00
98	64	811304.14	418423.96	3464.35	3465.35	1.00	0.00	-3464.35	0.00	-3465.35	0.00	0.00	8.59	8.59	3465.19	0.84	0.00	0.66	3464.48	0.13	0 12:00	0 00:00	0.00	0.00
99	64	811438.25	418534.63	3445.90	3446.90	1.00	0.00	-3445.90	0.00	-3446.90	0.00	0.00	8.76	8.76	3446.74	0.84	0.00	0.66	3446.03	0.13	0 12:00	0 00:00	0.00	0.00

SN	Element ID	Description	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-04		Time Series	NEW MEXICO, LEA COUNTY 25Y-24H	Cumulative	inches					User Defined

SN	Element ID	Description	Area (acres)	Drainage Node ID	Weighted Curve Number	Conductivity (inches/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (ft)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (inches)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (inches)	Pervious Area Manning's Roughness	Curb & Gutter Length (ft)	Rain Gage ID	Total Precipitation (inches)	Total Runon (inches)	Total Evaporation (inches)	Total Infiltration (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01		2.88	64	86.00	0.1500	2.00	4.0000	616.95	0.00	0.00	0.0800	0.0150	0.2000	0.1000	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	12.87	0 00:28:26
2	Sub-03		8.47	64	86.00	0.1500	2.00	4.0000	554.59	0.00	0.00	0.0800	0.0150	0.2000	0.1000	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.38	28.35	0 00:57:57
3	Sub-04		13.13	64	86.00	0.1500	2.00	4.0000	1697.95	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	70.26	0 00:15:31
4	Sub-05		7.96	64	86.00	0.1500	2.00	4.0000	571.63	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	39.17	0 00:22:07
5	Sub-06		2.26	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	11.88	0 00:17:03
6	Sub-08		0.61	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.46	3.46	0 00:07:45
7	Sub-09		0.82	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.46	4.65	0 00:09:18
8	Sub-10		0.98	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.46	5.52	0 00:10:21
9	Sub-11		1.26	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	7.00	0 00:12:01
10	Sub-12		1.41	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	7.74	0 00:12:49
11	Sub-13		1.67	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	9.05	0 00:14:12
12	Sub-16		3.69	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	17.96	0 00:22:54
13	Sub-17		16.94	64	86.00	0.1500	2.00	0.5000	959.36	0.00	0.00	0.0800	0.0150	0.2000	0.0150	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.41	67.80	0 00:37:48
14	Sub-18		18.06	Stor-03	86.00	0.1500	2.00	0.5000	666.62	0.00	0.00	0.0800	0.0150	0.2000	0.0150	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.39	65.95	0 00:48:52
15	Sub-19		2.08	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	11.06	0 00:16:14
16	Sub-20		1.79	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	9.66	0 00:14:50
17	Sub-21		1.87	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	10.05	0 00:15:14
18	Sub-22		1.90	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	10.17	0 00:15:21
19	Sub-23		1.85	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	9.97	0 00:15:09
20	Sub-24		1.85	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	9.96	0 00:15:08
21	Sub-25		2.29	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	12.03	0 00:17:12
22	Sub-26		4.97	64	86.00	0.1500	2.00	25.0000	100.00	0.00	1.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	22.60	0 00:27:22
23	Sub-27		3.17	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	15.86	0 00:20:53
24	Sub-28		2.76	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	14.11	0 00:19:13
25	Sub-29		2.90	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	14.70	0 00:19:47
26	Sub-30		2.54	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	13.18	0 00:18:19
27	Sub-31		2.35	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	12.30	0 00:17:28
28	Sub-32		2.78	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	14.21	0 00:19:18
29	Sub-33		0.58	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.46	3.29	0 00:07:31
30	Sub-34		0.88	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.46	4.94	0 00:09:39
31	Sub-36		1.57	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	8.59	0 00:13:44
32	Sub-37		1.61	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	8.76	0 00:13:54
33	Sub-38		2.11	Jun-100	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	11.20	0 00:16:23
34	Sub-39		2.63	Jun-101	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	13.55	0 00:18:40
35	Sub-40		2.94	Jun-102	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	14.87	0 00:19:57
36	Sub-41		7.82	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.41	31.69	0 00:35:55
37	Sub-42		1.76	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	9.53	0 00:14:42
38	Sub-43		1.67	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	9.08	0 00:14:14
39	Sub-44		1.59	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	8.64	0 00:13:47
40	Sub-45		1.70	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	9.20	0 00:14:21
41	Sub-46		1.60	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	8.73	0 00:13:52
42	Sub-47		1.64	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	8.91	0 00:14:03
43	Sub-48		1.47	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	8.04	0 00:13:09
44	Sub-49		12.89	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.39	47.25	0 00:48:30
45	Sub-50		1.87	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.45	10.06	0 00:15:14
46	Sub-51		4.49	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	20.95	0 00:25:46
47	Sub-52		3.07	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	15.45	0 00:20:30
48	Sub-53		3.55	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	17.39	0 00:22:22
49	Sub-54		3.99	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	19.11	0 00:24:00
50	Sub-55		17.26	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.38	57.89	0 00:57:46
51	Sub-56		5.75	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.42	25.15	0 00:29:51
52	Sub-57		3.13	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	15.68	0 00:20:43
53	Sub-58		3.53	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	17.32	0 00:22:17
54	Sub-59		3.93	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	18.87	0 00:23:46
55	Sub-60		4.02	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	19.22	0 00:24:06
56	Sub-61		3.69	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	17.96	0 00:22:54
57	Sub-62		4.83	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	22.12	0 00:26:54
58	Sub-63		4.56	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	21.18	0 00:25:59
59	Sub-65		3.42	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	16.89	0 00:21:53
60	Sub-66		5.79	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.42	25.29	0 00:30:00
61	Sub-67		4.97	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	22.61	0 00:27:22
62	Sub-68		4.49	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	20.95	0 00:25:46
63	Sub-69		4.12	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	19.58	0 00:24:27
64	Sub-70		3.80	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.43	18.36	0 00:23:17
65	Sub-71		3.33	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	16.53	0 00:21:32
66	Sub-72		2.69	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.44	13.82	0 00:18:56
67	Sub-73		8.91	64	86.00	0.1500	2.00	25.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.41	35.39	0 00:38:51

68	Sub-74	6.98	Stor-02	86.00	0.1500	2.00	5.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.38	24.20	0 00:54:24
69	Sub-75	11.06	Stor-01	86.00	0.1500	2.00	5.0000	100.00	0.00	0.00	0.0800	0.0150	0.2000	0.0220	0.00	Rain Gage-04	4.88	0.00	0.0000	1.2210	3.35	32.25	0 01:11:42

PROJECT:	North Ranch Surface Waste Management Permit Application– Run-on and Run-off Surface Water Management					**PAGE:**	**A** of **7**
JOB NO.:	35187378	**DATE:**	September 2019	**COMP. BY:**	MPB	**CHECKED BY:**	FOC

Exhibit A.3
Run-on Design Results
TR-55 Method Calculations

North Ranch Surface Waste Management Facility

Run-On Diversion Channel Design

	Parameter	Symbol	Value	Unit	Source

A. PEAK DISCHARGE (TR-55 Method)

1. Site Data

Composite N Based on USGS Web Soil Survey - Approximate Upstream AOI

Soil Type ID[2]	Soil Type Description[2]	Hydraulic Soil Group[2]	CN[1]	Area (Acres)[2]	CN x Area
BE	Berino-Cacique loamy fine sands association	B	35	467.5	16362.5
BF	Berino-Cacique fine sandy loams association	B	35	228.3	7990.5
BH	Berino-Cacique association, hummocky	B	35	306.8	10738
MM	Ratliff loam	B	35	79.2	2772
MN	Ratliff-Wink fine sandy loams	B	35	40.2	1407
MW	Mobeetie-Potter association, 1 to 15 percent slopes	A	30	93.3	2799
PU	Pyote and maljamar fine sands	A	30	1,890.50	56715
SE	Simona fine sandy loam, 0 to 3 percent slopes	D	55	0.9	49.5
SR	Simona-Upton association	D	55	2,422.20	133221
TF	Tonuco loamy fine sand, 0 to 3 percent slopes	D	55	22.4	1232
WK	Wink loamy fine sand	A	30	4.5	135
			Totals	5555.8	233421.5
				Composite CN (Total CN x Area / Total Area)	42.0

[1]TR-55 Manual, Table 2-2d for "Sage brush with Grass Understory - Good Conditions"

[2] From USDA Web Soil Survey for Site AOI includes area north of site up to New Mexico State Highway 128.

Parameter	Symbol	Value	Unit	Source
Hydraulic Soil Group		Variable	Unitless	
Curve Number	CN	42	Unitless	
Drainage Area (Assume Whole Site to One Channel)				
- Site Area	A1	5555.8	Acres	AutoCAD
2 year-24 hour Rainfall Depth	P_2	2.24	Inches	NOAA Atlas 14, Volume 1, Version 5. Jal, New Mexico, USA
25 year-24 hour Rainfall Depth	P_{25}	4.59	Inches	NOAA Atlas 14, Volume 1, Version 5. Jal, New Mexico, USA
25 year-24 hour Rainfall Intensity	I_{25}	0.191	In/hour	NOAA Atlas 14, Volume 1, Version 5. Jal, New Mexico, USA

2. Direct Run-off Calculation

Parameter	Symbol	Value	Unit	Source
Direct Run-off	Q	0.2	Inches	TR-55 Manual, Figure 2-1 using CN and P above.

3. Time of Concentration

Equations:

TR-55 Manual Chapter 3, eq. 3-3

$$Sheet\ Flow\ (T_1) = 0.007\left(\frac{(n_1L_1)^{0.8}}{P_2^{\,0.5}s_1^{\,0.4}}\right)$$

$$Shallow\ Concentrated\ (T_2) = \frac{L_2}{3600V_{sc}}$$

where: Velocity (V2) is taken from Figure 3-1 of the TR-55 Manual

Sheet Flow Time of Concentration:TOP DECK

Mannings	n_1	0.011	unitless	TR-55 Manual, Table 3-1 for bare soil
Flow Length	L_1	150	Feet	Maximum shallow flow length
2 year-24 hour Rainfall Depth	P_2	2.24	Inches	NOAA Atlas 14, Volume 1, Version 5. Jal, New Mexico, USA
Slope	s_1	0.04	ft/ft	Assumed
Shallow Flow Time of Concentration (TOP DECK):	T_1	0.03637046	Hour	

Shallow Concentrated Time of Concentration: (TOP DECK)_

Flow Length	L_2	23000	Feet	From GoogleEarth, no decernable channelization
Slope	s_1	0.009	ft/ft	USGS Quadrangle Map
Velocity	V_{sc1}	1.5	feet per second	TR-55 Manual, Figure 3-1 for unpaved surface
Shallow Concentrated Time of Concentration (TOP DECK):	T_2	4.259259259	Hour	

TOTAL TIME OF CONCENTRATION	T_C	4.296	Hour

4. Peak Discharge Calculation

Equations:

$$Peak\ Discharge\ (q_p) = q_u A_m Q F_p$$

TR-55 Manual Chapter 3, eq. 4-1

where

q_u	=	unit peak discharge (csm/in)
A_m	=	Drainage Area (mi^2)
Q	=	Direct Runoff (in)
F_p	=	pond and swamp adjustment factor

Data:

Total Drainage Area (A_1 + A_2)	A_m		8.6809375	mi^2	summed from above converted to square miles
Curve Number	CN		42	unitless	from above
Time of Concentration	T_C		4.30	hour	calculated above
Rainfall Distribution	-	II		unitless	TR-55 Manual Figure B-2
Swamps in Area	-	none		unitless	site data
Initial Abstraction	I_a		2.762	in	TR-55 Manual Table 4-1
Initial Abstraction / Rainfall Depth	I_a / P_{25}		0.50	unitless	calculated
Unit Peak Discharge	q_u		76	csm/in	TR-55 Manual Exhibit 4-II
Direct Runoff	Q		0.2	in	calculated above
Pond and Swamp Adjustment Factor	F_p		1	unitless	TR-55 Manual Figure 4-2

q_p (peak discharge)	=	132.0	cubic feet per second (CFS)
Half Peak Discharge, flow split along Northwest property boundary		66.0	cfs

B. STORMWATER CONVEYANCE CHANNEL SIZING

Section Data

Mannings Coefficient	n_2	0.022	unitless	https://www.lmnoeng.com/manningn.htm, Excavated Earth Channel - Clean
Channel Slope	s_5	0.001	ft/ft	Design Minimum

Hydraulic Radius R_n

Flow Depth(d)	d	2.00	ft
Side Slope	Z	3.00	H:V
Bottom Width	b	7.00	ft
Hydraulic Radius	R	1.323	FT
Note: assumed cross section			

Velocity V_{oc3} 2.58 feet per second

1. Size Channel Check — Mannings Equation for V-ditch

Channel Discharge Check	Q_n	67.1	Cubic Feet Per Second	$Q_n = V_n A$

Design Depth	2.30	ft
Design Freeboard	0.30	Ft

Attachment B

Revised Universal Soil Loss Equation (RUSLE) Calculation

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
REVISED UNIVERSAL SOIL LOSS EVALUATION (RUSLE)

ASSUMPTIONS:
- 2 areas or basin types to consider top deck of landfill and side slope of landfill between collection at diversion berms
- There is 1 top deck area and 38 areas between letdowns subdivided by side slope diversion berms

Basin Type Definition

Basin	Description	Slope (%)	Length (ft)
1	Top Deck	4	400
2	Side Slope Area Between Diversion Berms and Letdowns	25	100

C - Factor Calculation

C	=	$C_{PLU}*C_{CC}*C_{SC}*C_{SR}*C_{SM}$		
C_{PLU}	-	Prior Land Use Subfactor		
	=	1	For Rangeland	
C_{CC}	-	Canopy Cover Subfactor		
	=	1-FC*exp(-0.1*H)		Equation 5-11, NRCS Agricultural Handbook #703
		F_C = Fraction Land Covered by Canopy		
		F_C = 0.5	Conservative Estimate	
		H = Canopy Cover Height		
		H = 1	Conservative Estimate	
	=	0.55		
C_{SC}	-	Surface Cover Subfactor		
	=	$\exp[-b*S_P(0.24/R_U)^{.08}]$		Equation 5-12, NRCS Agricultural Handbook #703
		b = 0.39	Simanton et. al (1984)	
		$S_P = [1-\exp(-\alpha*B_S)]*100$		Equation 5-13, NRCS Agricultural Handbook #703
		α = 0.00055	Table 5-1, NRCS Agricultural Handbook #703	
		B_S = 5 ton/acre^{-1}		
		S_P = 93.61		
		R_U = 0.8	Short Grass, Desert	Table 5-6, NRCS Agricultural Handbook #703
	=	0.036		
C_{SR}	-	Surface Roughness Subfactor		
	=	$\exp[-0.66*(R_U-0.24)]$		Equation 5-23, NRCS Agricultural Handbook #703
	=	0.691		
C_{SM}	-	Soil Moisture Subfactor		
	=	1	Rangeland	
C	=	0.014		

RUSLE Equation Calculation

R	-	Rainfall Value Factor		
	=	45		Fig 2-1 & 2-2, NRCS Agricultural Handbook #703
K	-	Soil Erodibility Factor		
	=	0.13		Soil Type Poorly Graded Silty Sand
LS	-	Slope Length Factor		
	=	Basin	LS	Table 4-3, NRCS Agricultural Handbook #703
		1	1.14	
		2	1.56	
C	-	Covering Management Factor		
	=	0.014		see C factor calculation sheet
P	-	Support Practices Factor		
	=	1		Conservative Estimate
A	-	Calculated Soils Loss in tons/acre-year		
		Basin	A (tons/acrea-year)	
		1	0.093	
		2	0.128	

Total Soil Loss

Basin Type	Calculated Soil Loss A per Basin Type (tons/acre-year)	Number of Basins Types	Total Soil Loss (tons/acre-year)
1	0.093	1	0.093
2	0.128	38	4.864
Total Side Wide Soil Loss			4.957

Attachment C

Leachate Evaporation Pond Sizing – Incidental Precipitation Volume

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
LEACHATE EVAPORATION POND SIZING - INCIDENTAL PRECIPITATION VOLUME

ASSUMPTIONS:
- Area Assumes Largest Cell Open, Cell E-3, and Waste Slope in from Cell C-2
- Incidental precipitation from 25-year, 24-hour storm event

HYDROLOGY PARAMETERS SCS METHOD	VALUE	SOURCE
Precipitation (25-YEAR/24-HOUR EVENT, INCHES)	4.59	NOAA Atlas 14, Volume 1, Version 5. Jal, New Mexico, USA
Curve Number (unitless)	83	TR-55 Manual, Table 2-2a for "Streets/Roads-Dirt" for Hydraulic Soil Group B
Direct Runoff (inches)	2.75	TR-55 Manual, Figure 2-1 using CN and P above.
RUNOFF VOLUME		
Area (acres)	37.3	CALCULATED IN CAD
Runoff Volume (Ac-ft^3)	8.5	calculated
Runoff Volume (CY)	13790.6	calculated
INCIDENTAL RAINFALL OVER POND		
- Area From Site Development Design		
HYDROLOGY PARAMETERS SCS METHOD	VALUE	SOURCE
Precipitation (25-YEAR/24-HOUR EVENT, INCHES)	4.59	NOAA Atlas 14, Volume 1, Version 5. Jal, New Mexico, USA
Curve Number (unitless)	100	Exposed HDPE Impervious Surface
Direct Runoff (inches)	4.59	TR-55 Manual, Figure 2-1 using CN and P above.
RUNOFF VOLUME		
Area (acres)	2	CALCULATED IN CAD
Runoff Volume (Ac-ft^3)	0.765	calculated
Runoff Volume (CY)	1234.2	calculated
TOTAL Runoff Volume (Ac-ft3)	9.3	
TOTAL Runoff Volume (CY)	15024.8	
TOTAL Runoff Volume (CF)	405670.7	

Attachment D
Hydraulic Evaluation of Landfill Performance (HELP) Report

CALCULATIONS BY: Kyle Jackson – Staff Engineer
Michael P. Bradford, P.E. – Senior Project Manager

SOFTWARE: HELP Version 3.95D,
Hydrologic Evaluation of the Landfill Performance - A USACOE model for predicting landfill hydrologic and infiltration processes and testing of effectiveness of landfill designs that was updated by Institute of Soil Science, University of Hamburg, Germany dated August 10, 2012.

METHODOLOGY: *Guidance Document for Performance for an Alternate Cover/Liner Design Under Section 502.A.2 of the New Mexico Solid Waste Management Regulations (20 NMAC 9.1) Using HELP Modeling, New Mexico Environmental Department Solid Waste Bureau Permit Section, April 1, 1998 (Guidance)*
Provided in Exhibit I.

INTRODUCTION:

The following document comprises the HELP modeling for the NGL Water Solutions Permian, LLC (NGL) North Ranch Surface Waste Management Facility (Facility). The site is located 16 miles west Jal, New Mexico and is approximately 303 acres in size. The primary waste accepted by the Facility will be oil field waste.

The applicant proposes to permit, construct and operate the Facility and associated leachate evaporation pond and appurtenances. The facility design is split into Phase 1 and Phase 2, with a centrally located temporary road running between the phases. Each phase is divided into cells ranging from 15 acres to 23 acres in size with a total waste disposal size of 205 acres. The proposed disposal area design is expected to yield approximately 40,264,324 cubic yards of airspace. The weather data was obtained from NOAA using monthly averages for precipitation of the 5 wettest consecutive years (manually entered) and the monthly averages for temperature of the corresponding years (manually entered) (see **Exhibit J**) and solar inputs based on the corresponding years. The weather data used was the more complete data set from the Roswell Industrial Air Park station.

ANALYSIS:

The HELP Model version 3.95D was used to calculate approximate leachate flow rates and liquid heads above the liner system under eight different scenarios. The scenarios were to compare the alternate cover/liner systems proposed by Terracon and the prescriptive cover/liner system defined by NMAC 19.15.36.14.

Final Cover Demonstration – Tier 1 Analysis

- Scenario 1 portrays the prescriptive final cover system outlined in NMAC 19.15.36.14. See **Table D.1,** and **Exhibit A** for modeling results.
- Scenario 2 portrays the alternate final cover system designed by Terracon. See **Table D.2,** and **Exhibit B** for modeling results.

Base Liner Demonstration – Tier 1 Analysis

- Scenario 3 portrays the prescriptive liner system set forth by NMAC 19.15.36.14 of the largest cell in the disposal area. See **Table D.3,** and **Exhibit C** for modeling results.
- Scenario 4 portrays the alternate liner system designed by Terracon of the largest cell in the disposal area prior to waste being placed over the cell. See **Table D.4,** and **Exhibit D** for modeling results.

Base Liner Demonstration – Tier 2 Analysis

- Scenario 5 portrays the alternate liner system designed by Terracon of the largest cell in the disposal area prior to waste being placed over the cell. See **Table D.4,** and **Exhibit E** for modeling results.
- Scenario 6 portrays the alternate liner system of the entire disposal area with 20' of waste placed. See **Table D.5,** and **Exhibit F** for modeling results.
- Scenario 7 portrays the alternate liner system of the entire disposal area completely filled with alternative final cover placed but with no vegetation developed. See **Table D.6,** and **Exhibit G** for modeling results.
- Scenario 8 portrays the alternate liner system of the entire disposal area completely filled with alternative final cover placed with vegetation developed. See **Table D.7,** and **Exhibit H** for modeling results.

The layers for each scenario analyzed using the HELP Model are described below in **the following tables.**

Table D.1 Scenario 1 - Prescriptive Final Cover Design

Layer	Description	Thickness	K_{sat} (cm/se)
1	Erosion Layer	12-in	1×10^{-5}
2	Final Cover	12-in	1×10^{-5}
3	Drainage Sand	12-in	1×10^{-2}
4	Geomembrane	60-mil	2×10^{-13}
5	Drainage Sand	12-in	1×10^{-2}
6	Intermediate Cover	12-in	1×10^{-5}

Table D.2 Scenario 2 - Alternate Final Cover

Layer	Description	Thickness	K_{sat} (cm/se)
1	Erosion Layer	12-in	1×10^{-5}
2	Final Cover	36-in	1×10^{-5}
3	Intermediate Cover	12-in	1×10^{-5}

Table D.3 Scenario 3 - Prescriptive Liner

Layer	Description	Thickness	K_{sat} (cm/se)
1	Protective/Drainage Soil	24-in	1×10^{-2}
2	Geomembrane	60-mil	2×10^{-13}
3	On-Site Soil	24-in	1×10^{-5}
4	Geomembrane	60-mil	2×10^{-13}
5	Compacted Clay Liner	24-in	1×10^{-7}

Table D.4 Scenario 4 and 5 - Alternate Liner System Design

Layer	Description	Thickness	K_{sat} (cm/se)
1	Protective/Drainage Soil	24-in	1×10^{-5}
2	Geocomposite	200-mil	10
3	Geomembrane	60-mil	2×10^{-13}
4	Geocomposite Leak Detection	200-mil	10
5	Geomembrane	60-mil	2×10^{-13}
6	Geosynthetic Clay Liner	240-mil	3×10^{-9}

Table D.5 Scenario 6 - Alternate Liner - 20' Filled

Layer	Description	Thickness	K_{sat} (cm/se)
1	Waste	20-ft	1×10^{-3}
2	Protective/Drainage Soil	24-in	1×10^{-5}
3	Geocomposite	200-mil	10
4	Geomembrane	60-mil	2×10^{-13}
5	Geocomposite Leak Detection	200-mil	10
6	Geomembrane	60-mil	2×10^{-13}
7	Geosynthetic Clay Liner	240-mil	3×10^{-9}

Table D.6 Scenario 7 - Alternate Liner - Filled with Final Cover No Vegetation

Layer	Description	Thickness	K_{sat} (cm/se)
1	Erosion Layer	12-in	1×10^{-5}
2	Final Cover	36-in	1×10^{-5}
3	Intermediate Cover	12-in	1×10^{-5}
4	Waste	227-ft	1×10^{-3}
5	Protective/Drainage Soil	24-in	1×10^{-5}
6	Geocomposite	200-mil	10
7	Geomembrane	60-mil	2×10^{-13}

8	Geocomposite Leak Detection	200-mil	10
9	Geomembrane	60-mil	2×10^{-13}
10	Geosynthetic Clay Liner	240-mil	3×10^{-9}

Table D.7 Scenario 8 - Alternate Liner - Filled Established Vegetation

Layer	Description	Thickness	K_{sat} (cm/se)
1	Erosion Layer	12-in	1×10^{-5}
2	Final Cover	36-in	1×10^{-5}
3	Intermediate Cover	12-in	1×10^{-5}
4	Waste	227-ft	1×10^{-3}
5	Protective/Drainage Soil	24-in	1×10^{-5}
6	Geocomposite	200-mil	10
7	Geomembrane	60-mil	2×10^{-13}
8	Geocomposite Leak Detection	200-mil	10
9	Geomembrane	60-mil	2×10^{-13}
10	Geosynthetic Clay Liner	240-mil	3×10^{-9}

Site specific soil and climate conditions and parameters are established using HELP Model predefined input data. The cell floor is modeled assuming a 600 ft maximum lateral drainage length at 2% grade. The final cover is modeled with a maximum lateral drainage length of 750 ft at 4% grade. Initial moisture of soil components is calculated using the 25% rule stated in the Guidance. The individual HELP Model evaluation results stating the various conditions of the different scenarios can be found in **Exhibit A-H**.

SUMMARY OF RESULTS:
The following **Table D.8** is a summary of the HELP modeling results as related to the Guidance and NMAC requirements.

Table D.8 Summary of HELP Modeling Results

Scenario	Critical Layer	Percolation Through Critical Layer (inches)	Maximum Head on Primary Liner (Inches)	Comments
Tier I - Alternative Final Cover Equivalency Demonstration				
1 - Prescriptive Final Cover (NMAC 19.15.36.14.C(8))	Layer 4	0.0	n/a	none
2 – Alternative Final Cover	Layer 3	0.0	n/a	Equivalent hydraulic performance to prescriptive final cover system

Scenario	Critical Layer	Percolation Through Critical Layer (inches)	Maximum Head on Primary Liner (Inches)	Comments
Tier I – Alternative Base Liner Equivalency Demonstration				
3 – Prescriptive Liner Over Largest Cell (NMAC 19.15.26.14.C)	Layer 5	0.0	26.4	none
4 – Alternative Liner Over Largest Cell	Layer 6	0.0	0.257	Performance exceeds performance of the prescriptive line system. Is in compliance with NMAC 19.15.36.14.F as head over the liner does not exceed 1-ft.
Tier II – Alternative Base Liner Groundwater Protection Demonstration				
5 – Alternative Liner Over Entire Landfill, Prior to Waste Placement	Layer 6	0.0	0.025	No percolation through the clay barrier, thus protective of groundwater.
6 – Alternative Liner Over Entire Landfill, with 20' of Waste Placement	Layer 7	0.0	0.0	No percolation through the clay barrier, thus protective of groundwater.
7 – Alternative Liner Over Entire Landfill, Filled to Final Grade with Alternative Final Cover with no vegetation established	Layer 10	0.0	0.0	No percolation through the clay barrier, thus protective of groundwater.
8 – Alternative Liner Over Entire Landfill, Filled to Final Grade with Alternative Final Cover with poor cover vegetation established	Layer 10	0.0	0.0	No percolation through the clay barrier, thus protective of groundwater.

In conclusion, the proposed alternative final cover and base liner systems have demonstrated equivalent or better hydraulic performance to that of the NMAC prescriptive systems. In addition, as shown there is no percolation anticipated through the proposed alternative final cover system. The cap is designed to remove moisture from the cap by either evaporation or plant transpiration before moving through the cap's thickness. Therefore, the final cover system effectively prevents the "bathtub effect" and is in compliance with NMAC 19.15.39.14.C.(9).

Exhibit A
SCENARIO 1 HELP MODEL RESULTS

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.95 D          (10 August 2012)               **
**                            developed at                                  **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                              based on                                    **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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 TIME:  16.24     DATE:  24.09.2019


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Report\AttD-HELP\exhibits a-i\ExA-FinalCoverPrescriptive\Summary Output Files.out
 YEARLY  OUTPUT  DATA  FILE:    N:\Projects\2018\35187378\Working  Files\DRAFTS  (Proposal-Reports-
Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering
Report\AttD-HELP\exhibits a-i\ExA-FinalCoverPrescriptive\Summary Output Files.YR

 COLUMNS OF YEARLY OUTPUT DATA FILE:

      1    DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
      2    PRECIPITATION (INCH)
      3    RUNOFF (INCH)
      4    POTENTIAL EVAPOTRANSPIRATION (INCH)
      5    ACTUAL EVAPOTRANSPIRATION (INCH)
      6    DRAIN #1: LATERAL DRAINAGE FROM LAYER  3 (INCH)
      7    LEAK  #1: PERCOLATION/LEAKAGE THROUGH LAYER  4 (INCH)
      8    LEAK  #2: PERCOLATION/LEAKAGE THROUGH LAYER  5 (INCH)
      9    CHANGE IN TOTAL WATER STORAGE (INCH)
     10    CHANGE IN SOIL WATER STORAGE (INCH)
     11    CHANGE IN INTERCEPTION WATER STORAGE (INCH)
     12    CHANGE IN SNOW WATER STORAGE (INCH)
     13    ANNUAL WATER BUDGET BALANCE (INCH)


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      TITLE:  Prescriptive Final Cover

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                           WEATHER DATA SOURCES
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NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.35	0.72	0.30	0.67	2.01	3.48
1.90	2.74	1.83	1.90	0.81	0.86

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.40	45.20	52.50	61.00	69.50	76.10
79.30	78.50	71.00	61.10	50.00	40.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

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LAYER DATA 1

VALID FOR 5 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1340 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.1000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1720 VOL/VOL

```
            EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                                    LAYER  3
                                    -----------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   1
            THICKNESS                    =     12.00   INCHES
            POROSITY                     =      0.4170 VOL/VOL
            FIELD CAPACITY               =      0.0450 VOL/VOL
            WILTING POINT                =      0.0180 VOL/VOL
            INITIAL SOIL WATER CONTENT   =      0.0250 VOL/VOL
            EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-01 CM/SEC
            SLOPE                        =      4.00   PERCENT
            DRAINAGE LENGTH              =    750.0    FEET


                                    LAYER  4
                                    -----------

                        TYPE 4 - FLEXIBLE MEMBRANE LINER
                          MATERIAL TEXTURE NUMBER  35
            THICKNESS                    =      0.06   INCHES
            EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
            FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
            FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
            FML PLACEMENT QUALITY        = 3 - GOOD


                                    LAYER  5
                                    -----------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   1
            THICKNESS                    =     12.00   INCHES
            POROSITY                     =      0.4170 VOL/VOL
            FIELD CAPACITY               =      0.0450 VOL/VOL
            WILTING POINT                =      0.0180 VOL/VOL
            INITIAL SOIL WATER CONTENT   =      0.1720 VOL/VOL
            EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-01 CM/SEC


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                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
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                              VALID FOR   5 YEARS


          NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                   SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A
                   POOR STAND OF GRASS, A SURFACE SLOPE OF  4.%
                   AND A SLOPE LENGTH OF  750. FEET.

          SCS RUNOFF CURVE NUMBER              =     82.43
          FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE   =    205.000  ACRES
          EVAPORATIVE ZONE DEPTH               =     24.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE    =      3.672  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE   =     11.352  INCHES
          FIELD CAPACITY OF EVAPORATIVE ZONE   =      5.328  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE   =      2.496  INCHES
          SOIL EVAPORATION ZONE DEPTH          =     24.000  INCHES
          INITIAL SNOW WATER                   =      0.000  INCHES
          INITIAL INTERCEPTION WATER           =      0.000  INCHES
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INITIAL WATER IN LAYER MATERIALS	=	6.036	INCHES
TOTAL INITIAL WATER	=	6.036	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

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EVAPOTRANSPIRATION DATA 1

VALID FOR 5 YEARS

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ROSWELL NEW MEXICO

STATION LATITUDE	=	33.24 DEGREES
MAXIMUM LEAF AREA INDEX	=	1.20
START OF GROWING SEASON (JULIAN DATE)	=	76
END OF GROWING SEASON (JULIAN DATE)	=	310
EVAPORATIVE ZONE DEPTH	=	24.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.70 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	49.0 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	40.0 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	53.0 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	52.0 %

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.67	9428383.000	100.00
RUNOFF	2.440	1815890.500	19.26
POTENTIAL EVAPOTRANSPIRATION	76.038	56583840.000	
ACTUAL EVAPOTRANSPIRATION	10.243	7622132.000	80.84
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
PERC./LEAKAGE THROUGH LAYER 5	1.327622	987949.812	10.48
CHANGE IN WATER STORAGE	-1.341	-997593.688	-10.58
SOIL WATER AT START OF YEAR	6.336	4714927.000	
SOIL WATER AT END OF YEAR	4.995	3717333.250	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.548	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.13	16468041.000	100.00
RUNOFF	6.346	4722008.500	28.67
POTENTIAL EVAPOTRANSPIRATION	75.116	55897788.000	
ACTUAL EVAPOTRANSPIRATION	14.357	10683393.000	64.87
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
PERC./LEAKAGE THROUGH LAYER 5	0.063343	47136.418	0.29
CHANGE IN WATER STORAGE	1.365	1015503.750	6.17
SOIL WATER AT START OF YEAR	4.995	3717333.250	
SOIL WATER AT END OF YEAR	6.360	4732837.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.710	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.51	13774217.000	100.00
RUNOFF	4.117	3063777.250	22.24
POTENTIAL EVAPOTRANSPIRATION	75.152	55924352.000	
ACTUAL EVAPOTRANSPIRATION	14.163	10539217.000	76.51
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
PERC./LEAKAGE THROUGH LAYER 5	0.033784	25140.037	0.18

CHANGE IN WATER STORAGE	0.196	146084.109	1.06
SOIL WATER AT START OF YEAR	6.360	4732837.000	
SOIL WATER AT END OF YEAR	6.244	4646806.500	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.312	232114.266	1.69
ANNUAL WATER BUDGET BALANCE	0.0000	-1.153	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.91	11095278.000	100.00
RUNOFF	4.511	3356853.000	30.25
POTENTIAL EVAPOTRANSPIRATION	75.777	56389536.000	
ACTUAL EVAPOTRANSPIRATION	11.845	8814219.000	79.44
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
PERC./LEAKAGE THROUGH LAYER 5	0.022665	16865.910	0.15
CHANGE IN WATER STORAGE	-1.468	-1092660.125	-9.85
SOIL WATER AT START OF YEAR	6.244	4646806.500	
SOIL WATER AT END OF YEAR	5.088	3786261.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.312	232114.266	2.09
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.444	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	19.18	14272800.000	100.00
RUNOFF	5.755	4282273.500	30.00
POTENTIAL EVAPOTRANSPIRATION	74.468	55415588.000	
ACTUAL EVAPOTRANSPIRATION	12.905	9603489.000	67.29
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
PERC./LEAKAGE THROUGH LAYER 5	0.016789	12493.663	0.09
CHANGE IN WATER STORAGE	0.503	374542.531	2.62
SOIL WATER AT START OF YEAR	5.088	3786261.000	
SOIL WATER AT END OF YEAR	5.591	4160803.750	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.306	0.00

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	3.1436	0.2620
2	1.2480	0.1040
3	0.3000	0.0250
4	0.0000	0.0000
5	0.5998	0.0500
TOTAL WATER IN LAYERS	5.291	
SNOW WATER	0.000	
INTERCEPTION WATER	0.000	
TOTAL FINAL WATER	5.291	

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.22	2396163.000
RUNOFF	2.565	1908494.6250
DRAINAGE COLLECTED FROM LAYER 3	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000	
MAXIMUM HEAD ON TOP OF LAYER 4	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.436997	325191.65625
SNOW WATER	2.39	1774816.8750
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2385	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1040	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.25	0.43	0.33	0.48	2.06	2.41
	2.29	2.42	1.75	1.44	2.05	1.57
STD. DEVIATIONS	0.28	0.11	0.29	0.39	1.94	2.94
	1.07	1.68	1.12	1.68	2.50	1.09
RUNOFF						
TOTALS	0.028	0.000	0.000	0.037	0.661	1.365
	0.481	0.491	0.127	0.529	0.630	0.284
STD. DEVIATIONS	0.063	0.000	0.000	0.036	0.887	1.950
	0.366	0.445	0.238	1.016	0.947	0.364
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	3.006	3.630	5.121	7.372	9.278	10.074
	10.034	8.741	6.610	5.205	3.692	2.548
STD. DEVIATIONS	0.194	0.200	0.191	0.353	0.460	0.188
	0.100	0.266	0.307	0.177	0.178	0.242

ACTUAL EVAPOTRANSPIRATION

TOTALS	0.475	0.346	0.279	0.471	2.406	1.509
	1.759	1.935	1.260	0.739	0.810	0.712
STD. DEVIATIONS	0.171	0.087	0.097	0.182	1.017	1.562
	0.726	1.058	0.675	0.455	0.506	0.291

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.2098	0.0202	0.0134	0.0093	0.0077	0.0062
	0.0056	0.0050	0.0043	0.0041	0.0037	0.0035
STD. DEVIATIONS	0.4606	0.0380	0.0224	0.0140	0.0105	0.0078
	0.0065	0.0054	0.0044	0.0039	0.0033	0.0030

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	17.48	(3.719)	13007743.0	100.00
RUNOFF	4.634	(1.5231)	3448160.75	26.509
POTENTIAL EVAPOTRANSPIRATION	75.310	(0.6175)	56042220.00	
ACTUAL EVAPOTRANSPIRATION	12.702	(1.7099)	9452490.00	72.668
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.000	0.00000

AVERAGE HEAD ON TOP OF LAYER 4	0.000 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.29284 (0.57874)	217917.188	1.67529
CHANGE IN WATER STORAGE	-0.149 (1.2244)	-110824.68	-0.852

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Exhibit B

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.95 D          (10 August 2012)               **
**                             developed at                                 **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                               based on                                   **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
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 TIME:  16.29      DATE:  24.09.2019


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Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering
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Report\AttD-HELP\exhibits a-i\ExB-FinalCoverAlternate\Summary Output Files.YR

 COLUMNS OF YEARLY OUTPUT DATA FILE:

      1    DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
      2    PRECIPITATION (INCH)
      3    RUNOFF (INCH)
      4    POTENTIAL EVAPOTRANSPIRATION (INCH)
      5    ACTUAL EVAPOTRANSPIRATION (INCH)
      6    LEAK  #1: PERCOLATION/LEAKAGE THROUGH LAYER  3 (INCH)
      7    CHANGE IN TOTAL WATER STORAGE (INCH)
      8    CHANGE IN SOIL WATER STORAGE (INCH)
      9    CHANGE IN INTERCEPTION WATER STORAGE (INCH)
     10    CHANGE IN SNOW WATER STORAGE (INCH)
     11    ANNUAL WATER BUDGET BALANCE (INCH)


 ******************************************************************************

      TITLE:  Alternate Final Cover

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                           WEATHER DATA SOURCES
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NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.35	0.72	0.30	0.67	2.01	3.48
1.90	2.74	1.83	1.90	0.81	0.86

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.40	45.20	52.50	61.00	69.50	76.10
79.30	78.50	71.00	61.10	50.00	40.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

****

LAYER DATA 1

VALID FOR 5 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

```
THICKNESS                  =     12.00   INCHES
POROSITY                   =      0.4300 VOL/VOL
FIELD CAPACITY             =      0.3210 VOL/VOL
WILTING POINT              =      0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2460 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=     0.1000E-04 CM/SEC
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

```
THICKNESS                  =     36.00   INCHES
POROSITY                   =      0.4750 VOL/VOL
FIELD CAPACITY             =      0.3780 VOL/VOL
WILTING POINT              =      0.2650 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2930 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=     0.1000E-04 CM/SEC
```

```
                        LAYER  3
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
 THICKNESS                  =     12.00   INCHES
 POROSITY                   =      0.4750 VOL/VOL
 FIELD CAPACITY             =      0.3780 VOL/VOL
 WILTING POINT              =      0.2650 VOL/VOL
 INITIAL SOIL WATER CONTENT =      0.2930 VOL/VOL
 EFFECTIVE SAT. HYD. CONDUCT.=     0.1000E-04 CM/SEC


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          GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
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                VALID FOR   5 YEARS


       NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                SOIL DATA BASE USING SOIL TEXTURE #13 WITH A
                POOR STAND OF GRASS, A SURFACE SLOPE OF  4.%
                AND A SLOPE LENGTH OF  750. FEET.

       SCS RUNOFF CURVE NUMBER            =     91.59
       FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE =    205.000  ACRES
       EVAPORATIVE ZONE DEPTH             =     24.0    INCHES
       INITIAL WATER IN EVAPORATIVE ZONE  =      6.468  INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE =     10.860  INCHES
       FIELD CAPACITY OF EVAPORATIVE ZONE =      8.388  INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE =      5.832  INCHES
       SOIL EVAPORATION ZONE DEPTH        =     24.000  INCHES
       INITIAL SNOW WATER                 =      0.000  INCHES
       INITIAL INTERCEPTION WATER         =      0.000  INCHES
       INITIAL WATER IN LAYER MATERIALS   =     17.016  INCHES
       TOTAL INITIAL WATER                =     17.016  INCHES
       TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


 *****************************************************************************

                 EVAPOTRANSPIRATION DATA   1
-----------------------------------------------------------------------------

                VALID FOR   5 YEARS


       NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                ROSWELL                NEW MEXICO
           STATION LATITUDE                        = 33.24 DEGREES
           MAXIMUM LEAF AREA INDEX                 =  1.20
           START OF GROWING SEASON (JULIAN DATE)   =    76
           END OF GROWING SEASON (JULIAN DATE)     =   310
           EVAPORATIVE ZONE DEPTH                  = 24.0  INCHES
           AVERAGE ANNUAL WIND SPEED               =  8.70 MPH
           AVERAGE 1ST QUARTER RELATIVE HUMIDITY   = 49.0  %
           AVERAGE 2ND QUARTER RELATIVE HUMIDITY   = 40.0  %
           AVERAGE 3RD QUARTER RELATIVE HUMIDITY   = 53.0  %
           AVERAGE 4TH QUARTER RELATIVE HUMIDITY   = 52.0  %

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.67	9428383.000	100.00
RUNOFF	2.573	1914555.500	20.31
POTENTIAL EVAPOTRANSPIRATION	76.038	56583840.000	
ACTUAL EVAPOTRANSPIRATION	10.036	7468518.500	79.21
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	0.061	45305.766	0.48
SOIL WATER AT START OF YEAR	17.016	12662415.000	
SOIL WATER AT END OF YEAR	17.077	12707720.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.129	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.13	16468041.000	100.00
RUNOFF	7.130	5306129.500	32.22
POTENTIAL EVAPOTRANSPIRATION	75.116	55897788.000	
ACTUAL EVAPOTRANSPIRATION	13.297	9895285.000	60.09
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	1.702	1266625.375	7.69
SOIL WATER AT START OF YEAR	17.077	12707720.000	
SOIL WATER AT END OF YEAR	18.779	13974345.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.129	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.51	13774217.000	100.00
RUNOFF	4.766	3546614.750	25.75
POTENTIAL EVAPOTRANSPIRATION	75.152	55924352.000	
ACTUAL EVAPOTRANSPIRATION	13.899	10342769.000	75.09
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	-0.155	-115164.930	-0.84
SOIL WATER AT START OF YEAR	18.779	13974345.000	
SOIL WATER AT END OF YEAR	18.312	13627067.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.312	232114.266	1.69
ANNUAL WATER BUDGET BALANCE	0.0000	-1.419	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.91	11095278.000	100.00
RUNOFF	4.913	3655879.750	32.95
POTENTIAL EVAPOTRANSPIRATION	75.777	56389536.000	
ACTUAL EVAPOTRANSPIRATION	11.153	8299259.500	74.80
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	-1.155	-859862.812	-7.75
SOIL WATER AT START OF YEAR	18.312	13627067.000	
SOIL WATER AT END OF YEAR	17.469	12999317.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.312	232114.266	2.09

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.419	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	19.18	14272800.000	100.00
RUNOFF	6.201	4614677.000	32.33
POTENTIAL EVAPOTRANSPIRATION	74.468	55415588.000	
ACTUAL EVAPOTRANSPIRATION	12.973	9653585.000	67.64
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	0.006	4534.834	0.03
SOIL WATER AT START OF YEAR	17.469	12999317.000	
SOIL WATER AT END OF YEAR	17.475	13003852.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.839	0.00

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	3.7468	0.3122
2	10.2119	0.2837
3	3.5160	0.2930

TOTAL WATER IN LAYERS	17.475
SNOW WATER	0.000
INTERCEPTION WATER	0.000
TOTAL FINAL WATER	17.475

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.22	2396163.000
RUNOFF	2.561	1905583.0000
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000000	0.00000
SNOW WATER	2.39	1774816.8750
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.3582
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.2430

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.25	0.43	0.33	0.48	2.06	2.41
	2.29	2.42	1.75	1.44	2.05	1.57
STD. DEVIATIONS	0.28	0.11	0.29	0.39	1.94	2.94
	1.07	1.68	1.12	1.68	2.50	1.09
RUNOFF						
TOTALS	0.033	0.000	0.000	0.064	0.747	1.434
	0.546	0.555	0.151	0.575	0.688	0.324
STD. DEVIATIONS	0.073	0.000	0.000	0.061	0.915	2.014
	0.415	0.502	0.243	1.004	1.055	0.388
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	3.006	3.630	5.121	7.372	9.278	10.074
	10.034	8.741	6.610	5.205	3.692	2.548
STD. DEVIATIONS	0.194	0.200	0.191	0.353	0.460	0.188
	0.100	0.266	0.307	0.177	0.178	0.242
ACTUAL EVAPOTRANSPIRATION						
TOTALS	0.489	0.362	0.415	0.435	2.219	0.993
	1.777	1.921	1.216	0.764	0.908	0.774
STD. DEVIATIONS	0.248	0.087	0.295	0.124	0.989	1.105
	0.815	1.274	0.837	0.539	0.556	0.292
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	17.48	(3.719)	13007743.0	100.00
RUNOFF	5.117	(1.7225)	3807571.25	29.272
POTENTIAL EVAPOTRANSPIRATION	75.310	(0.6175)	56042220.00	
ACTUAL EVAPOTRANSPIRATION	12.272	(1.6156)	9131883.00	70.203
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00000	(0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.092	(1.0269)	68287.65	0.525

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Exhibit C

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.95 D          (10 August 2012)               **
**                               developed at                               **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                                 based on                                 **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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TIME: 15.39 DATE: 24.09.2019

PRECIPITATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\PRECIP~-.D4
TEMPERATURE DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\TEMPER~-.D7
SOLAR RADIATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\SOLARR~-.D13
EVAPOTRANSPIRATION DATA F. 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\EVAPOT~-.D11
SOIL AND DESIGN DATA FILE 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExC-PrescriptiveLiner\Soil and Design Data.d10
OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExC-PrescriptiveLiner\Summary Output.out
YEARLY OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExC-PrescriptiveLiner\Summary Output.YR

COLUMNS OF YEARLY OUTPUT DATA FILE:

```
     1    DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
     2    PRECIPITATION (INCH)
     3    RUNOFF (INCH)
     4    POTENTIAL EVAPOTRANSPIRATION (INCH)
     5    ACTUAL EVAPOTRANSPIRATION (INCH)
     6    DRAIN #1: LATERAL DRAINAGE FROM LAYER  1 (INCH)
     7    LEAK  #1: PERCOLATION/LEAKAGE THROUGH LAYER  2 (INCH)
     8    LEAK  #2: PERCOLATION/LEAKAGE THROUGH LAYER  4 (INCH)
     9    LEAK  #3: PERCOLATION/LEAKAGE THROUGH LAYER  5 (INCH)
    10    CHANGE IN TOTAL WATER STORAGE (INCH)
    11    CHANGE IN SOIL WATER STORAGE (INCH)
    12    CHANGE IN INTERCEPTION WATER STORAGE (INCH)
    13    CHANGE IN SNOW WATER STORAGE (INCH)
    14    ANNUAL WATER BUDGET BALANCE (INCH)
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     TITLE:  Prescriptive Liner

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WEATHER DATA SOURCES

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.35	0.72	0.30	0.67	2.01	3.48
1.90	2.74	1.83	1.90	0.81	0.86

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.40	45.20	52.50	61.00	69.50	76.10
79.30	78.50	71.00	61.10	50.00	40.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

****

LAYER DATA 1

VALID FOR 5 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0250	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.1000E-01	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	600.0	FEET

LAYER 2

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
EFFECTIVE SAT. HYD. CONDUCT.	=	0.2000E-12	CM/SEC

```
FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  3
                        -----------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.5010 VOL/VOL
FIELD CAPACITY               =      0.2840 VOL/VOL
WILTING POINT                =      0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2930 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                         LAYER  4
                        -----------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                 MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY        = 3 - GOOD


                         LAYER  5
                        -----------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER  16
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.4270 VOL/VOL
FIELD CAPACITY               =      0.4180 VOL/VOL
WILTING POINT                =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.3800 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-06 CM/SEC


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                GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
-------------------------------------------------------------------------------

                      VALID FOR   5 YEARS


     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
              SOIL DATA BASE USING SOIL TEXTURE # 1 WITH BARE
              GROUND CONDITIONS, A SURFACE SLOPE OF  2.% AND
              A SLOPE LENGTH OF  600. FEET.

     SCS RUNOFF CURVE NUMBER             =     71.76
     FRACTION OF AREA ALLOWING RUNOFF    =      0.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE  =     24.000  ACRES
     EVAPORATIVE ZONE DEPTH              =     14.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE   =      0.350  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE  =      5.838  INCHES
     FIELD CAPACITY OF EVAPORATIVE ZONE  =      0.630  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.252  INCHES
     SOIL EVAPORATION ZONE DEPTH         =     11.722  INCHES
     INITIAL SNOW WATER                  =      0.000  INCHES
     INITIAL INTERCEPTION WATER          =      0.000  INCHES
```

```
INITIAL WATER IN LAYER MATERIALS     =     16.752  INCHES
TOTAL INITIAL WATER                  =     16.752  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


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                   EVAPOTRANSPIRATION DATA    1
-------------------------------------------------------------------------------

                       VALID FOR    5 YEARS

      NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
               ROSWELL              NEW MEXICO
          STATION LATITUDE                        = 33.24 DEGREES
          MAXIMUM LEAF AREA INDEX                 =   0.00
          START OF GROWING SEASON (JULIAN DATE)   =     76
          END OF GROWING SEASON (JULIAN DATE)     =    310
          EVAPORATIVE ZONE DEPTH                  = 14.0  INCHES
          AVERAGE ANNUAL WIND SPEED               =   8.70 MPH
          AVERAGE 1ST QUARTER RELATIVE HUMIDITY   = 49.0  %
          AVERAGE 2ND QUARTER RELATIVE HUMIDITY   = 40.0  %
          AVERAGE 3RD QUARTER RELATIVE HUMIDITY   = 53.0  %
          AVERAGE 4TH QUARTER RELATIVE HUMIDITY   = 52.0  %

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                     ANNUAL TOTALS FOR YEAR    1
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	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.67	1103810.625	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	76.038	6624449.500	
ACTUAL EVAPOTRANSPIRATION	8.888	774333.812	70.15
DRAINAGE COLLECTED FROM LAYER 1	1.2060	105063.555	9.52
PERC./LEAKAGE THROUGH LAYER 2	0.062961	5485.164	0.50
AVG. HEAD ON TOP OF LAYER 2	1.7421		
PERC./LEAKAGE THROUGH LAYER 4	0.001302	113.420	0.01
AVG. HEAD ON TOP OF LAYER 4	0.9239		
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	2.576	224413.000	20.33
SOIL WATER AT START OF YEAR	24.828	2163015.000	
SOIL WATER AT END OF YEAR	27.404	2387428.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.125	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.13	1927965.875	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	75.116	6544130.500	
ACTUAL EVAPOTRANSPIRATION	12.436	1083456.750	56.20
DRAINAGE COLLECTED FROM LAYER 1	6.3987	557453.562	28.91
PERC./LEAKAGE THROUGH LAYER 2	0.324183	28242.811	1.46
AVG. HEAD ON TOP OF LAYER 2	9.2551		
PERC./LEAKAGE THROUGH LAYER 4	0.001808	157.552	0.01
AVG. HEAD ON TOP OF LAYER 4	1.3247		
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	3.295	287055.406	14.89
SOIL WATER AT START OF YEAR	27.404	2387428.000	
SOIL WATER AT END OF YEAR	30.699	2674483.250	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.166	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.51	1612591.375	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	75.152	6547241.500	
ACTUAL EVAPOTRANSPIRATION	11.720	1021062.312	63.32

DRAINAGE COLLECTED FROM LAYER 1	6.4143	558813.438	34.65
PERC./LEAKAGE THROUGH LAYER 2	0.324821	28298.393	1.75
AVG. HEAD ON TOP OF LAYER 2	9.3013		
PERC./LEAKAGE THROUGH LAYER 4	0.002970	258.735	0.02
AVG. HEAD ON TOP OF LAYER 4	2.2782		
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	0.376	32715.861	2.03
SOIL WATER AT START OF YEAR	30.699	2674483.250	
SOIL WATER AT END OF YEAR	30.762	2680024.750	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.312	27174.352	1.69
ANNUAL WATER BUDGET BALANCE	0.0000	-0.457	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.91	1298959.375	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	75.777	6601701.500	
ACTUAL EVAPOTRANSPIRATION	8.401	731919.438	56.35
DRAINAGE COLLECTED FROM LAYER 1	6.3879	556517.500	42.84
PERC./LEAKAGE THROUGH LAYER 2	0.323517	28184.820	2.17
AVG. HEAD ON TOP OF LAYER 2	9.2427		
PERC./LEAKAGE THROUGH LAYER 4	0.004641	404.294	0.03
AVG. HEAD ON TOP OF LAYER 4	3.6860		
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	0.121	10522.437	0.81
SOIL WATER AT START OF YEAR	30.762	2680024.750	
SOIL WATER AT END OF YEAR	31.195	2717721.750	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	

SNOW WATER AT START OF YEAR	0.312	27174.352	2.09
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.042	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	19.18	1670962.000	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	74.468	6487678.500	
ACTUAL EVAPOTRANSPIRATION	13.799	1202167.750	71.94
DRAINAGE COLLECTED FROM LAYER 1	6.5856	573738.438	34.34
PERC./LEAKAGE THROUGH LAYER 2	0.333020	29012.693	1.74
AVG. HEAD ON TOP OF LAYER 2	9.5428		
PERC./LEAKAGE THROUGH LAYER 4	0.006290	548.008	0.03
AVG. HEAD ON TOP OF LAYER 4	5.1238		
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
CHANGE IN WATER STORAGE	-1.205	-104944.695	-6.28
SOIL WATER AT START OF YEAR	31.195	2717721.750	
SOIL WATER AT END OF YEAR	29.991	2612777.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.499	0.00

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	4.3941	0.1831
2	0.0000	0.0000
3	8.3835	0.3493

4	0.0000	0.0000
5	9.1370	0.3807

TOTAL WATER IN LAYERS	21.915
SNOW WATER	0.000
INTERCEPTION WATER	0.000
TOTAL FINAL WATER	21.915

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.22	280526.406
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 1	0.03383	2947.16040
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.001691	147.28467
AVERAGE HEAD ON TOP OF LAYER 2	17.908	
MAXIMUM HEAD ON TOP OF LAYER 2	26.376	
LOCATION OF MAXIMUM HEAD IN LAYER 1 (DISTANCE FROM DRAIN)	158.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000020	1.71703
AVERAGE HEAD ON TOP OF LAYER 4	5.916	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00000
SNOW WATER	2.39	207783.4375
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.2869
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0187

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION						
TOTALS	0.25	0.43	0.33	0.48	2.06	2.41
	2.29	2.42	1.75	1.44	2.05	1.57
STD. DEVIATIONS	0.28	0.11	0.29	0.39	1.94	2.94
	1.07	1.68	1.12	1.68	2.50	1.09
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	3.006	3.630	5.121	7.372	9.278	10.074
	10.034	8.741	6.610	5.205	3.692	2.548
STD. DEVIATIONS	0.194	0.200	0.191	0.353	0.460	0.188
	0.100	0.266	0.307	0.177	0.178	0.242
ACTUAL EVAPOTRANSPIRATION						
TOTALS	0.550	0.318	0.275	0.368	1.234	0.905
	1.492	1.594	1.407	0.939	1.128	0.838
STD. DEVIATIONS	0.331	0.106	0.129	0.210	1.223	0.814
	0.607	1.011	0.674	0.710	0.740	0.425
LATERAL DRAINAGE COLLECTED FROM LAYER 1						
TOTALS	0.4670	0.3633	0.3406	0.2808	0.2827	0.3999
	0.5049	0.5231	0.5429	0.5407	0.5675	0.5852
STD. DEVIATIONS	0.3065	0.2387	0.2225	0.1837	0.1897	0.2805
	0.3627	0.3196	0.2190	0.1860	0.1887	0.1957
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	0.0236	0.0184	0.0174	0.0145	0.0146	0.0203
	0.0255	0.0264	0.0275	0.0274	0.0287	0.0296
STD. DEVIATIONS	0.0153	0.0120	0.0112	0.0093	0.0096	0.0141
	0.0181	0.0159	0.0107	0.0091	0.0092	0.0096
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003
	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
STD. DEVIATIONS	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	7.9744	6.7955	5.8165	4.9546	4.8278	7.0561
	8.6216	8.9336	9.5805	9.2329	10.0144	9.9938
STD. DEVIATIONS	5.2343	4.4419	3.8000	3.2408	3.2393	4.9506
	6.1944	5.4581	3.8647	3.1764	3.3294	3.3415

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	2.1288	2.2304	2.3441	2.4670	2.5877	2.6799
	2.7518	2.8147	2.8821	2.9605	3.0403	3.1205
STD. DEVIATIONS	1.5464	1.5660	1.5931	1.6249	1.6600	1.7046
	1.7476	1.7951	1.8444	1.8941	1.9292	1.9684

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	17.48 (3.719)	1522857.6	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
POTENTIAL EVAPOTRANSPIRATION	75.310 (0.6175)	6561040.00	
ACTUAL EVAPOTRANSPIRATION	11.049 (2.3247)	962588.00	63.209
LATERAL DRAINAGE COLLECTED FROM LAYER 1	5.39850 (2.34509)	470317.281	30.88386
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.27370 (0.11787)	23844.775	1.56579
AVERAGE HEAD ON TOP OF LAYER 2	7.817 (3.398)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00340 (0.00206)	296.402	0.01946
AVERAGE HEAD ON TOP OF LAYER 4	2.667 (1.737)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	1.033 (1.8553)	89952.40	5.907

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Exhibit D

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.95 D          (10 August 2012)               **
**                             developed at                                 **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                               based on                                   **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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TIME: 15.57 DATE: 24.09.2019

PRECIPITATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\PRECIP~-.D4
TEMPERATURE DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\TEMPER~-.D7
SOLAR RADIATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\SOLARR~-.D13
EVAPOTRANSPIRATION DATA F. 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\From Edward\EVAPOT~-.D11
SOIL AND DESIGN DATA FILE 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExD-Alternate Liner\Soil and Design Data.d10
OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExD-Alternate Liner\Summary Output.out
YEARLY OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExD-Alternate Liner\Summary Output.YR

COLUMNS OF YEARLY OUTPUT DATA FILE:

```
     1    DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
     2    PRECIPITATION (INCH)
     3    RUNOFF (INCH)
     4    POTENTIAL EVAPOTRANSPIRATION (INCH)
     5    ACTUAL EVAPOTRANSPIRATION (INCH)
     6    DRAIN #1: LATERAL DRAINAGE FROM LAYER  2 (INCH)
     7    LEAK  #1: PERCOLATION/LEAKAGE THROUGH LAYER  3 (INCH)
     8    DRAIN #2: LATERAL DRAINAGE FROM LAYER  4 (INCH)
     9    LEAK  #2: PERCOLATION/LEAKAGE THROUGH LAYER  6 (INCH)
    10    CHANGE IN TOTAL WATER STORAGE (INCH)
    11    CHANGE IN SOIL WATER STORAGE (INCH)
    12    CHANGE IN INTERCEPTION WATER STORAGE (INCH)
    13    CHANGE IN SNOW WATER STORAGE (INCH)
    14    ANNUAL WATER BUDGET BALANCE (INCH)
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     TITLE:  Alternate Liner

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WEATHER DATA SOURCES

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.35	0.72	0.30	0.67	2.01	3.48
1.90	2.74	1.83	1.90	0.81	0.86

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.40	45.20	52.50	61.00	69.50	76.10
79.30	78.50	71.00	61.10	50.00	40.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

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LAYER DATA 1

VALID FOR 5 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0250 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.1000E-04 CM/SEC

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20 INCHES
POROSITY	=	0.8500 VOL/VOL
FIELD CAPACITY	=	0.0100 VOL/VOL
WILTING POINT	=	0.0050 VOL/VOL

```
INITIAL SOIL WATER CONTENT  =      0.0250 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=       10.00     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    600.0    FEET


                        LAYER  3
                        ------------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY         =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  4
                        ------------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                   =      0.20   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0060 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=       10.00     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    600.0    FEET


                        LAYER  5
                        ------------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY         =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  6
                        ------------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                   =      0.24   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.3000E-08 CM/SEC


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            GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
------------------------------------------------------------------------------------

                          VALID FOR   5 YEARS
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NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 1 WITH BARE
         GROUND CONDITIONS, A SURFACE SLOPE OF  2.% AND
         A SLOPE LENGTH OF  600. FEET.

SCS RUNOFF CURVE NUMBER              =     71.76
FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =     24.000  ACRES
EVAPORATIVE ZONE DEPTH               =     14.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      0.350  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      5.838  INCHES
FIELD CAPACITY OF EVAPORATIVE ZONE   =      0.630  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.252  INCHES
SOIL EVAPORATION ZONE DEPTH          =     14.000  INCHES
INITIAL SNOW WATER                   =      0.000  INCHES
INITIAL INTERCEPTION WATER           =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =      0.786  INCHES
TOTAL INITIAL WATER                  =      0.786  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
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                        EVAPOTRANSPIRATION DATA    1
------------------------------------------------------------------------------

                            VALID FOR    5 YEARS

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  ROSWELL               NEW MEXICO
             STATION LATITUDE                         =  33.24 DEGREES
             MAXIMUM LEAF AREA INDEX                  =   0.00
             START OF GROWING SEASON (JULIAN DATE)    =     76
             END OF GROWING SEASON (JULIAN DATE)      =    310
             EVAPORATIVE ZONE DEPTH                   =  14.0  INCHES
             AVERAGE ANNUAL WIND SPEED                =   8.70 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  49.0  %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  40.0  %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  53.0  %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  52.0  %

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                          ANNUAL TOTALS FOR YEAR     1
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	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.67	1103810.625	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	76.038	6624449.500	
ACTUAL EVAPOTRANSPIRATION	9.453	823558.688	74.61
DRAINAGE COLLECTED FROM LAYER 2	0.0013	115.256	0.01
PERC./LEAKAGE THROUGH LAYER 3	0.001679	146.256	0.01
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0009	76.550	0.01

PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.010	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.215	280060.156	25.37
SOIL WATER AT START OF YEAR	0.791	68928.914	
SOIL WATER AT END OF YEAR	4.006	348989.062	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.047	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.13	1927965.875	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	75.116	6544130.500	
ACTUAL EVAPOTRANSPIRATION	18.113	1578003.500	81.85
DRAINAGE COLLECTED FROM LAYER 2	0.4908	42761.152	2.22
PERC./LEAKAGE THROUGH LAYER 3	0.845434	73654.188	3.82
AVG. HEAD ON TOP OF LAYER 3	0.0007		
DRAINAGE COLLECTED FROM LAYER 4	0.8454	73654.008	3.82
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.146	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0012		
CHANGE IN WATER STORAGE	2.681	233547.109	12.11
SOIL WATER AT START OF YEAR	4.006	348989.062	
SOIL WATER AT END OF YEAR	6.687	582536.188	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.036	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.51	1612591.375	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	75.152	6547241.500	
ACTUAL EVAPOTRANSPIRATION	14.649	1276185.125	79.14
DRAINAGE COLLECTED FROM LAYER 2	2.6341	229479.203	14.23
PERC./LEAKAGE THROUGH LAYER 3	2.079291	181147.859	11.23
AVG. HEAD ON TOP OF LAYER 3	0.0038		
DRAINAGE COLLECTED FROM LAYER 4	2.0748	180756.109	11.21
PERC./LEAKAGE THROUGH LAYER 6	0.000003	0.253	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0030		
CHANGE IN WATER STORAGE	-0.847	-73829.203	-4.58
SOIL WATER AT START OF YEAR	6.687	582536.188	
SOIL WATER AT END OF YEAR	5.527	481532.594	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.312	27174.352	1.69
ANNUAL WATER BUDGET BALANCE	0.0000	-0.312	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.91	1298959.375	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	75.777	6601701.500	
ACTUAL EVAPOTRANSPIRATION	10.638	926813.562	71.35
DRAINAGE COLLECTED FROM LAYER 2	1.8845	164181.453	12.64
PERC./LEAKAGE THROUGH LAYER 3	2.002334	174443.344	13.43
AVG. HEAD ON TOP OF LAYER 3	0.0027		

DRAINAGE COLLECTED FROM LAYER 4	2.0047	174645.422	13.45
PERC./LEAKAGE THROUGH LAYER 6	0.000003	0.253	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0029		
CHANGE IN WATER STORAGE	0.382	33318.848	2.57
SOIL WATER AT START OF YEAR	5.527	481532.594	
SOIL WATER AT END OF YEAR	6.222	542025.812	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.312	27174.352	2.09
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.208	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	19.18	1670962.000	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	74.468	6487678.500	
ACTUAL EVAPOTRANSPIRATION	16.005	1394371.125	83.45
DRAINAGE COLLECTED FROM LAYER 2	1.6368	142594.156	8.53
PERC./LEAKAGE THROUGH LAYER 3	2.021057	176074.484	10.54
AVG. HEAD ON TOP OF LAYER 3	0.0024		
DRAINAGE COLLECTED FROM LAYER 4	2.0225	176200.438	10.54
PERC./LEAKAGE THROUGH LAYER 6	0.000003	0.255	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0029		
CHANGE IN WATER STORAGE	-0.484	-42204.152	-2.53
SOIL WATER AT START OF YEAR	6.222	542025.812	
SOIL WATER AT END OF YEAR	5.737	499821.656	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.125	0.00

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	5.5474	0.2311
2	0.0020	0.0100
3	0.0000	0.0000
4	0.0027	0.0136
5	0.0000	0.0000
6	0.1800	0.7500

TOTAL WATER IN LAYERS	5.732
SNOW WATER	0.000
INTERCEPTION WATER	0.000
TOTAL FINAL WATER	5.732

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.22	280526.406
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.24451	21301.91602
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.052686	4589.96191
AVERAGE HEAD ON TOP OF LAYER 3	0.129	
MAXIMUM HEAD ON TOP OF LAYER 3	0.257	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	5.1 FEET	
DRAINAGE COLLECTED FROM LAYER 4	0.04531	3947.60962
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00144
AVERAGE HEAD ON TOP OF LAYER 5	0.024	
MAXIMUM HEAD ON TOP OF LAYER 5	0.043	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.39	207783.4375

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3807

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0180

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.25	0.43	0.33	0.48	2.06	2.41
	2.29	2.42	1.75	1.44	2.05	1.57
STD. DEVIATIONS	0.28	0.11	0.29	0.39	1.94	2.94
	1.07	1.68	1.12	1.68	2.50	1.09
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	3.006	3.630	5.121	7.372	9.278	10.074
	10.034	8.741	6.610	5.205	3.692	2.548
STD. DEVIATIONS	0.194	0.200	0.191	0.353	0.460	0.188
	0.100	0.266	0.307	0.177	0.178	0.242
ACTUAL EVAPOTRANSPIRATION						
TOTALS	0.579	0.352	0.301	0.472	1.620	1.691
	1.954	2.011	1.430	1.208	1.270	0.883
STD. DEVIATIONS	0.350	0.145	0.174	0.322	1.417	2.149
	1.304	1.042	0.807	0.819	0.872	0.476
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.1090	0.0592	0.0423	0.0268	0.0163	0.0173
	0.1894	0.0901	0.0598	0.0903	0.3797	0.2494
STD. DEVIATIONS	0.1155	0.0780	0.0427	0.0256	0.0153	0.0195
	0.2918	0.1217	0.0814	0.1130	0.4915	0.4263
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.1339	0.0954	0.0903	0.0716	0.0549	0.0460
	0.1613	0.1210	0.0944	0.1267	0.2031	0.1914
STD. DEVIATIONS	0.1263	0.1013	0.0844	0.0660	0.0501	0.0413
	0.1801	0.1267	0.0987	0.0924	0.2150	0.2229

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.1334	0.0957	0.0905	0.0717	0.0550	0.0457
	0.1600	0.1216	0.0946	0.1248	0.2019	0.1946
STD. DEVIATIONS	0.1260	0.1022	0.0847	0.0662	0.0502	0.0413
	0.1782	0.1273	0.1001	0.0895	0.2163	0.2270

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0019	0.0011	0.0007	0.0005	0.0003	0.0003
	0.0032	0.0015	0.0011	0.0015	0.0067	0.0043
STD. DEVIATIONS	0.0020	0.0015	0.0007	0.0005	0.0003	0.0003
	0.0050	0.0021	0.0014	0.0019	0.0087	0.0073

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0023	0.0018	0.0015	0.0013	0.0009	0.0008
	0.0027	0.0021	0.0017	0.0021	0.0036	0.0033
STD. DEVIATIONS	0.0022	0.0019	0.0014	0.0012	0.0009	0.0007
	0.0030	0.0022	0.0018	0.0015	0.0038	0.0039

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	17.48	(3.719)	1522857.6	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
POTENTIAL EVAPOTRANSPIRATION	75.310	(0.6175)	6561040.00	
ACTUAL EVAPOTRANSPIRATION	13.772	(3.6425)	1199786.38	78.785
LATERAL DRAINAGE COLLECTED FROM LAYER 2	1.32950	(1.06909)	115826.242	7.60585
PERCOLATION/LEAKAGE THROUGH LAYER 3	1.38996	(0.93170)	121093.227	7.95171
AVERAGE HEAD ON TOP OF LAYER 3	0.002	(0.002)		
LATERAL DRAINAGE COLLECTED FROM LAYER 4	1.38965	(0.93180)	121066.500	7.94995
PERCOLATION/LEAKAGE THROUGH	0.00000	(0.00000)	0.183	0.00001

```
  LAYER  6

AVERAGE HEAD ON TOP              0.002    (     0.001)
  OF LAYER 5

CHANGE IN WATER STORAGE          0.989    (  1.8525)      86178.55      5.659

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Exhibit E

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 **                                                                          **
 **                                                                          **
 **              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
 **                                                                          **
 **              HELP Version 3.95 D          (10 August 2012)               **
 **                               developed at                               **
 **        Institute of Soil Science, University of Hamburg, Germany         **
 **                                 based on                                 **
 **              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
 **                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
 **                    USAE WATERWAYS EXPERIMENT STATION                     **
 **             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
 **                                                                          **
 **                                                                          **
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TIME: 9.27 DATE: 19.09.2019

PRECIPITATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - Open\Precipitation Data.d4
TEMPERATURE DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - Open\Temperature Data.d7
SOLAR RADIATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - Open\Solar Radiation Data.d13
EVAPOTRANSPIRATION DATA F. 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - Open\Evapotranspiration Parameters.d11
SOIL AND DESIGN DATA FILE 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - Open\Soil and Design Data.d10
OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - Open\Summary Output.out
YEARLY OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - Open\Summary Output.YR

COLUMNS OF YEARLY OUTPUT DATA FILE:

```
      1    DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
      2    PRECIPITATION (INCH)
      3    RUNOFF (INCH)
      4    POTENTIAL EVAPOTRANSPIRATION (INCH)
      5    ACTUAL EVAPOTRANSPIRATION (INCH)
      6    DRAIN #1: LATERAL DRAINAGE FROM LAYER  2 (INCH)
      7    LEAK  #1: PERCOLATION/LEAKAGE THROUGH LAYER  3 (INCH)
      8    DRAIN #2: LATERAL DRAINAGE FROM LAYER  4 (INCH)
      9    LEAK  #2: PERCOLATION/LEAKAGE THROUGH LAYER  6 (INCH)
     10    CHANGE IN TOTAL WATER STORAGE (INCH)
     11    CHANGE IN SOIL WATER STORAGE (INCH)
     12    CHANGE IN INTERCEPTION WATER STORAGE (INCH)
     13    CHANGE IN SNOW WATER STORAGE (INCH)
     14    ANNUAL WATER BUDGET BALANCE (INCH)
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      TITLE:  Alternate Liner

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WEATHER DATA SOURCES

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.24	0.28	0.27	0.37	0.77	0.91
1.38	2.17	1.72	0.99	0.33	0.27

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
41.40	45.90	52.80	61.90	70.30	79.00
81.40	79.20	72.30	61.70	49.10	42.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

****

LAYER DATA 1

VALID FOR 2 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0250	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.1000E-04	CM/SEC

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0250	VOL/VOL

```
EFFECTIVE SAT. HYD. CONDUCT.=        10.00     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    600.0    FEET


                        LAYER  3
                        -----------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY         =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  4
                        -----------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                   =      0.20   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0060 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=        10.00     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    600.0    FEET


                        LAYER  5
                        -----------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY         =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  6
                        -----------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                   =      0.24   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.3000E-08 CM/SEC


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                GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
-------------------------------------------------------------------------------

                            VALID FOR   2 YEARS


          NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
```

SOIL DATA BASE USING SOIL TEXTURE # 1 WITH BARE
GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND
A SLOPE LENGTH OF 600. FEET.

SCS RUNOFF CURVE NUMBER	=	71.76	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	205.000	ACRES
EVAPORATIVE ZONE DEPTH	=	14.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.350	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	5.838	INCHES
FIELD CAPACITY OF EVAPORATIVE ZONE	=	0.630	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.252	INCHES
SOIL EVAPORATION ZONE DEPTH	=	14.000	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL INTERCEPTION WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	0.786	INCHES
TOTAL INITIAL WATER	=	0.786	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

****

EVAPOTRANSPIRATION DATA 1

VALID FOR 2 YEARS

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ROSWELL NEW MEXICO

STATION LATITUDE	=	33.24	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	76	
END OF GROWING SEASON (JULIAN DATE)	=	310	
EVAPORATIVE ZONE DEPTH	=	14.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.70	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	49.0	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	40.0	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	53.0	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	52.0	%

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.70	6474105.500	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	77.421	57612976.000	
ACTUAL EVAPOTRANSPIRATION	6.515	4848156.500	74.89
DRAINAGE COLLECTED FROM LAYER 2	0.0013	984.471	0.02
PERC./LEAKAGE THROUGH LAYER 3	0.001677	1247.987	0.02
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0009	652.646	0.01
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.022	0.00

AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	2.183	1624312.375	25.09
SOIL WATER AT START OF YEAR	0.791	588767.812	
SOIL WATER AT END OF YEAR	2.974	2213080.250	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.248	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.35	7701953.500	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	76.577	56984972.000	
ACTUAL EVAPOTRANSPIRATION	10.126	7535160.500	97.83
DRAINAGE COLLECTED FROM LAYER 2	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 3	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0000		
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	0.224	166794.609	2.17
SOIL WATER AT START OF YEAR	2.974	2213080.250	
SOIL WATER AT END OF YEAR	3.198	2379874.750	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-1.419	0.00

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FINAL WATER STORAGE AT END OF YEAR 2

LAYER	(INCHES)	(VOL/VOL)
1	3.0091	0.1254
2	0.0020	0.0100
3	0.0000	0.0000
4	0.0020	0.0100
5	0.0000	0.0000
6	0.1800	0.7500
TOTAL WATER IN LAYERS	3.193	
SNOW WATER	0.000	
INTERCEPTION WATER	0.000	
TOTAL FINAL WATER	3.193	

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 2

	(INCHES)	(CU. FT.)
PRECIPITATION	1.05	781357.438
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.00132	984.47137
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.001677	1247.98718
AVERAGE HEAD ON TOP OF LAYER 3	0.001	
MAXIMUM HEAD ON TOP OF LAYER 3	0.025	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 4	0.00059	437.39902
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00520
AVERAGE HEAD ON TOP OF LAYER 5	0.000	
MAXIMUM HEAD ON TOP OF LAYER 5	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.61	455364.3438
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2295	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0180	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.22	0.18	0.22	0.44	0.76	0.92
	1.18	2.13	2.15	0.21	0.61	0.48
STD. DEVIATIONS	0.31	0.01	0.28	0.16	1.05	1.30
	0.21	0.62	1.04	0.30	0.39	0.52
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	3.103	3.653	5.266	7.550	9.144	10.440
	10.356	8.756	6.951	5.374	3.675	2.733
STD. DEVIATIONS	0.354	0.277	0.005	0.400	0.417	0.399
	0.128	0.512	0.288	0.004	0.184	0.297
ACTUAL EVAPOTRANSPIRATION						
TOTALS	0.489	0.200	0.166	0.195	0.676	1.049
	0.798	1.687	1.738	0.575	0.395	0.354
STD. DEVIATIONS	0.553	0.176	0.128	0.022	0.832	1.371
	0.662	0.470	0.989	0.210	0.147	0.206
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 2

	INCHES		CU. FEET	PERCENT
PRECIPITATION	9.53	(1.167)	7088030.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
POTENTIAL EVAPOTRANSPIRATION	76.999	(0.5962)	57298972.00	
ACTUAL EVAPOTRANSPIRATION	8.320	(2.5532)	6191658.00	87.354
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.00066	(0.00094)	492.236	0.00694
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00084	(0.00119)	623.994	0.00880
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00044	(0.00062)	326.323	0.00460
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000	(0.00000)	0.011	0.00000
AVERAGE HEAD ON TOP	0.000	(0.000)		

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   OF LAYER  5

 CHANGE IN WATER STORAGE         1.203   (  1.3850)     895553.50     12.635

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Exhibit F

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.95 D          (10 August 2012)               **
**                                developed at                              **
**        Institute of Soil Science, University of Hamburg, Germany        **
**                                  based on                                **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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TIME: 9.20 DATE: 19.09.2019

PRECIPITATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - 20' Filled\Precipitation Data.d4
TEMPERATURE DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - 20' Filled\Temperature Data.d7
SOLAR RADIATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - 20' Filled\Solar Radiation Data.d13
EVAPOTRANSPIRATION DATA F. 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - 20' Filled\Evapotranspiration Parameters.d11
SOIL AND DESIGN DATA FILE 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - 20' Filled\Soil and Design Data.d10
OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - 20' Filled\Summary Output.out
YEARLY OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\10-Appendix J\Attachment D - HELP\ATT D2 - Results\Alternate Liner - 20' Filled\Summary Output.YR

COLUMNS OF YEARLY OUTPUT DATA FILE:

```
     1    DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
     2    PRECIPITATION (INCH)
     3    RUNOFF (INCH)
     4    POTENTIAL EVAPOTRANSPIRATION (INCH)
     5    ACTUAL EVAPOTRANSPIRATION (INCH)
     6    DRAIN #1: LATERAL DRAINAGE FROM LAYER  3 (INCH)
     7    LEAK  #1: PERCOLATION/LEAKAGE THROUGH LAYER  4 (INCH)
     8    DRAIN #2: LATERAL DRAINAGE FROM LAYER  5 (INCH)
     9    LEAK  #2: PERCOLATION/LEAKAGE THROUGH LAYER  7 (INCH)
    10    CHANGE IN TOTAL WATER STORAGE (INCH)
    11    CHANGE IN SOIL WATER STORAGE (INCH)
    12    CHANGE IN INTERCEPTION WATER STORAGE (INCH)
    13    CHANGE IN SNOW WATER STORAGE (INCH)
    14    ANNUAL WATER BUDGET BALANCE (INCH)
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     TITLE:  Alternate Liner - 20' Filled

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WEATHER DATA SOURCES

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.24	0.28	0.27	0.37	0.77	0.91
1.38	2.17	1.72	0.99	0.33	0.27

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
41.40	45.90	52.80	61.90	70.30	79.00
81.40	79.20	72.30	61.70	49.10	42.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

****

LAYER DATA 1

VALID FOR 5 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	240.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2000 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.1000E-02 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0250 VOL/VOL

```
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                        LAYER  3
                       -----------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                    =      0.20   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0060 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=       10.00      CM/SEC
SLOPE                        =      2.00   PERCENT
DRAINAGE LENGTH              =    600.0    FEET


                        LAYER  4
                       -----------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                        LAYER  5
                       -----------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                    =      0.20   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0060 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=       10.00      CM/SEC
SLOPE                        =      2.00   PERCENT
DRAINAGE LENGTH              =    600.0    FEET


                        LAYER  6
                       -----------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                        LAYER  7
                       -----------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                    =      0.24   INCHES
POROSITY                     =      0.7500 VOL/VOL
FIELD CAPACITY               =      0.7470 VOL/VOL
WILTING POINT                =      0.4000 VOL/VOL
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INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.3000E-08 CM/SEC
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                GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
--------------------------------------------------------------------------------

                            VALID FOR   5 YEARS

         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE #18 WITH BARE
                  GROUND CONDITIONS, A SURFACE SLOPE OF  4.% AND
                  A SLOPE LENGTH OF  750. FEET.

        SCS RUNOFF CURVE NUMBER              =     79.20
        FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE   =    205.000  ACRES
        EVAPORATIVE ZONE DEPTH               =     14.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE    =      2.800  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE   =      9.394  INCHES
        FIELD CAPACITY OF EVAPORATIVE ZONE   =      4.088  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.078  INCHES
        SOIL EVAPORATION ZONE DEPTH          =     14.000  INCHES
        INITIAL SNOW WATER                   =      0.000  INCHES
        INITIAL INTERCEPTION WATER           =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS     =     48.782  INCHES
        TOTAL INITIAL WATER                  =     48.782  INCHES
        TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
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                       EVAPOTRANSPIRATION DATA   1
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                           VALID FOR   5 YEARS

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  ROSWELL              NEW MEXICO
             STATION LATITUDE                         = 33.24 DEGREES
             MAXIMUM LEAF AREA INDEX                  =  0.00
             START OF GROWING SEASON (JULIAN DATE)    =    76
             END OF GROWING SEASON (JULIAN DATE)      =   310
             EVAPORATIVE ZONE DEPTH                   = 14.0  INCHES
             AVERAGE ANNUAL WIND SPEED                =  8.70 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY    = 49.0  %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY    = 40.0  %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY    = 53.0  %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY    = 52.0  %

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                         ANNUAL TOTALS FOR YEAR    1
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                                         INCHES          CU. FEET      PERCENT
                                       ------------    --------------  ---------
  PRECIPITATION                            8.70         6474105.500    100.00

  RUNOFF                                   0.000              0.000      0.00
```

POTENTIAL EVAPOTRANSPIRATION	77.421	57612976.000	
ACTUAL EVAPOTRANSPIRATION	8.016	5964840.500	92.13
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.684	509261.219	7.87
SOIL WATER AT START OF YEAR	48.784	36302292.000	
SOIL WATER AT END OF YEAR	49.468	36811552.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.548	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.35	7701953.500	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	76.577	56984972.000	
ACTUAL EVAPOTRANSPIRATION	9.421	7010889.500	91.03
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.929	691066.188	8.97
SOIL WATER AT START OF YEAR	49.468	36811552.000	
SOIL WATER AT END OF YEAR	50.397	37502620.000	

INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-2.129	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.33	7687068.500	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	76.472	56906980.000	
ACTUAL EVAPOTRANSPIRATION	10.757	8004682.500	104.13
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	-0.427	-317614.406	-4.13
SOIL WATER AT START OF YEAR	50.397	37502620.000	
SOIL WATER AT END OF YEAR	49.970	37185004.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.710	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.25	6883389.500	100.00

RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	77.070	57351340.000	
ACTUAL EVAPOTRANSPIRATION	9.044	6730242.500	97.78
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.206	153145.406	2.22
SOIL WATER AT START OF YEAR	49.970	37185004.000	
SOIL WATER AT END OF YEAR	50.176	37338148.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.129	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.68	7203372.000	100.00
RUNOFF	0.000	0.000	0.00
POTENTIAL EVAPOTRANSPIRATION	75.845	56440384.000	
ACTUAL EVAPOTRANSPIRATION	9.039	6726316.500	93.38
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 6	0.0000		
CHANGE IN WATER STORAGE	0.641	477056.031	6.62
SOIL WATER AT START OF YEAR	50.176	37338148.000	

SOIL WATER AT END OF YEAR	50.817	37815204.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.710	0.00

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	50.0330	0.2085
2	0.6000	0.0250
3	0.0012	0.0060
4	0.0000	0.0000
5	0.0012	0.0060
6	0.0000	0.0000
7	0.1800	0.7500

TOTAL WATER IN LAYERS	50.815
SNOW WATER	0.000
INTERCEPTION WATER	0.000
TOTAL FINAL WATER	50.815

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	1.17	870655.500
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000	
MAXIMUM HEAD ON TOP OF LAYER 4	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 3		

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          (DISTANCE FROM DRAIN)               0.0 FEET

    DRAINAGE COLLECTED FROM LAYER  5          0.00000          0.00000

    PERCOLATION/LEAKAGE THROUGH LAYER   7     0.000000         0.00000

    AVERAGE HEAD ON TOP OF LAYER  6           0.000

    MAXIMUM HEAD ON TOP OF LAYER  6           0.000

    LOCATION OF MAXIMUM HEAD IN LAYER   5
          (DISTANCE FROM DRAIN)               0.0 FEET

    SNOW WATER                                0.61        455364.3438

    MAXIMUM VEG. SOIL WATER (VOL/VOL)                 0.3367

    MINIMUM VEG. SOIL WATER (VOL/VOL)                 0.0965

     ***  Maximum heads are computed using McEnroe's equations.  ***

          Reference:  Maximum Saturated Depth over Landfill Liner
                      by Bruce M. McEnroe, University of Kansas
                      ASCE Journal of Environmental Engineering
                      Vol. 119, No. 2, March 1993, pp. 262-270.

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         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------
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	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.18	0.17	0.29	0.26	0.78	0.63
	1.66	1.91	1.64	0.79	0.84	0.49
STD. DEVIATIONS	0.19	0.04	0.26	0.21	0.74	0.77
	0.78	1.32	1.04	0.91	1.02	0.34
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	3.134	3.701	5.148	7.467	9.389	10.427
	10.279	8.815	6.728	5.253	3.633	2.703
STD. DEVIATIONS	0.197	0.192	0.191	0.353	0.446	0.205
	0.101	0.268	0.309	0.179	0.177	0.208
ACTUAL EVAPOTRANSPIRATION						
TOTALS	0.339	0.298	0.301	0.221	0.756	0.752
	0.928	1.885	1.461	1.022	0.694	0.599
STD. DEVIATIONS	0.073	0.079	0.062	0.024	0.736	0.669
	0.809	1.387	0.690	0.595	0.533	0.269

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	9.66	(0.710)	7189978.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
POTENTIAL EVAPOTRANSPIRATION	76.677	(0.6011)	57059340.00	

ACTUAL EVAPOTRANSPIRATION	9.255	(0.9887)	6887394.00	95.792
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 6	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.407	(0.5338)	302582.88	4.208

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Exhibit G

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.95 D          (10 August 2012)               **
**                              developed at                                **
**        Institute of Soil Science, University of Hamburg, Germany        **
**                                based on                                  **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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TIME: 15.44 DATE: 24.09.2019

PRECIPITATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExG-AltLiner-FilledBare\Precipitation Data.d4
TEMPERATURE DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExG-AltLiner-FilledBare\Temperature Data.d7
SOLAR RADIATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExG-AltLiner-FilledBare\Solar Radiation Data.d13
EVAPOTRANSPIRATION DATA F. 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExG-AltLiner-FilledBare\Evapotranspiration Parameters.d11
SOIL AND DESIGN DATA FILE 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExG-AltLiner-FilledBare\Soil and Design Data.d10
OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExG-AltLiner-FilledBare\Summary Output.out
YEARLY OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExG-AltLiner-FilledBare\Summary Output.YR

COLUMNS OF YEARLY OUTPUT DATA FILE:

```
     1    DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
     2    PRECIPITATION (INCH)
     3    RUNOFF (INCH)
     4    POTENTIAL EVAPOTRANSPIRATION (INCH)
     5    ACTUAL EVAPOTRANSPIRATION (INCH)
     6    DRAIN #1: LATERAL DRAINAGE FROM LAYER  6 (INCH)
     7    LEAK  #1: PERCOLATION/LEAKAGE THROUGH LAYER  7 (INCH)
     8    DRAIN #2: LATERAL DRAINAGE FROM LAYER  8 (INCH)
     9    LEAK  #2: PERCOLATION/LEAKAGE THROUGH LAYER 10 (INCH)
    10    CHANGE IN TOTAL WATER STORAGE (INCH)
    11    CHANGE IN SOIL WATER STORAGE (INCH)
    12    CHANGE IN INTERCEPTION WATER STORAGE (INCH)
    13    CHANGE IN SNOW WATER STORAGE (INCH)
    14    ANNUAL WATER BUDGET BALANCE (INCH)
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     TITLE:  Alternate Liner

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WEATHER DATA SOURCES

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.24	0.28	0.27	0.37	0.77	0.91
1.38	2.17	1.72	0.99	0.33	0.27

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
41.40	45.90	52.80	61.90	70.30	79.00
81.40	79.20	72.30	61.70	49.10	42.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

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LAYER DATA 1

VALID FOR 2 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1340 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.1000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL

```
INITIAL SOIL WATER CONTENT  =      0.1340 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                        LAYER  3
                        -----------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4730 VOL/VOL
FIELD CAPACITY              =      0.2220 VOL/VOL
WILTING POINT               =      0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1340 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                        LAYER  4
                        -----------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =   2724.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2000 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-02 CM/SEC


                        LAYER  5
                        -----------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.4170 VOL/VOL
FIELD CAPACITY              =      0.0450 VOL/VOL
WILTING POINT               =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0250 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                        LAYER  6
                        -----------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                   =      0.20   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0060 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=       10.00     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    600.0    FEET


                        LAYER  7
                        -----------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY         =      4.00   HOLES/ACRE
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           FML INSTALLATION DEFECTS     =       4.00   HOLES/ACRE
           FML PLACEMENT QUALITY        =  3 - GOOD


                                LAYER  8
                                --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER  20
           THICKNESS                    =      0.20   INCHES
           POROSITY                     =      0.8500 VOL/VOL
           FIELD CAPACITY               =      0.0100 VOL/VOL
           WILTING POINT                =      0.0050 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.0060 VOL/VOL
           EFFECTIVE SAT. HYD. CONDUCT.=       10.00     CM/SEC
           SLOPE                        =      2.00   PERCENT
           DRAINAGE LENGTH              =    600.0    FEET


                                LAYER  9
                                --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
           THICKNESS                    =      0.06   INCHES
           EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
           FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
           FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
           FML PLACEMENT QUALITY        = 3 - GOOD


                                LAYER 10
                                --------

                      TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  17
           THICKNESS                    =      0.24   INCHES
           POROSITY                     =      0.7500 VOL/VOL
           FIELD CAPACITY               =      0.7470 VOL/VOL
           WILTING POINT                =      0.4000 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
           EFFECTIVE SAT. HYD. CONDUCT.=      0.3000E-08 CM/SEC


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                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
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                             VALID FOR   2 YEARS


         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE # 7 WITH BARE
                  GROUND CONDITIONS, A SURFACE SLOPE OF  4.% AND
                  A SLOPE LENGTH OF  750. FEET.

        SCS RUNOFF CURVE NUMBER              =     87.89
        FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE   =    205.000  ACRES
        EVAPORATIVE ZONE DEPTH               =     14.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE    =      1.876  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE   =      6.622  INCHES
        FIELD CAPACITY OF EVAPORATIVE ZONE   =      3.108  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.456  INCHES
        SOIL EVAPORATION ZONE DEPTH          =     14.000  INCHES
        INITIAL SNOW WATER                   =      0.000  INCHES
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INITIAL INTERCEPTION WATER          =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    553.622  INCHES
TOTAL INITIAL WATER                 =    553.622  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
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                  EVAPOTRANSPIRATION DATA    1
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                      VALID FOR   2 YEARS

    NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
             ROSWELL              NEW MEXICO
        STATION LATITUDE                        = 33.24 DEGREES
        MAXIMUM LEAF AREA INDEX                 =  0.00
        START OF GROWING SEASON (JULIAN DATE)   =    76
        END OF GROWING SEASON (JULIAN DATE)     =   310
        EVAPORATIVE ZONE DEPTH                  = 14.0  INCHES
        AVERAGE ANNUAL WIND SPEED               =  8.70 MPH
        AVERAGE 1ST QUARTER RELATIVE HUMIDITY   = 49.0  %
        AVERAGE 2ND QUARTER RELATIVE HUMIDITY   = 40.0  %
        AVERAGE 3RD QUARTER RELATIVE HUMIDITY   = 53.0  %
        AVERAGE 4TH QUARTER RELATIVE HUMIDITY   = 52.0  %

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                   ANNUAL TOTALS FOR YEAR    1
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	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.70	6474105.500	100.00
RUNOFF	1.489	1108083.750	17.12
POTENTIAL EVAPOTRANSPIRATION	77.421	57612976.000	
ACTUAL EVAPOTRANSPIRATION	6.051	4502638.500	69.55
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	1.160	863375.688	13.34
SOIL WATER AT START OF YEAR	553.624	411979008.000	
SOIL WATER AT END OF YEAR	554.784	412842368.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	7.452	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.35	7701953.500	100.00
RUNOFF	1.657	1233255.375	16.01
POTENTIAL EVAPOTRANSPIRATION	76.577	56984972.000	
ACTUAL EVAPOTRANSPIRATION	8.419	6264959.500	81.34
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.274	203751.047	2.65
SOIL WATER AT START OF YEAR	554.784	412842368.000	
SOIL WATER AT END OF YEAR	555.058	413046144.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-12.065	0.00

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FINAL WATER STORAGE AT END OF YEAR 2

LAYER	(INCHES)	(VOL/VOL)
1	3.1020	0.2585
2	4.7640	0.1323
3	1.6080	0.1340

4	544.8000	0.2000
5	0.6000	0.0250
6	0.0012	0.0060
7	0.0000	0.0000
8	0.0012	0.0060
9	0.0000	0.0000
10	0.1800	0.7500

TOTAL WATER IN LAYERS	555.056
SNOW WATER	0.000
INTERCEPTION WATER	0.000
TOTAL FINAL WATER	555.056

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 2

	(INCHES)	(CU. FT.)
PRECIPITATION	1.05	781357.438
RUNOFF	0.644	479548.8438
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.61	455364.3438
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2898	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1078	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas

ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.22	0.18	0.22	0.44	0.76	0.92
	1.18	2.13	2.15	0.21	0.61	0.48
STD. DEVIATIONS	0.31	0.01	0.28	0.16	1.05	1.30
	0.21	0.62	1.04	0.30	0.39	0.52
RUNOFF						
TOTALS	0.041	0.000	0.000	0.000	0.000	0.197
	0.130	0.707	0.353	0.012	0.079	0.055
STD. DEVIATIONS	0.058	0.000	0.000	0.000	0.000	0.278
	0.180	0.093	0.439	0.017	0.111	0.077
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	3.103	3.653	5.266	7.550	9.144	10.440
	10.356	8.756	6.951	5.374	3.675	2.733
STD. DEVIATIONS	0.354	0.277	0.005	0.400	0.417	0.399
	0.128	0.512	0.288	0.004	0.184	0.297
ACTUAL EVAPOTRANSPIRATION						
TOTALS	0.261	0.195	0.151	0.256	0.667	0.839
	0.533	1.313	1.545	0.518	0.561	0.398
STD. DEVIATIONS	0.007	0.001	0.051	0.242	0.800	1.058
	0.628	0.686	0.313	0.258	0.394	0.037
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 2

	INCHES		CU. FEET	PERCENT
PRECIPITATION	9.53	(1.167)	7088030.0	100.00
RUNOFF	1.573	(0.1189)	1170669.62	16.516
POTENTIAL EVAPOTRANSPIRATION	76.999	(0.5962)	57298972.00	
ACTUAL EVAPOTRANSPIRATION	7.235	(1.6746)	5383798.50	75.956
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.717	(0.6268)	533563.31	7.528

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Exhibit H

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.95 D          (10 August 2012)               **
**                              developed at                                **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                                based on                                  **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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TIME: 15.46 DATE: 24.09.2019

PRECIPITATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExH-AltLiner-FilledPoor\Precipitation Data.d4
TEMPERATURE DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExH-AltLiner-FilledPoor\Temperature Data.d7
SOLAR RADIATION DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExH-AltLiner-FilledPoor\Solar Radiation Data.d13
EVAPOTRANSPIRATION DATA F. 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExH-AltLiner-FilledPoor\Evapotranspiration Parameters.d11
SOIL AND DESIGN DATA FILE 1: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExH-AltLiner-FilledPoor\Soil and Design Data.d10
OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExH-AltLiner-FilledPoor\Summary Output.out
YEARLY OUTPUT DATA FILE: N:\Projects\2018\35187378\Working Files\DRAFTS (Proposal-Reports-Communications)\McCloy Permit Narrative\092019 FINAL SUBMITTAL to OCD\VOLUME 2\App J - Engineering Report\AttD-HELP\exhibits a-i\ExH-AltLiner-FilledPoor\Summary Output.YR

COLUMNS OF YEARLY OUTPUT DATA FILE:

1 DATE OF ULTIMO (yyyy1231, years 2101 to 2200 from weather generator)
2 PRECIPITATION (INCH)
3 RUNOFF (INCH)
4 POTENTIAL EVAPOTRANSPIRATION (INCH)
5 ACTUAL EVAPOTRANSPIRATION (INCH)
6 DRAIN #1: LATERAL DRAINAGE FROM LAYER 6 (INCH)
7 LEAK #1: PERCOLATION/LEAKAGE THROUGH LAYER 7 (INCH)
8 DRAIN #2: LATERAL DRAINAGE FROM LAYER 8 (INCH)
9 LEAK #2: PERCOLATION/LEAKAGE THROUGH LAYER 10 (INCH)
10 CHANGE IN TOTAL WATER STORAGE (INCH)
11 CHANGE IN SOIL WATER STORAGE (INCH)
12 CHANGE IN INTERCEPTION WATER STORAGE (INCH)
13 CHANGE IN SNOW WATER STORAGE (INCH)
14 ANNUAL WATER BUDGET BALANCE (INCH)

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TITLE: Alternate Liner

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WEATHER DATA SOURCES

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.24	0.28	0.27	0.37	0.77	0.91
1.38	2.17	1.72	0.99	0.33	0.27

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
41.40	45.90	52.80	61.90	70.30	79.00
81.40	79.20	72.30	61.70	49.10	42.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ROSWELL NEW MEXICO
AND STATION LATITUDE = 33.24 DEGREES

****

LAYER DATA 1

VALID FOR 28 YEARS

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS = 12.00 INCHES
POROSITY = 0.4730 VOL/VOL
FIELD CAPACITY = 0.2220 VOL/VOL
WILTING POINT = 0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1340 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.= 0.1000E-04 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS = 36.00 INCHES
POROSITY = 0.4730 VOL/VOL
FIELD CAPACITY = 0.2220 VOL/VOL
WILTING POINT = 0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1340 VOL/VOL

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EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                         LAYER  3
                        -----------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.4730 VOL/VOL
FIELD CAPACITY               =      0.2220 VOL/VOL
WILTING POINT                =      0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1340 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                         LAYER  4
                        -----------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                    =   2724.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
FIELD CAPACITY               =      0.2920 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2000 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-02 CM/SEC


                         LAYER  5
                        -----------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.4170 VOL/VOL
FIELD CAPACITY               =      0.0450 VOL/VOL
WILTING POINT                =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0250 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC


                         LAYER  6
                        -----------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                    =      0.20   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0060 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=       10.00     CM/SEC
SLOPE                        =      2.00   PERCENT
DRAINAGE LENGTH              =    600.0    FEET


                         LAYER  7
                        -----------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
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FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  8
                        -----------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                   =      0.20   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0060 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=       10.00     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    600.0    FEET


                        LAYER  9
                        -----------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
EFFECTIVE SAT. HYD. CONDUCT.=      0.2000E-12 CM/SEC
FML PINHOLE DENSITY         =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       = 3 - GOOD


                        LAYER 10
                        -----------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                   =      0.24   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.=      0.3000E-08 CM/SEC


***************************************************************************

          GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
------------------------------------------------------------------------------

                    VALID FOR  28 YEARS


   NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #13 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  4.%
            AND A SLOPE LENGTH OF  750. FEET.

  SCS RUNOFF CURVE NUMBER              =     91.59
  FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE   =    205.000  ACRES
  EVAPORATIVE ZONE DEPTH               =     24.0    INCHES
  INITIAL WATER IN EVAPORATIVE ZONE    =      3.216  INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE   =     11.352  INCHES
  FIELD CAPACITY OF EVAPORATIVE ZONE   =      5.328  INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE   =      2.496  INCHES
  SOIL EVAPORATION ZONE DEPTH          =     24.000  INCHES
  INITIAL SNOW WATER                   =      0.000  INCHES
  INITIAL INTERCEPTION WATER           =      0.000  INCHES
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INITIAL WATER IN LAYER MATERIALS    =    553.622  INCHES
TOTAL INITIAL WATER                 =    553.622  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
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                     EVAPOTRANSPIRATION DATA    1
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                         VALID FOR  28 YEARS

    NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              ROSWELL            NEW MEXICO
        STATION LATITUDE                        = 33.24 DEGREES
        MAXIMUM LEAF AREA INDEX                 =  1.20
        START OF GROWING SEASON (JULIAN DATE)   =    76
        END OF GROWING SEASON (JULIAN DATE)     =   310
        EVAPORATIVE ZONE DEPTH                  = 24.0  INCHES
        AVERAGE ANNUAL WIND SPEED               =  8.70 MPH
        AVERAGE 1ST QUARTER RELATIVE HUMIDITY   = 49.0  %
        AVERAGE 2ND QUARTER RELATIVE HUMIDITY   = 40.0  %
        AVERAGE 3RD QUARTER RELATIVE HUMIDITY   = 53.0  %
        AVERAGE 4TH QUARTER RELATIVE HUMIDITY   = 52.0  %

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                       ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
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	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.70	6474105.500	100.00
RUNOFF	0.896	666436.812	10.29
POTENTIAL EVAPOTRANSPIRATION	77.421	57612976.000	
ACTUAL EVAPOTRANSPIRATION	7.845	5837720.000	90.17
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.040	-30022.164	-0.46
SOIL WATER AT START OF YEAR	553.624	411979008.000	
SOIL WATER AT END OF YEAR	553.583	411948960.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-29.097	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.35	7701953.500	100.00
RUNOFF	0.875	650883.688	8.45
POTENTIAL EVAPOTRANSPIRATION	76.577	56984972.000	
ACTUAL EVAPOTRANSPIRATION	9.244	6878927.500	89.31
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.231	172139.188	2.24
SOIL WATER AT START OF YEAR	553.583	411948960.000	
SOIL WATER AT END OF YEAR	553.815	412121120.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.548	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.33	7687068.500	100.00
RUNOFF	0.542	403351.406	5.25
POTENTIAL EVAPOTRANSPIRATION	76.472	56906980.000	
ACTUAL EVAPOTRANSPIRATION	9.527	7089696.000	92.23

DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.261	194031.297	2.52
SOIL WATER AT START OF YEAR	553.815	412121120.000	
SOIL WATER AT END OF YEAR	554.075	412315136.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-9.935	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.25	6883389.500	100.00
RUNOFF	1.576	1172830.250	17.04
POTENTIAL EVAPOTRANSPIRATION	77.070	57351340.000	
ACTUAL EVAPOTRANSPIRATION	8.161	6072664.500	88.22
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.487	-362128.156	-5.26
SOIL WATER AT START OF YEAR	554.075	412315136.000	
SOIL WATER AT END OF YEAR	553.589	411953024.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	22.710	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.68	7203372.000	100.00
RUNOFF	0.474	353023.469	4.90
POTENTIAL EVAPOTRANSPIRATION	75.845	56440384.000	
ACTUAL EVAPOTRANSPIRATION	8.282	6162752.500	85.55
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.924	687557.562	9.54
SOIL WATER AT START OF YEAR	553.589	411953024.000	
SOIL WATER AT END OF YEAR	554.513	412640608.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	38.323	0.00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.14	4569081.000	100.00
RUNOFF	0.036	26800.961	0.59
POTENTIAL EVAPOTRANSPIRATION	77.114	57384016.000	

ACTUAL EVAPOTRANSPIRATION	6.951	5172790.500	113.21
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.847	-630465.438	-13.80
SOIL WATER AT START OF YEAR	554.513	412640608.000	
SOIL WATER AT END OF YEAR	553.665	412010112.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-45.064	0.00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.91	8118676.500	100.00
RUNOFF	1.570	1168274.375	14.39
POTENTIAL EVAPOTRANSPIRATION	76.817	57163692.000	
ACTUAL EVAPOTRANSPIRATION	9.108	6777628.000	83.48
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.232	172729.641	2.13
SOIL WATER AT START OF YEAR	553.665	412010112.000	
SOIL WATER AT END OF YEAR	553.898	412182816.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	

INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	45.419	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.25	6883388.000	100.00
RUNOFF	1.531	1139458.625	16.55
POTENTIAL EVAPOTRANSPIRATION	77.523	57688988.000	
ACTUAL EVAPOTRANSPIRATION	7.651	5693326.000	82.71
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.068	50642.531	0.74
SOIL WATER AT START OF YEAR	553.898	412182816.000	
SOIL WATER AT END OF YEAR	553.966	412233472.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-39.032	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.01	7448942.000	100.00
RUNOFF	1.880	1399259.625	18.78

POTENTIAL EVAPOTRANSPIRATION	76.850	57187568.000	
ACTUAL EVAPOTRANSPIRATION	8.270	6153983.500	82.62
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.140	-104328.156	-1.40
SOIL WATER AT START OF YEAR	553.966	412233472.000	
SOIL WATER AT END OF YEAR	553.825	412129152.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	26.968	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.96	5179284.000	100.00
RUNOFF	1.010	751703.250	14.51
POTENTIAL EVAPOTRANSPIRATION	77.489	57663276.000	
ACTUAL EVAPOTRANSPIRATION	6.420	4777680.500	92.25
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.470	-350092.031	-6.76
SOIL WATER AT START OF YEAR	553.825	412129152.000	
SOIL WATER AT END OF YEAR	553.355	411779072.000	

INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-7.097	0.00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.58	8617257.000	100.00
RUNOFF	1.473	1095850.250	12.72
POTENTIAL EVAPOTRANSPIRATION	77.254	57488208.000	
ACTUAL EVAPOTRANSPIRATION	9.658	7186683.500	83.40
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.450	334694.906	3.88
SOIL WATER AT START OF YEAR	553.355	411779072.000	
SOIL WATER AT END OF YEAR	553.805	412113760.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	28.387	0.00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.55	7850782.000	100.00

RUNOFF	1.304	970393.500	12.36
POTENTIAL EVAPOTRANSPIRATION	76.673	57056368.000	
ACTUAL EVAPOTRANSPIRATION	9.011	6705824.500	85.42
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.235	174591.828	2.22
SOIL WATER AT START OF YEAR	553.805	412113760.000	
SOIL WATER AT END OF YEAR	554.039	412288352.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-28.387	0.00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.66	7932641.500	100.00
RUNOFF	2.074	1543183.125	19.45
POTENTIAL EVAPOTRANSPIRATION	77.232	57471952.000	
ACTUAL EVAPOTRANSPIRATION	9.097	6769792.500	85.34
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.511	-380341.344	-4.79
SOIL WATER AT START OF YEAR	554.039	412288352.000	

SOIL WATER AT END OF YEAR	553.528	411908000.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	7.097	0.00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.01	8193092.500	100.00
RUNOFF	1.548	1151899.000	14.06
POTENTIAL EVAPOTRANSPIRATION	75.901	56481776.000	
ACTUAL EVAPOTRANSPIRATION	9.126	6791020.000	82.89
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.336	250214.984	3.05
SOIL WATER AT START OF YEAR	553.528	411908000.000	
SOIL WATER AT END OF YEAR	553.864	412158208.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-41.161	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT

PRECIPITATION	10.43	7761484.500	100.00
RUNOFF	2.205	1641222.375	21.15
POTENTIAL EVAPOTRANSPIRATION	78.085	58106976.000	
ACTUAL EVAPOTRANSPIRATION	8.243	6134048.500	79.03
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.019	-13852.891	-0.18
SOIL WATER AT START OF YEAR	553.864	412158208.000	
SOIL WATER AT END OF YEAR	553.846	412144384.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	66.000	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.36	5476944.500	100.00
RUNOFF	0.929	691114.188	12.62
POTENTIAL EVAPOTRANSPIRATION	77.147	57409100.000	
ACTUAL EVAPOTRANSPIRATION	7.177	5340730.000	97.51
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.746	-554887.688	-10.13

SOIL WATER AT START OF YEAR	553.846	412144384.000	
SOIL WATER AT END OF YEAR	553.100	411589504.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-12.065	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.70	4985805.000	100.00
RUNOFF	1.405	1045202.812	20.96
POTENTIAL EVAPOTRANSPIRATION	78.052	58082228.000	
ACTUAL EVAPOTRANSPIRATION	5.298	3942235.250	79.07
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.002	-1589.676	-0.03
SOIL WATER AT START OF YEAR	553.100	411589504.000	
SOIL WATER AT END OF YEAR	553.098	411587872.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-43.645	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.77	5782045.500	100.00
RUNOFF	1.201	893559.688	15.45
POTENTIAL EVAPOTRANSPIRATION	77.282	57509108.000	
ACTUAL EVAPOTRANSPIRATION	6.259	4657980.000	80.56
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.310	230503.000	3.99
SOIL WATER AT START OF YEAR	553.098	411587872.000	
SOIL WATER AT END OF YEAR	553.408	411818400.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	2.484	0.00

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.21	4621171.500	100.00
RUNOFF	1.203	895374.188	19.38
POTENTIAL EVAPOTRANSPIRATION	75.597	56255460.000	
ACTUAL EVAPOTRANSPIRATION	4.779	3555970.750	76.95
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		

CHANGE IN WATER STORAGE	0.228	169822.797	3.67
SOIL WATER AT START OF YEAR	553.408	411818400.000	
SOIL WATER AT END OF YEAR	553.636	411988224.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	3.903	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.13	5305789.500	100.00
RUNOFF	0.636	473141.250	8.92
POTENTIAL EVAPOTRANSPIRATION	78.745	58597860.000	
ACTUAL EVAPOTRANSPIRATION	6.670	4963255.000	93.54
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.176	-130625.938	-2.46
SOIL WATER AT START OF YEAR	553.636	411988224.000	
SOIL WATER AT END OF YEAR	553.460	411857568.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	19.161	0.00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.95	8148443.500	100.00
RUNOFF	3.359	2499398.500	30.67
POTENTIAL EVAPOTRANSPIRATION	77.824	57912380.000	
ACTUAL EVAPOTRANSPIRATION	7.733	5754294.500	70.62
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.141	-105236.539	-1.29
SOIL WATER AT START OF YEAR	553.460	411857568.000	
SOIL WATER AT END OF YEAR	553.319	411752352.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-13.484	0.00

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.16	5328114.000	100.00
RUNOFF	0.746	555316.750	10.42
POTENTIAL EVAPOTRANSPIRATION	76.666	57050800.000	
ACTUAL EVAPOTRANSPIRATION	6.168	4589947.500	86.15
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00

AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.246	182812.734	3.43
SOIL WATER AT START OF YEAR	553.319	411752352.000	
SOIL WATER AT END OF YEAR	553.565	411935200.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	36.903	0.00

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.48	4822092.500	100.00
RUNOFF	0.858	638535.500	13.24
POTENTIAL EVAPOTRANSPIRATION	77.183	57436084.000	
ACTUAL EVAPOTRANSPIRATION	5.565	4141166.000	85.88
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.057	42421.637	0.88
SOIL WATER AT START OF YEAR	553.565	411935200.000	
SOIL WATER AT END OF YEAR	553.622	411977600.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-31.226	0.00

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.13	8282390.000	100.00
RUNOFF	2.192	1630820.500	19.69
POTENTIAL EVAPOTRANSPIRATION	77.005	57303156.000	
ACTUAL EVAPOTRANSPIRATION	8.662	6445582.000	77.82
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.277	205976.578	2.49
SOIL WATER AT START OF YEAR	553.622	411977600.000	
SOIL WATER AT END OF YEAR	553.898	412183552.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	10.645	0.00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.07	8981895.000	100.00
RUNOFF	1.561	1161613.250	12.93
POTENTIAL EVAPOTRANSPIRATION	75.945	56514708.000	
ACTUAL EVAPOTRANSPIRATION	10.626	7907093.500	88.03
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00

PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.117	-86796.305	-0.97
SOIL WATER AT START OF YEAR	553.898	412183552.000	
SOIL WATER AT END OF YEAR	553.782	412096768.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-15.613	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.66	8676789.000	100.00
RUNOFF	2.070	1540065.875	17.75
POTENTIAL EVAPOTRANSPIRATION	77.882	57955628.000	
ACTUAL EVAPOTRANSPIRATION	9.942	7398248.500	85.26
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.351	-261524.391	-3.01
SOIL WATER AT START OF YEAR	553.782	412096768.000	
SOIL WATER AT END OF YEAR	553.430	411835264.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.710	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.86	11058069.000	100.00
RUNOFF	1.860	1384078.375	12.52
POTENTIAL EVAPOTRANSPIRATION	77.591	57739340.000	
ACTUAL EVAPOTRANSPIRATION	12.460	9272262.000	83.85
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.540	401688.375	3.63
SOIL WATER AT START OF YEAR	553.430	411835264.000	
SOIL WATER AT END OF YEAR	553.970	412236928.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	41.161	0.00

ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.54	10075791.000	100.00
RUNOFF	1.323	984453.438	9.77
POTENTIAL EVAPOTRANSPIRATION	74.171	55194268.000	
ACTUAL EVAPOTRANSPIRATION	12.523	9318839.000	92.49
DRAINAGE COLLECTED FROM LAYER 6	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 7	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0000		

DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.306	-227459.922	-2.26
SOIL WATER AT START OF YEAR	553.970	412236928.000	
SOIL WATER AT END OF YEAR	553.665	412009472.000	
INTERCEPTION WATER AT START OF YEAR	0.000	0.000	
INTERCEPTION WATER AT END OF YEAR	0.000	0.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-42.581	0.00

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FINAL WATER STORAGE AT END OF YEAR 28

LAYER	(INCHES)	(VOL/VOL)
1	2.0089	0.1674
2	4.4640	0.1240
3	1.6080	0.1340
4	544.8000	0.2000
5	0.6000	0.0250
6	0.0012	0.0060
7	0.0000	0.0000
8	0.0012	0.0060
9	0.0000	0.0000
10	0.1800	0.7500

TOTAL WATER IN LAYERS	553.663
SNOW WATER	0.000
INTERCEPTION WATER	0.000
TOTAL FINAL WATER	553.663

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 28

	(INCHES)	(CU. FT.)
PRECIPITATION	2.28	1696662.000
RUNOFF	1.704	1268329.1250
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.61	455364.3438
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1941	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1040	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 28

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.25	0.29	0.23	0.37	0.72	0.80
	1.32	2.24	1.49	1.07	0.45	0.37
STD. DEVIATIONS	0.24	0.20	0.22	0.42	0.79	0.63
	0.69	1.60	0.90	1.04	0.55	0.30
RUNOFF						
TOTALS	0.001	0.000	0.000	0.061	0.115	0.089
	0.098	0.425	0.296	0.240	0.014	0.028
STD. DEVIATIONS	0.005	0.000	0.000	0.146	0.242	0.160

	0.174	0.596	0.364	0.367	0.045	0.092

POTENTIAL EVAPOTRANSPIRATION

TOTALS	3.125	3.589	5.452	7.559	9.413	10.513
	10.027	8.928	6.935	5.169	3.497	2.769
STD. DEVIATIONS	0.193	0.240	0.300	0.309	0.281	0.270
	0.251	0.283	0.253	0.271	0.194	0.206

ACTUAL EVAPOTRANSPIRATION

TOTALS	0.226	0.187	0.182	0.336	1.273	0.872
	1.214	1.598	1.057	0.618	0.384	0.285
STD. DEVIATIONS	0.104	0.064	0.119	0.167	0.555	0.631
	0.653	0.953	0.556	0.377	0.259	0.156

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 28

	INCHES		CU. FEET	PERCENT
PRECIPITATION	9.60	(2.272)	7144638.0	100.00
RUNOFF	1.369	(0.6754)	1018830.19	14.260
POTENTIAL EVAPOTRANSPIRATION	76.979	(0.9113)	57283916.00	
ACTUAL EVAPOTRANSPIRATION	8.230	(1.9033)	6124720.00	85.725
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.001	(0.3981)	1088.44	0.015

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Exhibit I

Guidance Document

for

Performance Demonstration for an Alternate Cover Design under Section 502.A.2 of the New Mexico Solid Waste Management Regulations (20 NMAC 9.1) Using HELP Modeling

and

Performance Demonstration for an Alternate Liner Design under Section 306.A.2 of the New Mexico Solid Waste Management Regulations (20 NMAC 9.1) Using HELP Modeling

This document is for guidance only and is subject to change. However, any deviations from this document must be fully justified to the satisfaction of the Department.

Prepared by the
New Mexico Environment Department
Solid Waste Bureau
Permit Section
April 1, 1998

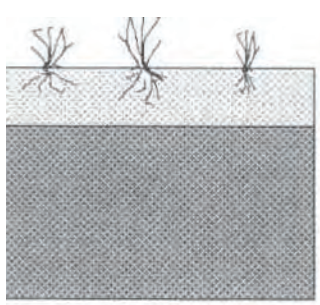
Performance Demonstration for an Alternative <u>Cover</u> Design under Section 502.A.2 of the New Mexico Solid Waste Management Regulations (20 NMAC 9.1) Using HELP Modeling

1. Existing Solid Waste Landfills without a Liner System:

A prescriptive landfill <u>cover</u> system must, in accordance with Section 502.A. l, consist of an infiltration layer comprised of a minimum of 18 inches of earthen material with the required hydraulic conductivity (K) and a minimum of 6 inches of soil that is capable of sustaining native plant growth as an erosion layer (Figure 1). The cover component of 18 inches of earthen material must be equivalent to the least hydraulically conductive natural subsoils or a saturated hydraulic conductivity of no greater than 1 x 10-s cm/sec. For example, if the hydraulic conductivity of the natural subsoils is 5 x 10^{-6} cm/sec, then the K of the infiltration layer material must be equivalent to these soils. *However, this example is for modeling purposes only. If the K of the underlying subsoils is less than 1 x 10^{-5} cm/sec (e.g., 5 x 10^{-6} cm/sec), then an alternative cover design must be proposed since 1 x 10^{-5} cm/sec is the lowest acceptable actual Kfor soils used in covers due to desiccation and root penetration (see example below).* If the hydraulic conductivity of the natural subsoils is greater than 1 x l0^{-5} cm/sec (e.g., 1 x 1Q-4 cm/sec), the K of the infiltration layer material must equate to the 1 x 10^{-5} cm/sec requirement.

If the infiltration layer meets the minimum hydraulic conductivity of 1 x 10-s cm/sec or that of the natural subsoils and the minimum 18 inch condition then a Hydrologic Evaluation of Landfill Performance (HELP) Model simulation is not required. If an alternative cover design is proposed, it must achieve an equivalent reduction in infiltration as the infiltration layer specified in Section 502.A.1.a. Therefore, a HELP Model simulation is required to demonstrate that the design of such a cover provides equivalent reduction in infiltration as the prescriptive cover design. If the natural subsoils have a hydraulic conductivity ofless than 1 x 10-s cm/sec (e.g., 5 x 10^{-6} cm/sec), then the cover must achieve equivalent reduction in infiltration as that of the prescriptive cover but with an 18 inch infiltration layer with a hydraulic conductivity of 5 x 10^{-6} cm/sec.

Prescriptive Cover System (*for modeling only)



6 inch Erosion/Vegetative Layer

18 inch [K= 1 x 10^{-5} cm/sec (or less*)]

Figure 1. Prescriptive Cover System

A demonstration of equivalent reduction in infiltration is determined by using the EPA HELP Model. The HELP Model simulations need to compare the prescriptive cover and the alternative cover design (Figure 2). The simulation for the prescriptive cover must include the erosion, infiltration and intermediate cover layers. The alternative cover design simulation includes the intermediate and alternative cover layers. The two designs are to be simulated for years 1 through 5 with "poor" vegetation during the post-closure care period to demonstrate equivalency (Simulations #1 & #2). In New Mexico, it is assumed for a conservative value that the vegetation will be between "bare ground" and "fair vegetation" designated as "poor vegetation". Precipitation (wettest 5 consecutive year period using Climatedata CD or NOAA data files: discs or manual entry), evapotranspiration, temperature (use values associated with wettest 5 consecutive years of precipitation), and solar radiation data must be site specific and identical for both alternative and prescriptive cover designs simulations. Provide justification for all input parameters in the model utilizing the attached forms. Indicate characteristics of on-site or other sources of soil proposed for the construction of cover and the parameter values in the model. It is anticipated that the entire area of the landfill or cell will be modeled. The Department recommends initializing the soil moisture content to be the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity - wilting point) x 0.25 + wilting point]. Other values deviating from this range may be used but must be fully justified. The leaf area index may be between 0.8 and 1.6 depending on the site location. The evaporative zone depth may be between 18" and 28" depending on the site location.

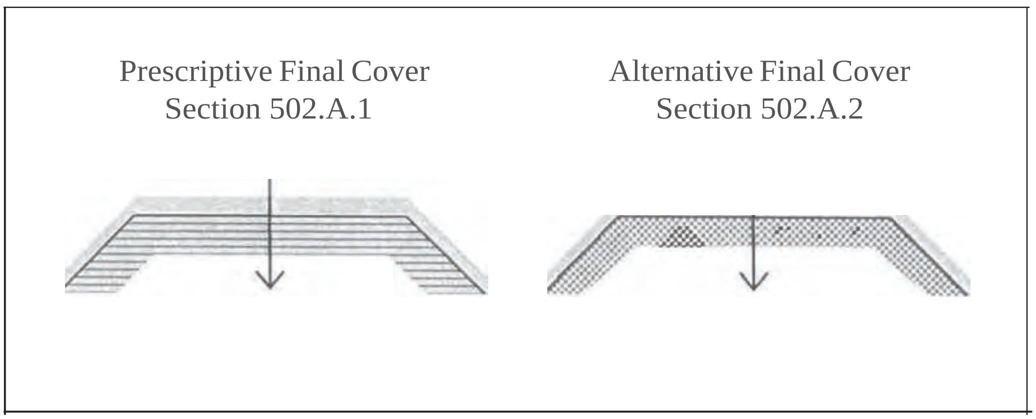


Figure 2

For example, comparing the prescriptive cover of:

1) 6 inches of topsoil
2) 18 inches of compacted soil (K = 5 x 10^{-6} cm/sec* - to meet natural subsoils K = 5 x 10^{-6})
3) Intermediate cover layer (optional* for modeling purposes) [*unless an intermediate cover layer is used for modeling purposes with a proposed alternative cover system (see below), then an intermediate cover layer must be used for modeling purposes]

with a proposed alternative cover system of:

1) 6 inches of topsoil
2) 30 inches of compacted (K = 1 x 10^{-5} cm/sec*)
3) Intermediate cover layer (optional for modeling purposes)

* K = 5 x 10^{-6} cm/sec is for modeling purposes only since 1 x 10^{-5} cm/sec is the lowest acceptable actual K for soils used in covers. Even if soils with K = 5 x 10^{-6} cm/sec are available for use in the cover, over time the K will increase to 1 x 10^{-5} cm/sec due to desiccation and root penetration.

Input Parameters for HELP Simulation #1 (Prescriptive Cover)

Weather data

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 18" to 28" corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Clovis would be 20"; Santa Fe and Roswell would be 24"; Las Cruces, Albuquerque, and Farmington would be 28")

Maximum leaf area index: 0.8 to 1.6 corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 3 - e.g., Clovis would be 1.6; Santa Fe and Roswell would be 1.2; Farmington would be 1.0; Las Cruces and Albuquerque would be 0.8)

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from the wettest 5 consecutive years for the appropriate weather reporting station

Temperature: daily* minimum and maximum temperatures corresponding with the wettest 5 consecutive years for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: Type 2 for "poor"

SCS Runoff curve#: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 100%; "closed"

Surface area: entire disposal area of landfill

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number oflayers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 6" of topsoil, 18" of infiltration layer, 12" of intermediate cover layer* [*optional for modeling purposes (unless an intermediate cover layer is used for modeling purposes with a proposed alternative cover system in Simulation #2, then an intermediate cover layer must be used for modeling purposes)]

Layer type: "1" vertical percolation layer for all cover materials

Soil texture: The texture# should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content should be initialized to be the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity - wilting point) x 0.25 + wilting point].

Saturated hydraulic conductivity **(K):** The K of the infiltration layer must be the greatest actual value (unless greater than lx 10^{-5} cm/sec*) of the underlying soil [e.g., If the actual (two tested samples - different locations) K of the underlying soil= lx 10^{-6} cm/sec and 2 x 10-6, then model 18" of2 x 10^{-6} cm/sec for the infiltration layer; *If the K of the underlying soil = 5 x 10^{-5} cm/sec, then model 18" of lx 10^{-5} cm/sec].

Input Parameters for HELP Simulation #2 (Proposed Alternate Cover)

Weather data (must be the same as Simulation #1)

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 18" to 28" corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Clovis would be 20"; Santa Fe and Roswell would be 24"; Las Cruces, Albuquerque, and Farmington would be 28")

Maximum leaf area index: 0.8 to 1.6 corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 3 - e.g., Clovis would be 1.6; Santa Fe and Roswell would be 1.2; Farmington would be 1.0; Las Cruces and Albuquerque would be 0.8)

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from the wettest 5 consecutive years for the appropriate weather reporting station

Temperature: daily* minimum and maximum temperatures corresponding with the wettest 5 consecutive years for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: Type 2 for "poor"

SCS Runoff curve #: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 100%; "closed"

Surface area: entire disposal area of landfill

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number oflayers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 6" of topsoil, 18" to proposed thickness of infiltration layer, 12" of intermediate cover layer* (*optional for modeling purposes)

Layer type: "1" vertical percolation layer for all* cover materials including GCLs used (*consult with the Department if a FML is proposed to be used in the cover)

Soil texture: The texture# should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content should be initialized to be the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity- wilting point) x 0.25 + wilting point].

Saturated hydraulic conductivity (K): The K must be tested for the actual value unless the K is less than 1×10^{-5} cm/sec* (e.g., If the tested K is 5×10^{-5} cm/sec, then model the proposed thickness of the infiltration layer at 5×10^{-5} cm/sec. However, if the tested K is 2×10^{-6}, the lowest value to be modeled would be 1×10^{-5} cm/sec). *I x 10^{-5} cm/sec is the lowest acceptable K for soils used in covers due to desiccation and root penetration; unless a GCL is proposed, then the actual K may be modeled for the GCL layer (i.e., 0.24" at 3×10^{-9} cm/sec).

2. New Solid Waste Landfills:

As in the above case, the cover for the proposed landfill with a prescriptive or alternative liner must achieve an equivalent protection as the liner. If an alternative final cover is proposed for the landfill, then a demonstration must be submitted to the Bureau for approval pursuant to Section 502.A. It must be determined by this demonstration that the proposed final cover design includes an infiltration layer that achieves an equivalent reduction in infiltration as the bottom liner (Figure 3). A HELP Model simulation comparison is acceptable for this demonstration for a 5 year period with vegetation. Precipitation (wettest 5 consecutive year period using Climatedata CD or NOAA data files: discs or manual entry), evapotranspiration, temperature (use values associated with wettest 5 consecutive years of precipitation) , and solar radiation data must be site specific and identical for both liner and cover design simulations. Provide justification for all input parameters in the model utilizing the attached forms. Demonstrate the relationship of the characteristics of on-site or other sources of soil proposed for the construction of cover or liner and the parameter values in the model. It is anticipated that the entire area of the landfill or cell will be modeled. The Department recommends initializing the soil moisture content to be at least the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity - wilting point) x 0.25 + wilting point]. Other values deviating from this range may be used but must be fully justified.

For example, the comparison must include a HELP Model simulation for the liner and the proposed final cover systems as below (see Simulations #4 & #3, respectively).

The simulation for an alternative liner system* could include:

1) the drainage/protective layer of the liner with leachate collection system,
2) the 60-mil HDPE FML,
3) the 0.25 inch ($K = 3 \times 10^{-9}$) GCL (geosynthetic clay liner),
4) the 6 inches of compacted in situ soil used as the prepared subgrade, and
5) with the solid waste cell open and no runoff.

*Any alternative liner system must meet the demonstration as described in the "Performance Demonstration For An Alternative Liner Design under Section 306.A.2 of the New Mexico Solid Waste Management Regulations (20 NMAC 9.1) Using HELP Modeling".

A liner system is compared with a HELP Model simulation for a proposed final cover:

1) 18 inches non-compacted material (6 inches of topsoil with poor grass and 12 inches of non-compacted soil),
2) the 0.25 inch GCL ($K = 3 \times 10^{-9}$),
3) 12 inches of intermediate cover (6 inches of compacted soil and 6 inches of non-compacted soil), and
4) with the solid waste cell closed and final placement of the cover to include runoff.

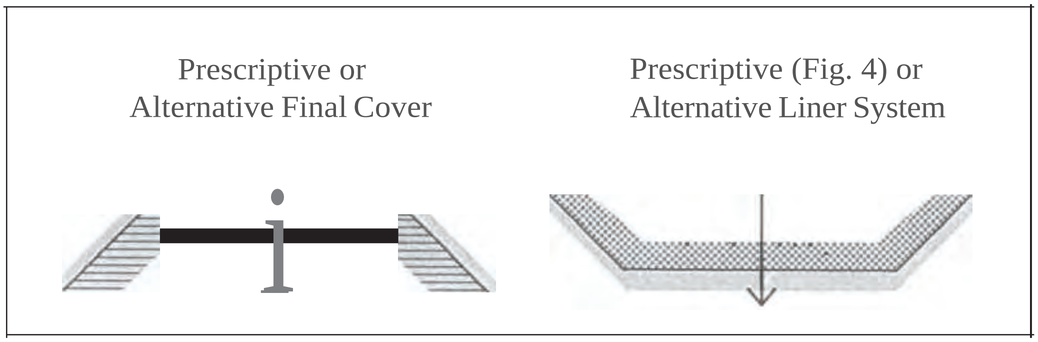


Figure 3

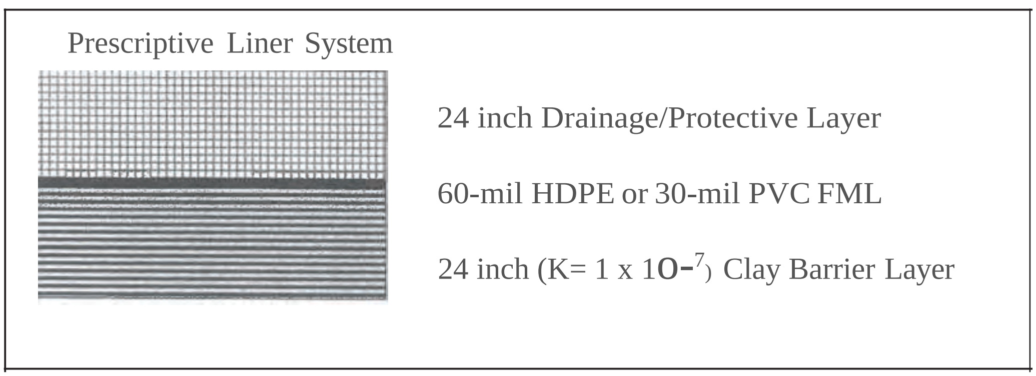


Figure 4

Input Parameters for HELP Simulation #3 (Proposed Alternate Cover)

Weather data

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 18" to 28" corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Clovis would be 20"; Santa Fe and Roswell would be 24"; Las Cruces, Albuquerque, and Farmington would be 28")

Maximum leaf area index: 0.8 to 1.6 corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 3 - e.g., Clovis would be 1.6; Santa Fe and Roswell would be 1.2; Farmington would be 1.0; Las Cruces and Albuquerque would be 0.8)

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from the wettest 5 consecutive years for the appropriate weather reporting station

Temperature: daily* minimum and maximum temperatures corresponding with the wettest 5 consecutive years for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: Type 2 for "poor"

SCS Runoff curve #: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 100%; "closed"

Surface area: entire disposal area of landfill or cell (leachate collection basin)

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number of layers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 6" of topsoil, Proposed thickness of infiltration layer or rooting medium or drainage layer, Possible GCL (0.24") or FML, subgrade thickness for GCL or FML (minimum of 6"), 12" of intermediate cover layer* (*optional for modeling purposes)

Layer type: Type "1" - vertical percolation layer for all* cover materials including GCLs used (*consult with the Department if a FML is proposed to be used in the cover)

Soil texture: The texture # should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content should be initialized to be the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity - wilting point) x 0.25 + wilting point].

Saturated hydraulic conductivity (K): The K must be tested for the actual value unless the K is less than 1 x 10^{-5} cm/sec* (e.g., If the tested K is 5 x 10^{-5} cm/sec, then model the proposed thickness of the infiltration layer at 5 x 10^{-5} cm/sec. However, if the tested K is 2 x 10^{-6}, the lowest value to be modeled would be 1 x 10^{-5} cm/sec). *1 x 10^{-5} cm/sec is the lowest acceptable K for soils used in covers due to desiccation and root penetration; unless a GCL is proposed, then the actual K may be modeled for the GCL layer (i.e., 0.24" at 3 x 10^{-9} cm/sec).

Input Parameters for HELP Simulation #4 (Prescriptive Liner or Proposed Alternate Liner - Tier I)

Weather data (must be the same as Simulation #3)

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 12" to 18" corresponding with bare ground (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Santa Fe and Roswell would be 14"; Las Cruces, Albuquerque, and Farmington would be 18")

Maximum leaf area index: 0.0 corresponding with bare ground

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from the wettest 5 consecutive years for the appropriate weather reporting station

Temperature: daily* minimum and maximum temperatures corresponding with the wettest 5 consecutive years for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: Type 1 for "bare ground"

SCS Runoff curve #: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 0%; "open"

Surface area: entire disposal area of landfill or cell (leachate collection basin)

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number of layers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 24" of drainage/protection layer, possible geonet*, FML, 24" of 1 x 10^{-7} cm/sec clay barrier layer for prescriptive liner or GCL or other proposed thickness of clay barrier layer for an alternate liner. (*A demonstration that no more than one foot of head will be on the liner must be made for this simulation. Therefore, a geonet may be necessary if the 24" drainage layer material is incapable of transmitting leachate so 12" of head is not on the liner.)

Layer type: Type "2" for lateral drainage layer - slope (minimum of 2%) and drainage length must be designated (consult with the Department if leachate recirculation is proposed); Type "4" for geomembrane liners - geomembrane pinhole density of 1/acre, geomembrane installation defects of 4/acre and liner installation quality of "good"; Type "3" for barrier soil layers including GCLs (any soil layer underlying a geomembrane must be considered to be a barrier soil layer)

Soil texture: The texture # should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content should be initialized to be the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity - wilting point) x 0.25 + wilting point].

Saturated hydraulic conductivity (K): For the 24" of drainage/protection layer use the tested K* for modeling the prescriptive liner design and for a proposed alternate liner design; for a possible geonet use the lowest value from the manufacture's specifications; for the FML use a K* value which is the greatest value from the manufacture's specifications; 24" of 1 x 10^{-7} cm/sec clay barrier layer for prescriptive liner or GCL (3 x 10^{-9} cm/sec) or other proposed soil barrier layer for an alternate liner. (*must be the same value in both Simulation #5 & #6)

Performance Demonstration for an Alternate Liner Design under Section 306.A.2 of the New Mexico Solid Waste Management Regulations (20 NMAC 9.1) Using HELP Modeling

1. Permit applicants proposing an alternate liner in accordance with Section 306.A.2 must demonstrate the liner"... provides equivalent protection as the composite liner ... and ensures concentration values listed in Section 1110 will not be exceeded in the uppermost aquifer ... ". This requires that a two tier demonstration be made:

Tier 1 - the alternative liner provides equivalent protection, and

Tier 2 - the alternate liner ensures the uppermost aquifer will be protected.

The first tier of this demonstration may be satisfied through mathematical modeling using the EPA Hydrologic Evaluation of Landfill Performance (HELP) model. Two computer modeling analyses must be performed - (1) an analysis of the composite liner as specified in Section 306.A.l and (2) an analysis of the proposed alternate liner as specified in Section 306.A.2. Each of these analyses must be performed under identical hydrologic and climatologic loading conditions of five years with no solid waste in the landfill (see Simulations #5 & 6). This time period is necessary to adequately evaluate the performance of the two liners. A successful demonstration of equivalent protection has been made when the analyses show equal or less percolation/leakage through the bottom layer of the proposed alternate liner than the percolation/leakage through the bottom layer of the Section 306.A.1 composite liner (Figure 5).

The second tier of the demonstration must include HELP modeling of the actual design conditions and the entire operational development of the landfill as closely as possible by doing a succession of model simulations which consider the factors in Section 306.A.2.a. To aid in accomplishing this, each successive computer simulation must use the previous simulation's moisture content output as the input for the following simulation (Figure 6). The modeling design method must be fully described. If no leakage is indicated at the end of the second simulation (#8) and subsequent simulations (#9 & #10) continue to indicate no leakage, then a successful demonstration has been made that the uppermost aquifer will be protected as required by Section 306.A.2 and it will not be necessary to perform a fate and transport modeling.

2. Justification for all input parameters in the HELP modeling must be provided utilizing the attached forms. Demonstrate the relationship of the characteristics of the soil proposed for the construction and operation of the landfill and the parameter values used in the model. Show justification for the soil and waste moisture content parameters as well as geomembrane liner data and storm water runoff fractions. The initial moisture content of the soil should be initialized by the use in the HELP model. The Department recommends initializing the soil moisture content to be the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity - wilting point) x 0.25 + wilting point]. Other values deviating from this range may be used but must be fully justified.

3(1) First Tier of the Demonstration

Two simulations must be made, one of the Section 306.A.1 specified liner and one of the proposed alternate liner, both using the same precipitation (wettest 5 consecutive year period using Climatedata or NOAA tapes), temperature (use values associated with 5 wettest consecutive years), solar radiation, and evapotranspiration data (see Simulations #5 & #6). Current historic NOAA weather data from the nearest representative weather station as published by the National Climatic Data Center in Asheville, North Carolina must be used for the precipitation and temperature files. Both simulations must be made for the landfill in the open condition with no run-off and a Leaf Area Index of zero. *Simulations:*

#5 A simulation for the specified liner design must be performed using a 24 inch protective layer, a lateral drainage layer (which may be integral with the protective layer), an FML, and a 24 inch barrier layer of soil with a saturated hydraulic conductivity of 1 x 10^{-7} cm/sec. This simulation must be performed using no solid waste and for a five year period.

#6 A simulation for the proposed alternate liner design must be performed using a 24 inch protective layer, a lateral drainage layer (which may be integral with the protective layer), and the other proposed liner layer (the bottom layer must be modeled as a barrier layer). This simulation must be performed using no solid waste and for a five year period.

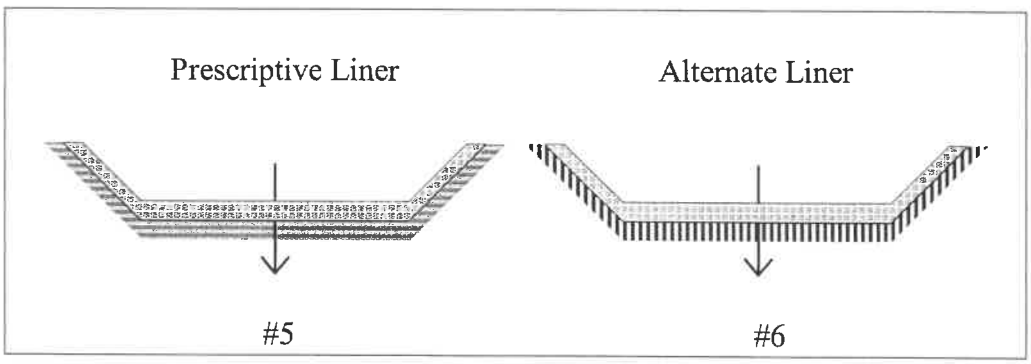


Figure 5

Compare the average annual percolation from the bottom layer of the two simulations. If the percolation is equivalent, a successful demonstration has been made for the first tier.

Input Parameters for HELP Simulation #5* (Prescriptive Liner - Tier I)

same as Simulation #4 with prescriptive liner design

Input Parameters for HELP Simulation #6* (Proposed Alternate Liner - Tier I)

same as Simulation #4 with proposed alternate liner design

*One of these simulations will also serve for the alternate cover design equivalency demonstration.

3(2) Second Tier of the Demonstration

Four simulations encompassing the entire life cycle of the facility to model actual design conditions and operational development as closely as possible must be performed (see Simulations #7, #8, #9 & #10). This is accomplished through a succession of four model simulations: one simulation of the open landfill, a second with the landfill partially filled with solid waste, a third with the landfill in the closed condition with bare ground, and a fourth with the landfill in the closed condition with "poor" vegetation. *Simulations:*

#7 The initial simulation must model the open landfill at start-up when the landfill contains no solid waste. The time period should extend for the anticipated duration of this condition (a minimum of two years).

#8 A succeeding simulation to model conditions of the partially filled landfill for a five year period*. This would incorporate daily and intermediate covers. (*This period may vary in accordance with anticipated operations.)

#9 Model the landfill in the closed condition with bare ground (a minimum of a two years).

#10 Finally, perform a simulation to model the landfill in the closed condition with poor vegetation for remainder of the post-closure care period (a minimum of 28 years).

If the simulations indicate no leakage after the third simulation (#9) and the subsequent simulation (#10), then the simulations have served to demonstrate the concentration values delineated in Section 1110 of the Regulations will not be exceeded in the uppermost aquifer at the relative point of compliance. Therefore, a successful demonstration has been made for the second tier.

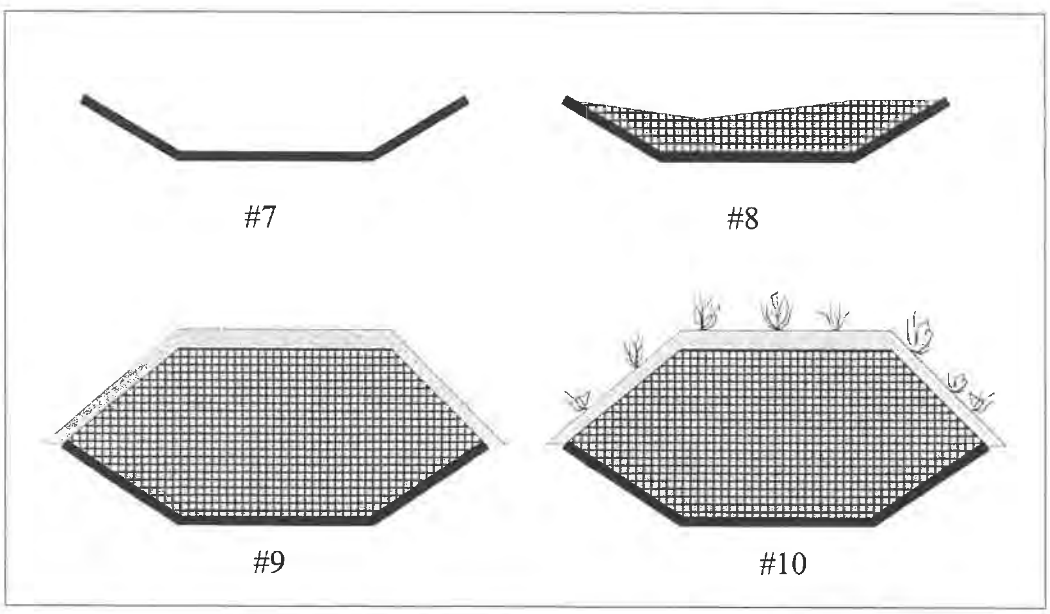


Figure 6

Inout Parameters for HELP Simulation #7 (Prooosed Alternate Liner - Tier II)

Weather data (must be the same as Simulation #3)

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 12" to 18" corresponding with bare ground (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Santa Fe and Roswell would be 14"; Las Cruces, Albuquerque, and Farmington would be 18")

Maximum leaf area index: 0.0 corresponding with bare ground

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from 2 consecutive years for the appropriate weather reporting station

Temperature: daily* minimum and maximum temperatures corresponding with 2 consecutive years for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: Type 1 for "bare ground"

SCS Runoff curve#: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 0%; "open"

Surface area: entire disposal area oflandfill or cell (leachate collection basin)

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number oflayers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 24" of drainage/protection layer, possible geonet, FML, 24" of 1 x 10^{-7} cm/sec clay barrier layer for prescriptive liner or GCL or other proposed thickness of clay barrier layer for an alternate liner.

Layer type: Type "2" for lateral drainage layer - slope (minimum of 2%) and drainage length must be designated (consult with the Department if leachate recirculation is proposed); Type "4" for geomembrane liners - geomembrane pinhole density of 1/acre, geomembrane installation defects of 4/acre and liner installation quality of "good"; Type "3" for barrier soil layers including GCLs (any soil layer underlying a geomembrane must be considered to be a barrier soil layer)

Soil texture: The texture# should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content should be initialized to be the value of the wilting point plus 25% of the difference between the wilting point and the field capacity [i.e., (field capacity- wilting point) x 0.25 + wilting point].

Saturated hydraulic conductivity (K): For the 24" of drainage/protection layer use the tested K for modeling the proposed alternate liner design; for a possible geonet use the lowest value from the manufacture's specifications; for the FML use a K value which is the greatest value from the manufacture's specifications; GCL (3 x 10^{-9} cm/sec) or other proposed soil barrier layer for an alternate liner.

Input Parameters for HELP Simulation #8 (Proposed Alternate Liner - Tier II)

Weather data (must be the same as Simulation #3)

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 12" to 18" corresponding with bare ground (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Santa Fe and Roswell would be 14"; Las Cruces, Albuquerque, and Farmington would be 18")

Maximum leaf area index: 0.0 corresponding with bare ground

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from 2 to 5* consecutive years for the appropriate weather reporting station (*may vary with landfill operations)

Temperature: daily* minimum and maximum temperatures corresponding with 2 to 5 years (same years as precipitation) for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: bare ground

SCS Runoff curve#: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 0%; "open"

Surface area: entire disposal area oflandfill or cell (leachate collection basin)

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number of layers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 240" of solid waste (this thickness may vary depending on landfill operations); 24" of drainage/protection layer; possible geonet*; FML; 24" of 1 x 10^{-7} cm/sec clay barrier layer for prescriptive liner or GCL or other proposed thickness of clay barrier layer for an alternate liner.

Layer type: Type "l ", vertical percolation layer, must be used for solid waste. Type "2" for lateral drainage layer - slope (minimum of 2%) and drainage length must be designated (consult with the Department if leachate recirculation is proposed); Type "4" for geomembrane liners - geomembrane pinhole density of 1/acre, geomembrane installation defects of 4/acre and liner installation quality of "good"; Type "3" for barrier soil layers including GCLs (any soil layer underlying a geomembrane must be considered to be a barrier soil layer)

Soil texture: The texture# should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content must be initialized to be the value of the previous simulation's (from Simulation #7) moisture content output as the input for the following simulation (Simulation #8). For compacted municipal solid waste with a HELP soil texture number of"l8" use 20%* by volume/volume (which is greater than per mass basis - see EPA HELP User's Guide for Version 3 for conversion) (*a lower value may be used if justified)

Saturated hydraulic conductivity **(K):** For compacted municipal solid waste with a HELP soil texture number of" 18" will have a **K** of 1 x 10^{-3} cm/sec. For the 24" of drainage/protection layer use the tested K for modeling the proposed alternate liner design; for a possible geonet use the lowest value from the manufacture's specifications; for the FML use a K value which is the greatest value from the manufacture's specifications; GCL (3 x 10^{-9} cm/sec) or other proposed soil barrier layer for an alternate liner.

Input Parameters for HELP Simulation #9 (Proposed Alternate Liner -Tier II)

Weather data

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 12" to 18" corresponding with bare ground (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Santa Fe and Roswell would be 14"; Las Cruces, Albuquerque, and Farmington would be 18")

Maximum leaf area index: 0.0 corresponding with bare ground

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from 2 consecutive years for the appropriate weather reporting station

Temperature: daily* minimum and maximum temperatures corresponding with 2 consecutive years for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: Type 1 for "bare ground"

SCS Runoff curve#: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 100%; "closed"

Surface area: entire disposal area of landfill or cell (leachate collection basin)

3710
3490
220

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number oflayers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 6" of topsoil, Proposed thickness of infiltration layer or rooting medium or drainage layer, Possible GCL (0.24") or FML, subgrade thickness for GCL or FML (minimum of 6"), 12" of intermediate cover layer* (*optional for modeling); Proposed thickness of solid waste (this thickness will vary depending on landfill design); 24" of drainage/protection layer; possible geonet*; FML; 24" of 1 x 10^{-7} cm/sec clay barrier layer for prescriptive liner or GCL or other proposed thickness of clay barrier layer for an alternate liner.

Layer type: Type "1" - vertical percolation layer for all* cover materials including GCLs used in the cover (*consult with the Department if a FML is proposed to be used in the cover).Type "l ", vertical percolation layer, must be used for solid waste. Type "2" for lateral drainage layer - slope (minimum of2%) and drainage length must be designated (consult with the Department if leachate recirculation is proposed); Type "4" for geomembrane liners - geomembrane pinhole density of 1/acre, geomembrane installation defects of 4/acre and liner installation quality of "good"; Type "3" for barrier soil layers including GCLs (any soil layer underlying a geomembrane must be considered to be a barrier soil layer)

Soil texture: The texture# should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content must be initialized to be the value of the previous simulation's (from Simulation #8) moisture content output as the input for the following simulation (Simulation #9).

Saturated hydraulic conductivity (K): The K must be tested for the actual value unless the K is less than 1 x 10^{-5} cm/sec* (e.g., If the tested K is 5 x 10^{-5} cm/sec, then model the proposed thickness of the infiltration layer at 5 x 10^{-5} cm/sec. However, if the tested K is 2 x 10-6, the lowest value to be modeled would be 1 x 10^{-5} cm/sec). *1 x 10^{-5} cm/sec is the lowest acceptable K for soils used in covers due to desiccation and root penetration; unless a GCL is proposed, then the actual K may be modeled for the GCL layer (i.e., 0.24" at 3 x 10^{-9} cm/sec). For compacted municipal solid waste with a HELP soil texture number of "18" will have a K of 1 x 10^{-3} cm/sec. For the 24" of drainage/protection layer use the tested K for modeling the proposed alternate liner design; for a possible geonet use the lowest value from the manufacture's specifications; for the FML use a K value which is the greatest value from the manufacture's specifications; GCL (3 x 10^{-9} cm/sec) or other proposed soil barrier layer for an alternate liner.

Input Parameters for HELP Simulation #10 (Proposed Alternate Liner - Tier II)

Weather data

City/State: The weather data should be from the nearest reporting station that has at least 40 years of data.

Latitude: The latitude must be specific for the site to use in synthesizing solar radiation data.

Evaporative zone depth: 18" to 28" corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 5 - e.g., Clovis would be 20"; Santa Fe and Roswell would be 24"; Las Cruces, Albuquerque, and Farmington would be 28")

Maximum leaf area index: 0.8 to 1.6 corresponding with "poor" vegetation (see EPA Engineering Documentation for Version 3, Figure 3 - e.g., Clovis would be 1.6; Santa Fe and Roswell would be 1.2; Farmington would be 1.0; Las Cruces and Albuquerque would be 0.8)

Growing season start and end day: from solar radiation data (default)

Average wind speed: from solar radiation data (default)

Relative humidity: from solar radiation data (default)

Precipitation: daily precipitation from 28 consecutive years for the appropriate weather reporting station

Temperature: daily* minimum and maximum temperatures corresponding with 28 consecutive years for the appropriate weather reporting station
(*may be monthly averages if manual entry is used)

Solar radiation data: synthetically generated using coefficients for the appropriate* default (HELP) weather reporting station (*should be the closest by distance or latitude - consult with the Department if the appropriate station is not obvious)

Landfill Cover Data

Type of vegetation: Type 2 for "poor"

SCS Runoff curve#: may be generated from HELP or user specified* (*must be justified)

% of area allowing runoff: 100%; "closed"

Surface area: entire disposal area of landfill or cell (leachate collection basin)

Soil and Design Data

Source of soil characteristics: geotechnical data should be obtained from the source material.

Number oflayers: There should be a layer for each type of material used (or compacted v. non-compacted)

Layer Number: (There should be a justification sheet for each layer.)

Thickness: 6" of topsoil, Proposed thickness of infiltration layer or rooting medium or drainage layer, Possible GCL (0.24") or FML, subgrade thickness for GCL or FML (minimum of 6"), 12" of intermediate cover layer* (*optional for modeling); Proposed thickness of solid waste (this thickness will vary depending on landfill design); 24" of drainage/protection layer; possible geonet*; FML; 24" of 1 x 10^{-7} cm/sec clay barrier layer for prescriptive liner or GCL or other proposed thickness of clay barrier layer for an alternate liner.

Layer type: Type "l" - vertical percolation layer for all* cover materials including GCLs used (*consult with the Department if a FML is proposed to be used in the cover). Type "l", vertical percolation layer, must be used for solid waste. Type "2" for lateral drainage layer - slope (minimum of 2%) and drainage length must be designated (consult with the Department ifleachate recirculation is proposed); Type "4" for geomembrane liners - geomembrane pinhole density of I/acre, geomembrane installation defects of 4/acre and liner installation quality of "good"; Type "3" for barrier soil layers including GCLs (any soil layer underlying a geomembrane must be considered to be a barrier soil layer)

Soil texture: The texture# should approximate the geotechnical characteristics (see EPA HELP User's Guide for Version 3, Table 4).

Total porosity: If the actual porosity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Field capacity: If the actual field capacity is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Wilting point: If the actual wilting point is not known, then the default value may be used that most closely approximates the geotechnical characteristics.

Moisture content: The moisture content must be initialized to be the value of the previous simulation's (from Simulation #9) moisture content output as the input for the following simulation (Simulation #10).

Saturated hydraulic conductivity (K): The K must be tested for the actual value unless the K is less than 1 x 10^{-5} cm/sec* (e.g., If the tested K is 5 x 10^{-5} cm/sec, then model the proposed thickness of the infiltration layer at 5 x 10^{-5} cm/sec. However, if the tested K is 2 x 10^{-6}, the lowest value to be modeled would be 1 x 10^{-5} cm/sec). *1 x 10^{-5} cm/sec is the lowest acceptable K for soils used in covers due to desiccation and root penetration; unless a GCL is proposed, then the actual K may be modeled for the GCL layer (i.e., 0.24" at 3 x 10^{-9} cm/sec). For compacted municipal solid waste with a HELP soil texture number of "18" will have a K of 1 x 10^{-3} cm/sec. For the 24" of drainage/protection layer use the tested K for modeling the proposed alternate liner design; for a possible geonet use the lowest value from the manufacture's specifications; for the FML use a K value which is the greatest value from the manufacture's specifications; GCL (3 x 10^{-9} cm/sec) or other proposed soil barrier layer for an alternate liner.

Eguivalencv Demonstrations

Typical "New" Landfill:

Alternate Cover Design Equivalency Demonstration (two simulations)

Simulation #3 & (either Simulation #5 or #6)

Average Annual Percolation from bottom layer of Simulation #3 must be less than or equal to (equivalent*) the Average Annual Percolation from the bottom layer of Simulation #5 or #6 (depending on the proposed liner design).

Alternate Liner Design Equivalency Demonstration

Tier I (two simulations) - Simulation #5 & Simulation #6

Average Annual Percolation from bottom layer of Simulation #6 must be less than or equal to (equivalent*) the Average Annual Percolation from the bottom layer of Simulation #5.

Tier II (four simulations) - Simulations #7, #8, #9, #10

Average Annual Percolation from bottom layer of Simulation #7 must decrease to zero for Simulations #9 & #10.

For closing an "old" (no liner svstem) landfill:

Alternate Cover Design Equivalency Demonstration (tvvo simulations)

Simulation #1 & Simulation #2

Average Annual Percolation from bottom layer of Simulation #2 must be less than or equal to (equivalent*) the Average Annual Percolation from the bottom layer of Simulation #1

Submit hardcopies of all output files and submit all input files on 3.5" diskette.

*If the two Average Annual Percolation values are within 0.00001" of each other, then the demonstration is successful since these values are practically equal (the definition of equivalent) and well within modeling uncertainty.

Exhibit J

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Global Summary of the Month for 1984

Generated on 09/25/2019

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3664 ft. Lat: 33.4594° N Lon: -104.4041° W
Station: **BITTER LAKES WL REFUGE, NM US USC00290992**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
										Number of Days					Greatest Observed		Snow, Sleet			Number of Days		
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Max >= 90	Max <= 32	Min <= 32	Min <= 0	Total	Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	36.2	52.2	20.2	748	0	73	30	0	19	0	3	26	1	0.04	0.04	18	1.3	2	18	1	0	0
Feb	43.4	64.6	22.2	568	0	77	15	14	29	0	0	23	0	0.03	0.03	27	0.0	0	29	1	0	0
Mar	49.9	68.7	31.1	413	0	86	17	15	06	0	0	17	0	0.20	0.15	05	1.5	2	05	2	1	0
Apr	57.7	77.0	38.4	238	29	92	18	24	04	2	0	6	0	0.22	0.18	08	0.0	0	30	2	1	0
May														1.99	1.10	16	0.0	0	31	3	3	1
Jun	76.0	89.9	62.2	0	276	99	11	52	06	14	0	0	0	5.83	1.81	28	0.0	0	30	13	9	2
Jul	77.6	92.3	62.9	0	353	98	21	59	19	22	0	0	0	2.05	1.10	28	0.0	0	31	7	4	1
Aug	75.8	88.6	63.0	0	281	97	01	58	16	15	0	0	0	5.82	1.73	10	0.0	0	31	9	7	3
Sep														0.82	0.73	28	0.0	0	30	4	1	0
Oct	56.1	70.8	41.4	238	8	86	15	28	19	0	0	2	0	3.17	1.24	04	0.0	0	31	12	8	1
Nov	48.5	65.9	31.2	444	0	84	09	21	11	0	0	14	0	1.81	0.00	30	0.0	0	30	0	0	0
Dec	40.9	54.2	27.7	722	0	72	09	14	05	0	2	21	0	1.52	0.65	14	4.5	3	14	7	5	0

Notes

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\+ Occurred on one or more previous dates during the month. The date in the Date field is the last day of occurrence.

A Accumulated amount.

X Monthly means or totals based on incomplete time series.

T Trace Amount.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Global Summary of the Month for 1985

Generated on 09/25/2019

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3664 ft. Lat: 33.4594° N Lon: -104.4041° W
Station: **BITTER LAKES WL REFUGE, NM US USC00290992**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
										Number of Days					Greatest Observed		Snow, Sleet			Number of Days		
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Max >= 90	Max <= 32	Min <= 32	Min <= 0	Total	Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	36.7	54.2	19.2			75	20	8	31	0	1	26	0	0.31	0.15	27	1.5	1	13	4	1	0
Feb	39.3	57.0	21.5	598	0	75	26	-1	02	0	2	23	1	0.16	0.10	02				4	1	0
Mar	53.9	72.4	35.4			85	28	16	05	0	0	12	0	0.82	0.61	20	0.0	0	31	3	3	0
Apr	62.7	81.8	43.6	92	37	93	16	26	02	2	0	1	0	1.52	1.26	28	0.0	0	30	4	2	1
May	68.8	87.1	50.4	28	134	100	31	35	15	9	0	0	0	0.57	0.25	19	0.0	0	31	4	2	0
Jun	75.4	91.3	59.5	7	298	101	22	45	06	18	0	0	0	4.38	1.82	06	0.0	0	30	7	6	2
Jul	78.9	96.3	61.5	0	389	109	15	53	02	26	0	0	0	3.51	1.63	26	0.0	0	31	10	7	1
Aug	79.4	96.9	61.9	0	432	104	23	52	30	29	0	0	0	0.28	0.22	12	0.0	0	31	3	1	0
Sep	70.4	86.6	54.3	33	186	103	04	41	29	12	0	0	0	2.44	0.66	15	0.0	0	30	12	7	0
Oct	59.1	75.0	43.3	169	15	93	08	33	05	2	0	0	0	1.07	0.37	09	0.0			6	3	0
Nov	51.0	71.1	31.0	359	0	84	10	15	21	0	0	14	0	0.11	0.08	04	0.0	0	30	3	0	0
Dec	38.5	59.6	17.4	687	0	78	08	3	14	0	1	26	0	0.00	0.00	31	0.0	0	31	0	0	0

Notes

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T Trace Amount.

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Global Summary of the Month
for 1986

Generated on 09/25/2019

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3664 ft. Lat: 33.4594° N Lon: -104.4041° W
Station: **BITTER LAKES WL REFUGE, NM US USC00290992**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
										Number of Days					Greatest Observed		Snow, Sleet			Number of Days		
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Max >= 90	Max <= 32	Min <= 32	Min <= 0	Total	Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	42.0	62.6	21.3	663	0	78	29	10	08	0	0	30	0	0.54	0.54	07	4.0	4	07	1	1	0
Feb	45.6	63.5	27.6	533	0	89	21	12	10	0	3	19	0	0.44	0.27	10	5.3			3	2	0
Mar	53.5	73.1	33.9	328	2	86	09	22	21	0	0	17	0	0.08	0.05	20	0.0	0	31	2	0	0
Apr	63.8	83.0	44.6	90	59	94	08	28	20	6	0	4	0	0.15	0.10	09	0.0	0	30	4	1	0
May	69.0	88.6	49.3	25	145	102	22	32	18	15	0	1	0	2.11	0.91	31	0.0	0	31	5	4	0
Jun	74.3	89.2	59.4	4	233	105	17	49	10	17	0	0	0	3.48	1.67	25	0.0	0	30	11	5	1
Jul	77.8	93.5	62.2	0	357	103	28	58	25	23	0	0	0	2.05	1.84	02	0.0	0	31	3	2	1
Aug	78.1	93.2	63.0	0	342	103	21	55	20	22	0	0	0	6.13	1.66	22	0.0	0	31	13	10	3
Sep	70.6	85.7	55.4	4	138	93	20	42	27	5	0	0	0	2.76			0.0	0	30			
Oct	57.9	72.2	43.6	202	6	88	02	31	15	0	0	4	0	2.69	1.25	10	0.0	0	31	11	5	1
Nov														1.87	0.90	03	0.0	0	30	6	2	0
Dec	38.7	52.2	25.2	762	0	68	03	17	31	0	1	27	0	1.44	0.58	22	0.0	0	31	6	5	0

Notes

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T Trace Amount.

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Global Summary of the Month for 1987

Generated on 09/25/2019

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3664 ft. Lat: 33.4594° N Lon: -104.4041° W
Station: **BITTER LAKES WL REFUGE, NM US USC00290992**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Number of Days				Total	Greatest Observed		Snow, Sleet			Number of Days		
										Max >= 90	Max <= 32	Min <= 32	Min <= 0		Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	39.0	56.5	21.5			74	28	8	21	0	1	26	0	0.46	0.21	21	5.8	6	21	3	3	0
Feb	44.8	61.3	28.4	519	0	78	12	7	22	0	0	19	0	1.39	0.91	22	0.0	5	20	3	2	0
Mar														0.37	0.15	29	1.0	0	31	3	3	0
Apr														0.18	0.18	06	0.0	0	30	1	1	0
May														2.32	1.15	06	0.0	0	31	6	4	1
Jun	75.1	92.0	58.3	0	254	102	24	51	23	17	0	0	0	3.09	1.70	04	0.0	0	30	4	3	1
Jul	79.5	96.8	62.2	0	402	108	05	57	06	26	0	0	0	0.24	0.05	28	0.0	0	31	1	0	0
Aug	77.8	93.4	62.2	0	371	103	02	51	31	19	0	0	0	3.23	1.66	10	0.0	0	31	11	6	1
Sep	68.9	85.5	52.2	16	125	95	14	43	25	5	0	0	0	1.04	0.31	15	0.0	0	30	7	3	0
Oct	60.9	79.9	41.9	117	11	93	09	35	17	1	0	0	0	0.30	0.30	15	0.0	0	31	1	1	0
Nov			28.4					9	19			18	0	0.58	0.48	02	0.0	0	30	4	1	0
Dec	35.8	53.7	18.0	776	0	78	12	-8	15	0	5	28	3	0.58	0.39	14	13.0			3	2	0

Notes

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A Accumulated amount.

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T Trace Amount.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Global Summary of the Month for 1988

Generated on 09/25/2019

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3664 ft. Lat: 33.4594° N Lon: -104.4041° W
Station: **BITTER LAKES WL REFUGE, NM US USC00290992**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
										Number of Days					Greatest Observed		Snow, Sleet			Number of Days		
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Max >= 90	Max <= 32	Min <= 32	Min <= 0	Total	Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan														0.05	0.00	31	0.0	0	31	0	0	0
Feb	42.5	60.8	24.2	616	0	79	29	6	08	0	1	24	0	1.45	1.43	05	16.0	16	05	2	1	1
Mar														0.00	0.00	31	0.0	0	31	0	0	0
Apr	57.5	77.3	37.7	198	11	90	09	24	16	1	0	8	0	0.34	0.11	01	0.0	0	30	3	1	0
May														2.24	0.67	20	0.0	0	31	6	3	0
Jun														1.04	0.72	29	0.0	0	30	4	3	0
Jul														3.03	1.22	20	0.0	0	31	9	6	2
Aug														0.47	0.24	19	0.0	0	31	7	1	0
Sep																	0.0	0	30			
Oct														0.04	0.04	08	0.0	0	31	1	0	0
Nov														0.01	0.01	15	0.0	0	30	1	0	0
Dec														0.45	0.28	09	3.3	3	09	2	2	0

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National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Global Summary of the Month for 1984

Generated on 09/25/2019

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3649 ft. Lat: 33.3075° N Lon: -104.5083° W
Station: **ROSWELL INDUSTRIAL AIR PARK, NM US USW00023009**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Number of Days				Total	Greatest Observed		Snow, Sleet			Number of Days		
										Max >= 90	Max <= 32	Min <= 32	Min <= 0		Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	38.5	50.5	26.5	822	0	72	29	8	18	0	4	24	0	0.04	0.02	18	0.5	1	18	3	0	0
Feb	46.5	61.7	31.3	537	0	74	14	22	29	0	0	17	0	0.00	0.00	26	0.0	0	29	0	0	0
Mar	51.7	66.8	36.6	414	2	83	17	19	06	0	0	9	0	0.46	0.42	05	4.8	1	06	2	1	0
Apr	60.1	75.9	44.4	171	24	89	17	32	04	0	0	1	0	0.03	0.03	07	0.0	0	30	1	0	0
May	72.4	86.1	58.8	21	251	98	27	41	08	13	0	0	0	1.62	0.89	15	0.0	0	31	4	3	0
Jun	75.8	87.4	64.2	0	324	97	10	57	04	15	0	0	0	4.51	0.91	19	0.0	0	30	13	9	0
Jul	79.0	90.8	67.2	0	434	96	15	63	26	24	0	0	0	0.85	0.78	24	0.0	0	31	3	1	0
Aug	76.2	86.8	65.6	0	347	94	29	63	29	13	0	0	0	5.03	2.45	08	0.0	0	31	12	6	2
Sep	69.3	82.0	56.5	57	186	97	09	44	30	10	0	0	0	1.05	0.74	28	0.0	0	30	6	2	0
Oct	57.6	69.4	45.9	233	6	82	14	36	19	0	0	0	0	2.74	0.86	03	0.0	0	31	9	5	0
Nov	48.5	61.1	35.8	497	0	83	07	25	28	0	0	11	0	1.57	0.74	24	0.0	0	30	4	3	0
Dec	42.1	53.1	31.0	711	0	72	08	20	16	0	1	19	0	0.85	0.31	13	5.4	4	15	7	3	0

Notes

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National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3649 ft. Lat: 33.3075° N Lon: -104.5083° W
Station: **ROSWELL INDUSTRIAL AIR PARK, NM US USW00023009**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Number of Days				Total	Greatest Observed		Snow, Sleet			Number of Days		
										Max >= 90	Max <= 32	Min <= 32	Min <= 0		Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	36.9	49.4	24.4	870	0	75	19	9	31	0	3	28	0	0.37	0.09	26	1.9	0	31	10	0	0
Feb	43.2	57.7	28.6	612	0	73	21	3	02	0	1	19	0	0.04	0.02	21	0.3	1	02	2	0	0
Mar	54.4	68.8	40.0	329	6	83	10	24	05	0	0	5	0	0.70	0.32	20	0.0	0	31	3	2	0
Apr	63.4	78.4	48.4	88	41	88	15	35	02	0	0	0	0	2.48	1.48	28	0.0	0	30	4	3	1
May	70.1	84.0	56.2	11	169	96	29	43	14	6	0	0	0	2.22	0.92	18	0.0	0	31	6	5	0
Jun	75.8	89.5	62.0	2	325	100	21	52	06	19	0	0	0	2.59	1.25	09	0.0	0	30	5	4	1
Jul	79.4	92.8	66.0	0	447	101	05	61	02	25	0	0	0	2.71	1.65	25	0.0	0	31	6	4	1
Aug	80.4	93.3	67.5	0	477	100	06	62	31	26	0	0	0	0.34	0.14	21	0.0	0	31	7	1	0
Sep	70.7	82.4	59.0	48	218	96	01	43	30	7	0	0	0	1.93	0.79	18	0.0	0	30	12	6	0
Oct	61.1	73.6	48.7	136	16	89	07	42	31	0	0	0	0	0.98	0.43	16	0.0	0	31	6	4	0
Nov	53.2	68.4	38.0	354	0	81	05	23	15	0	0	7	0	0.12	0.12	01	0.0	0	30	1	1	0
Dec	40.2	57.0	23.4	768	0	72	30	9	14	0	2	28	0	0.07	0.07	12	1.1	0	31	1	0	0

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National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3649 ft. Lat: 33.3075° N Lon: -104.5083° W
Station: **ROSWELL INDUSTRIAL AIR PARK, NM US USW00023009**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
										Number of Days					Greatest Observed		Snow, Sleet			Number of Days		
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Max >= 90	Max <= 32	Min <= 32	Min <= 0	Total	Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	44.1	60.8	27.4	648	0	77	28	13	09	0	0	26	0	0.67	0.47	07	5.4	3	08	2	2	0
Feb	46.8	60.6	33.0	510	0	85	26	14	10	0	5	11	0	0.50	0.31	09	4.9	4	12	5	1	0
Mar	56.2	72.5	39.8	279	5	88	31	30	21	0	0	4	0	0.12	0.05	19	0.0	0	31	4	0	0
Apr	64.6	80.7	48.5	81	69	92	07	37	20	2	0	0	0	0.31	0.31	08	0.0	0	30	1	1	0
May	69.5	85.2	53.9	16	158	97	21	38	18	9	0	0	0	1.20	0.51	30	0.0	0	31	7	3	0
Jun	75.8	88.7	63.0	0	324	102	16	53	01	17	0	0	0	5.02	1.44	24	0.0	0	30	9	5	3
Jul	79.2	92.4	65.9	0	439	101	27	62	19	23	0	0	0	1.11	0.66	01	0.0	0	31	8	3	0
Aug	78.6	90.9	66.3	0	421	103	20	61	25	21	0	0	0	3.11	0.85	26	0.0	0	31	13	9	0
Sep	72.1	85.0	59.2	0	213	93	19	48	30	5	0	0	0	3.93	1.71	02	0.0	0	30	8	5	1
Oct	59.3	71.6	47.0	186	9	88	01	36	14	0	0	0	0	5.48	3.46	10	0.0	0	31	8	6	1
Nov	46.0	59.3	32.7	570	0	76	17	22	25	0	1	15	0	1.89	0.79	03	0.5	0	13	6	4	0
Dec	39.9	51.0	28.9	777	0	67	07	20	12	0	1	23	0	1.47	0.44	22	3.4	0	22	7	6	0

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U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Global Summary of the Month for 1987

Generated on 09/25/2019

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3649 ft. Lat: 33.3075° N Lon: -104.5083° W
Station: **ROSWELL INDUSTRIAL AIR PARK, NM US USW00023009**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Number of Days Max >= 90	Max <= 32	Min <= 32	Min <= 0	Total	Greatest Observed Amount	Date	Snow, Sleet Total Fall	Max Depth	Max Date	Number of Days >=.01	>=.10	>=1.0
Jan	39.7	54.9	24.5	784	0	74	27	8	21	0	2	27	0	0.45	0.19	20	5.5	4	18	5	2	0
Feb	44.9	58.1	31.7	562	0	78	02	14	22	0	0	12	0	2.02	0.91	20	8.7	6	20	8	5	0
Mar	49.1	64.3	33.8	493	0	77	06	14	30	0	1	9	0	0.20	0.11	26	0.5	0	31	4	1	0
Apr	57.3	73.6	41.0	248	16	93	18	26	03	2	0	3	0	0.26	0.12	04	0.0	0	30	3	2	0
May	67.4	81.7	53.1	25	100	91	17	43	04	1	0	0	0	1.54	0.46	24	0.0	0	31	7	5	0
Jun	75.8	89.9	61.7	0	323	101	23	56	05	17	0	0	0	3.70	1.22	03	0.0	0	30	9	8	1
Jul	80.2	94.6	65.7	0	470	104	03	60	06	26	0	0	0	0.40	0.20	10	0.0	0	31	5	1	0
Aug	78.7	91.5	65.9	0	423	101	08	57	31	19	0	0	0	4.72	2.20	22	0.0	0	31	13	6	2
Sep	70.5	84.5	56.6	4	170	94	13	48	24	4	0	0	0	0.78	0.38	14	0.0	0	30	6	2	0
Oct	63.8	79.3	48.4	75	38	93	08	41	21	1	0	0	0	0.28	0.24	14	0.0	0	31	3	1	0
Nov	49.0	64.3	33.6	481	0	79	04	20	19	0	0	17	0	0.46	0.43	01	0.0	0	30	2	1	0
Dec	39.3	54.1	24.5	797	0	79	11	-3	27	0	5	22	2	1.41	0.61	13	15.3	10	15	6	5	0

Notes

(Blank) Data element not reported or missing.

\+ Occurred on one or more previous dates during the month. The date in the Date field is the last day of occurrence.

A Accumulated amount.

X Monthly means or totals based on incomplete time series.

T Trace Amount.

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Global Summary of the Month for 1988

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National Centers for Environmental Information
151 Patton Avenue
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Current Location: Elev: 3649 ft. Lat: 33.3075° N Lon: -104.5083° W
Station: **ROSWELL INDUSTRIAL AIR PARK, NM US USW00023009**

Date	Temperature (F)													Precipitation (Inches)								
Elem ->	TAVG	TMAX	TMIN	HTDD	CLDD	EMXT		EMNT		DX90	DX32	DT32	DT00	PRCP	EMXP		SNOW	EMSD		DP01	DP10	DP1X
										Number of Days					Greatest Observed		Snow, Sleet			Number of Days		
Month	Mean	Mean Max.	Mean Min	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Max >= 90	Max <= 32	Min <= 32	Min <= 0	Total	Amount	Date	Total Fall	Max Depth	Max Date	>=.01	>=.10	>=1.0
Jan	37.5	51.2	23.8	852	0	72	15	14	25	0	1	30	0	0.22	0.11	06	0.4	0	31	4	1	0
Feb	44.4	59.6	29.3	596	0	77	28	12	08	0	1	21	0	1.48	1.05	05	16.9	9	06	3	2	1
Mar	51.3	69.2	33.3	425	0	85	24	16	14	0	0	14	0	0.03	0.03	03	0.0	0	31	1	0	0
Apr	59.7	76.2	43.1	169	9	90	08	27	02	1	0	2	0	0.27	0.15	16	0.0	0	30	4	1	0
May	68.1	83.4	52.9	39	137	98	15	37	03	6	0	0	0	3.42	1.41	28	0.0	0	31	6	4	2
Jun	77.4	92.0	62.9	0	373	99	22	51	01	20	0	0	0	1.27	0.47	27	0.0	0	30	7	3	0
Jul	78.6	91.7	65.5	0	422	102	13	59	22	24	0	0	0	4.45	3.32	19	0.0	0	31	10	5	1
Aug	78.7	90.4	67.0	7	432	99	13	56	28	25	0	0	0	0.51	0.12	09	0.0	0	31	10	2	0
Sep	72.2	87.2	57.1	7	222	99	08	46	30	12	0	0	0	1.56	0.72	20	0.0	0	30	6	2	0
Oct	63.9	79.4	48.5	63	29	93	17	41	29	1	0	0	0	0.01	0.01	07	0.0	0	31	1	0	0
Nov	53.3	70.1	36.5	366	15	87	08	20	28	0	0	13	0	0.03	0.03	08	0.0	0	30	1	0	0
Dec	40.6	54.9	26.4	756	0	68	03	15	28	0	0	28	0	0.51	0.28	08	3.9	4	09	3	2	0

Notes

(Blank) Data element not reported or missing.

\+ Occurred on one or more previous dates during the month. The date in the Date field is the last day of occurrence.

A Accumulated amount.

X Monthly means or totals based on incomplete time series.

T Trace Amount.

GSOM (Global Summary of the Month) documentation

I. Description

The Global Summary of the Month (GSOM) dataset includes climate data for thousands of locations worldwide. Data files contain over 50 climatological variables computed from the summary of the day observations of the Global Historical Climatology Network Daily dataset (GHCN-D). A description of each of these is included below. GSOM data can be accessed at https://www.ncdc.noaa.gov/cdo-web/search?datasetid=GSOM or for bulk delivery at https://www.ncei.noaa.gov/data/gsom.

II. Format/Observation Definitions

Users are given the choice between the following two delivery formats:

1) Portable Document Format (PDF) output. All units are standard.

2) CSV file for use in spreadsheet applications. Users will be able to choose between standard or metric units with this option.

A. Data observations

Each record represents all selected observations (i.e. elements) available for a given station-month. The initial section of each record is ordered as follows with the following definitions:

STATION (11 characters) is the station identification code.

STATION_NAME (max 50 characters) is the name of the station (usually city/airport name). This is an optional output field.

LATITUDE (8 characters) is the latitude (decimated degrees w/Northern Hemisphere values > 0). This is an optional output field.

LONGITUDE (9 characters) is the longitude (decimated degrees w/Western Hemisphere values < 0 and Eastern Hemisphere values > 0). This is an optional output field.

ELEVATION (13 characters) is the elevation above mean sea level in meters (to nearest thousandth of a meter). This is an optional output field.

DATE is the year of the record (4 digits) followed by a month (2 digits).

GHCN-Daily Dataset Measurement Flag (M) These flags that pertain to temperature, precipitation and wind measurement are given in the attribute fields following many of the data variables described below as noted.

Blank = no measurement information applicable

A = value in precipitation or snow is a multi-day total, accumulated since last measurement (used on Daily Form pdf file)
B = precipitation total formed from two twelve-hour totals
D = precipitation total formed from four six-hour totals
H = represents highest or lowest hourly temperature (TMAX or TMIN) or average of hourly values (TAVG)
K = converted from knots
L = temperature appears to be lagged with respect to reported hour of observation
O = converted from oktas
P = identified as "missing presumed zero" in DSI 3200 and 3206
T = trace of precipitation, snowfall, or snow depth
W = converted from 16-point WBAN code (for wind direction)

Table A (variables)

AWND – Monthly Average Wind Speed. Given in miles per hour for PDF output and miles per hour or meters per second depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

AWND_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

CDSD – Cooling Degree Days (season-to-date). Running total of monthly cooling degree days through the end of the most recent month. Each month is summed to produce a season-to-date total. Season starts in January in Northern Hemisphere and July in Southern Hemisphere. Given in Fahrenheit degrees in PDF output and Celsius or Fahrenheit degrees depending on user specification in CSV output.

CDSD_ATTRIBUTES – S where:

S = GHCN-Daily Dataset Source Code (values are given below in Table B)

CLDD - Cooling Degree Days. Computed when daily average temperature is more than 65 degrees Fahrenheit/18.3 degrees Celsius. CDD = mean daily temperature - 65 degrees Fahrenheit/18.3 degrees Celsius. Each day is summed to produce a monthly total. Given in Fahrenheit units on PDF output. CSV output is Fahrenheit or Celsius units depending on user specification.

CLDD_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DP01 – Number of days with >= 0.01 inch/0.254 millimeter in the month

DP01_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DP10 – Number of days with >= 0.1 inch/2.54 millimeters in the month.

DP10_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DP1X – Number of days with >= 1 inch/25.4 millimeters in the month.

DP1X_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DSND – Number of days with snow depth >= 1 inch/25 millimeters.

DSND_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DSNW – Number of days with snowfall >= 1 inch/25 millimeters.

DSNW_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DT00 – Number of days with maximum temperature <= 0 degrees Fahrenheit/-17.8 degrees Celsius.

DT00_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DT32 – Number of days with maximum temperature <= 32 degrees Fahrenheit/0 degrees Celsius.

DT32_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DX32 – Number of days with maximum temperature <= 32 degrees Fahrenheit/0 degrees Celsius.
DX32_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DX70 – Number of days with maximum temperature <= 70 degrees Fahrenheit/21.1 degrees Celsius.

DX70_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

DX90 – Number of days with maximum temperature >= 90 degrees Fahrenheit/32.2 degrees Celsius.

DX90_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

EMNT – Extreme minimum temperature for month. Lowest daily minimum temperature for the month. Given in Fahrenheit units on PDF output. CSV output is Fahrenheit or Celsius units depending on user specification.

EMNT_ATTRIBUTES – a,S,cc,d where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
cc = two-digit date during the month when the EMNT value occurred (always latest date if more than one occurrence)
d = + if there is more than one date of occurrence, blank if only one date of occurrence

EMSD – Highest daily snow depth in the month. Given in inches for PDF output. CSV output is in inches or millimeters depending on user specification.

EMSD_ATTRIBUTES – a,M,S,cc,d where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
cc = two-digit date during the month when the EMNT value occurred (always latest date if more than one occurrence)

d = + if there is more than one date of occurrence, blank if only one date of occurrence

EMSN – Highest daily snowfall in the month. Given in inches for PDF output. CSV output is in inches or millimeters depending on user specification.

EMSN_ATTRIBUTES – a,M,S,cc,d where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
cc = two-digit date during the month when the EMNT value occurred (always latest date if more than one occurrence)
d = + if there is more than one date of occurrence, blank if only one date of occurrence

EMXP – Highest daily total of precipitation in the month. Given in inches for PDF output. CSV output is in inches or millimeters depending on user specification.

EMXP_ATTRIBUTES – a,M,S,cc,d where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
cc = two-digit date during the month when the EMNT value occurred (always latest date if more than one occurrence)
d = + if there is more than one date of occurrence, blank if only one date of occurrence

EMXT – Extreme maximum temperature for month. Highest daily maximum temperature for the month. Given in Fahrenheit units on PDF output. CSV output is Fahrenheit or Celsius units depending on user specification.

EMXT_ATTRIBUTES – a,S,cc,d where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
cc = two-digit date during the month when the EMNT value occurred (always latest date if more than one occurrence)
d = + if there is more than one date of occurrence, blank if only one date of occurrence

EVAP – Total Monthly Evaporation. Given in inches for PDF output. CSV output is in inches or millimeters depending on user specification. Measurement Flags: T is used for trace amount, *a* is used for any accumulation within a month that includes missing days. If no days are missing, no flag is used. Source Flag: Source flag from GHCN-Daily (see separate documentation for GHCN-Daily). Days Miss Flag: Number of days missing or flagged.

EVAP_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)

Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

HDSD – Heating Degree Days (season-to-date). Running total of monthly heating degree days through the end of the most recent month. Each month is summed to produce a season-to-date total. Season starts in July in Northern Hemisphere and January in Southern Hemisphere. Given in Fahrenheit degrees in PDF output and Celsius or Fahrenheit degrees depending on user specification in CSV output.

HDSD_ATTRIBUTES – S where:

S = GHCN-Daily Dataset Source Code (values are given below in Table B)

HNyz – Highest minimum soil temperature for the month. Given in Fahrenheit for PDF output and Fahrenheit or Celsius depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged. Note: “yz” portion of variable name correspond with values in Table E below.

HNyz_ATTRIBUTES = a,M,Q,S,y,z where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
y = ground cover code (see table E below)
z = soil depth code (see table E below)

HTDD - Heating Degree Days. Computed when daily average temperature is less than 65 degrees Fahrenheit/18.3 degrees Celsius. HDD = 65(F)/18.3(C) – mean daily temperature. Each day is summed to produce a monthly total. Given in Fahrenheit units on PDF output. CSV output is Fahrenheit or Celsius units depending on user specification.

HTDD_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

HXyz – Highest maximum soil temperature for the month. Given in Fahrenheit for PDF output and Fahrenheit or Celsius depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged. Note: “yz” portion of variable name correspond with values in Table E below.

HXyz_ATTRIBUTES = a,M,Q,S,y,z where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

y = ground cover code (see table E below)
z = soil depth code (see table E below)

LNyz – Lowest minimum soil temperature for the month. Given in Fahrenheit for PDF output and Fahrenheit or Celsius depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged. Note: "yz" portion of variable name correspond with values in Table E below.

LNyz_ATTRIBUTES = a,M,Q,S,y,z where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
y = ground cover code (see table E below)
z = soil depth code (see table E below)

LXyz – Lowest maximum soil temperature for the month. Given in Fahrenheit for PDF output and Fahrenheit or Celsius depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged. Note: "yz" portion of variable name correspond with values in Table E below.

LXyz_ATTRIBUTES = a,M,Q,S,y,z where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
y = ground cover code (see table E below)
z = soil depth code (see table E below)

MNPN – Monthly Mean Minimum Temperature of evaporation pan water. Given in Fahrenheit units for PDF output and Celsius or Fahrenheit units in CSV output depending on user specification. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

MNPN_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

MNyz – Monthly Mean of daily minimum soil temperature. Given in Fahrenheit for PDF output and Fahrenheit or Celsius depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

MNyz_ATTRIBUTES = a,M,Q,S,y,z where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
y = ground cover code (see table E below)
z = soil depth code (see table E below)

MXPN – Monthly Mean Maximum Temperature of evaporation pan water. Given in Fahrenheit units for PDF output and Celsius or Fahrenheit units in CSV output depending on user specification. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

MXPN_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

MXyz – Monthly Mean of daily maximum soil temperature. Given in Fahrenheit for PDF output and Fahrenheit or Celsius depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

MXyz_ATTRIBUTES = a,M,Q,S,y,z where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)
y = ground cover code (see table E below)
z = soil depth code (see table E below)

PRCP – Total Monthly Precipitation. Given in inches for PDF output. CSV output is in inches or millimeters depending on user specification. Measurement Flags: T is used for trace amount, a is used for any accumulation within a month that includes missing days. If no days are missing, no flag is used.

PRCP_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

PSUN – Monthly Average of the daily percents of possible sunshine.

PSUN_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

SNOW – Total Monthly Snowfall. Given in inches for PDF output. CSV output is in inches or millimeters depending on user specification. Measurement Flags: T is used for trace amount, *a* is used for any accumulation within a month that includes missing days. If no days are missing, no flag is used. Source Flag: Source flag from GHCN-Daily (see separate documentation for GHCN-Daily). Days Miss Flag: Number of days missing or flagged.

SNOW_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

TAVG – Average Monthly Temperature. Computed by adding the unrounded monthly/annual maximum and minimum temperatures and dividing by 2. Fahrenheit units on PDF output. CSV output is Fahrenheit or Celsius units depending on user specification. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

TAVG_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

TMAX – Monthly Maximum Temperature. Average of daily maximum temperature given in Fahrenheit on PDF output. CSV output is given in Fahrenheit or Celsius depending on user specification. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

TMAX_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

TMIN – Monthly Minimum Temperature. Average of daily minimum temperature given in Fahrenheit units on PDF output. CSV output is given in Fahrenheit or Celsius units depending on user specification. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

TMIN_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided

M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

TSUN – Monthly total sunshine in minutes.

TSUN_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WDF1 – Wind Direction for Maximum Wind Speed/Fastest 1-Minute (WSF1). Given in 360-degree compass point directions (e.g. 360 = north, 180 = south, etc.). Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WDF1_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WDF2 – Wind Direction for Maximum Wind Speed/Fastest 2-Minute (WSF2). Given in 360-degree compass point directions (e.g. 360 = north, 180 = south, etc.). Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WDF2_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WDF5 – Wind Direction for Peak Wind Gust Speed – Fastest 5-second (WSF5). Given in 360-degree compass point directions (e.g. 360 = north, 180 = south, etc.). Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WDF5_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WDFG – Wind Direction for Peak Wind Gust Speed (WSFG). Given in 360-degree compass point directions (e.g. 360 = north, 180 = south, etc.). Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WDFG_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided

S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WDFI –Direction of highest instantaneous wind speed (WDFI). Given in 360-degree compass point directions (e.g. 360 = north, 180 = south, etc.). Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WDFI_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WDFM – Wind Direction for Maximum Wind Speed/Fastest Mile (WSFM). Given in 360-degree compass point directions (e.g. 360 = north, 180 = south, etc.).

WDFM_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WDMV – Total Monthly Wind Movement over evaporation pan. Given in miles for PDF output and miles or kilometers depending on user specification for CSV output.

WDMV_ATTRIBUTES = a,M,Q,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
M = GHCN-Daily Dataset Measurement Flag (values are given below in Table C)
Q = GHCN-Daily Dataset Quality Flag (values are given below in Table D)
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WSF1 - Maximum Wind Speed/Fastest 1-minute. Maximum wind speed for the month reported as the fastest 1-minute. Given in miles per hour for PDF output and miles per hour or meters per second depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WSF1_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WSF2 – Maximum Wind Speed/Fastest 2-minute. Maximum wind speed for the month reported as the fastest 2-minute. Given in miles per hour for PDF output and miles per hour or meters per second depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WSF2_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WSF5 – Peak Wind Gust Speed – Fastest 5-second wind. Maximum wind gust for the month. Given in miles per hour for PDF output and miles per hour or meters per second depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WSF5_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WSFG – Peak Wind Gust Speed. Maximum wind gust for the month. Given in miles per hour for PDF output and miles per hour or meters per second depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WSFG_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WSFI – Highest instantaneous wind speed for the month. Given in miles per hour for PDF output and miles per hour or meters per second depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WSFI_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

WSFM – Maximum Wind Speed/Fastest Mile. Maximum wind speed for the month reported as the fastest mile. Given in miles per hour for PDF output and miles per hour or meters per second depending on user specification for CSV output. Missing if more than 5 days within the month are missing or flagged or if more than 3 consecutive values within the month are missing or flagged.

WSFM_ATTRIBUTES – a,S where:

a = DaysMissing (Numeric value): The number of days (from 1 to 5) missing or flagged is provided
S = GHCN-Daily Dataset Source Code (values are given below in Table B)

Table B - GHCN-Daily Dataset Source Codes:

Blank = No source (i.e., data value missing)
0 = U.S. Cooperative Summary of the Day (NCDC DSI-3200)
6 = CDMP Cooperative Summary of the Day (NCDC DSI-3206)
7 = U.S. Cooperative Summary of the Day -- Transmitted via WxCoder3 (NCDC DSI-3207)

A = U.S. Automated Surface Observing System (ASOS) real-time data (since January 1, 2006)
a = Australian data from the Australian Bureau of Meteorology
B = U.S. ASOS data for October 2000-December 2005 (NCDC DSI-3211)
b = Belarus update
C = Environment Canada
E = European Climate Assessment and Dataset (Klein Tank et al., 2002)
F = U.S. Fort data
G = Official Global Climate Observing System (GCOS) or other government-supplied data
H = High Plains Regional Climate Center real-time data
I = International collection (non U.S. data received through personal contacts)
K = U.S. Cooperative Summary of the Day data digitized from paper observer forms (from 2011 to present)
M = Monthly METAR Extract (additional ASOS data)
N = Community Collaborative Rain, Hail,and Snow (CoCoRaHS)
Q = Data from several African countries that had been "quarantined", that is, withheld from public release until permission was granted from the respective meteorological services
R = NCEI Reference Network Database (Climate Reference Network and Regional Climate Reference Network)
r = All-Russian Research Institute of Hydrometeorol Information-World Data Center
S = Global Summary of the Day (NCDC DSI-9618)

NOTE: "S" values are derived from hourly synoptic reports exchanged on the Global Telecommunications System (GTS). Daily values derived in this fashion may differ significantly from "true" daily data, particularly for precipitation (i.e., use with caution).

s = China Meteorological Administration/National Meteorological Information Center/ Climatic Data Center (http://cdc.cma.gov.cn)
T = SNOwpack TELemtry (SNOTEL) data obtained from the U.S. Department of Agriculture's Natural Resources Conservation Service
U = Remote Automatic Weather Station (RAWS) data obtained from the Western Regional Climate Center
u = Ukraine update
W = WBAN/ASOS Summary of the Day from NCDC's Integrated Surface Data (ISD).
X = U.S. First-Order Summary of the Day (NCDC DSI-3210)
Z = Datzilla official additions or replacements
z = Uzbekistan update

Table C - GHCN-Daily Dataset Measurement Flags:

Blank = no measurement information applicable
B = precipitation total formed from two 12-hour totals
D = precipitation total formed from four six-hour totals
H = represents highest or lowest hourly temperature (TMAX or TMIN) or the average of hourly values (TAVG)
K = converted from knots

L = temperature appears to be lagged with respect to reported hour of observation
O = converted from oktas
P = identified as "missing presumed zero" in DSI 3200 and 3206
T = trace of precipitation, snowfall, or snow depth
W = converted from 16-point WBAN code (for wind direction)

Table D - GHCN-Daily Dataset Quality Flags (as of 1/9/2017):

Blank = did not fail any quality assurance check
D = failed duplicate check
G = failed gap check
I = failed internal consistency check
K = failed streak/frequent-value check
L = failed check on length of multiday period
M = failed megaconsistency check
N = failed naught check
O = failed climatological outlier check
R = failed lagged range check
S = failed spatial consistency check
T = failed temporal consistency check
W = temperature too warm for snow
X = failed bounds check
Z = flagged as a result of an official Datzilla investigation

Table E – Ground cover code (y) and soil depth code (z) for HXyz, HNyz, LXyz, LNyz, MNYZ and MXYZ

Y (ground cover):
1 = grass
2 = fallow
3 = bare ground
4 = brome grass
5 = sod
6 = straw mulch
7 = grass muck
8 = bare muck
0 = unknown

Z (soil depth):
1 = 2 inches or 5 centimeters depth
2 = 4 inches or 10 centimeters depth
3 = 8 inches or 20 centimeters depth
4 = 20 inches or 50 centimeters depth
5 = 40 inches or 100 centimeters depth
6 = 60 inches or 150 centimeters depth
7 = 72 inches or 180 centimeters depth
0 = unknown

Attachment E

Liner System Design Calculations

Attachment E1

Settlement and Liner Stress Calculations

CALCULATIONS BY: Deep K. Khatri, P.E. (TX) – Senior Staff Geotechnical Engineer
F. Owen Carpenter, P.E. (AR, CO, OK), P.G. – Senior Solid Waste Engineer
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PURPOSE

This calculation package includes settlement analyses for the proposed North Ranch landfill to be located within Section 9 and 10 of T25S, R34E approximately 16 miles west of the City of Jal in Lea County, New Mexico. The settlement analyses include both foundation and waste settlements. The settlement analyses were performed to determine that the final cover slope, liner, and leachate collection system (after settlement) are consistent with the performance specifications of the project. The following calculations show the anticipated strains on the geosynthetic materials are less the allowable strains and the designed grades for final cover and leachate collection system will allow adequate drainage even after settlement.

METHOD OF ANALYSIS

The methodology for estimating settlements involves calculating settlements at multiple points and evaluating the resultant change in the designed grade and its impact on the landfill elements. Points were conservatively selected from a cross-section based on the thickness of waste material. The location of the cross-section is shown on the liner and final cover grading plans (Figures 1 and 2). The cross-section drawing and settlement location points are shown in Figure 3.

Foundation Soil Settlement

On-site (native) soils predominately consist of granular soils, medium to very dense sandy soils and strongly cemented, calcareous interbedded caliche materials in the upper approximately 2 to 65 feet of existing grades, underlain by sandstone extending to boring termination depths of 165 feet below existing grade. For granular soils, settlement is caused by the compression of the soil skeleton as the particles rearrange due to the applied loads. The immediate (elastic) settlement of the foundation soils was calculated using the following equation:

$$S = \Delta\sigma / M_s * H$$

where:
S = elastic settlement of soil layer
H = thickness of soil layer
$\Delta\sigma$ = Applied Stress
M_s = constrained modulus of soils

Waste Material Settlements

The compression settlement of oil field wastes can be analyzed using the one-dimensional consolidation theory, commonly used for cohesive soils. Based on this theory, waste settlement has two components: settlement due to primary consolidation and settlement due to secondary consolidation. The primary settlement component of waste material is related to the increase in effective vertical stresses resulting from the additional waste material and landfill final cover system. The secondary settlement component is typically related to compression of the waste structure (skeleton) and is time-dependent.

Settlements resulting from primary consolidation of the waste were calculated using the general form of the 1-D consolidation theory settlement equation as given below [Holtz and Kovacs, 1981]:

$$Sp = Cer * H * log(\sigma'p/\sigma'vo) + Cec * H * log(\sigma'f\ /\sigma'p)$$

where: Sp = primary settlement
C_{ec} = primary compression index ratio
C_{er} = recompression index ratio
H = initial thickness of the waste layer before settlement
σ'_{vo} = initial effective pressure in the waste layer
σ'_{p} = effective pressure in the waste layer
σ'_{p} = pre-consolidation stress
σ'_{f} = final overburden pressure applied at the mid-level of the waste layer

The mechanisms for secondary settlement are mechanical creep, chemical reactions, and biodegradation. This type of compression is dependent on time, not applied loads. Settlements resulting from secondary settlement of the waste may be calculated according to the following equation [Qian, Koerner, and Gray, 2002]:

$$\Delta H_\alpha = C'_\alpha * H_o * log\frac{t_2}{t_1}$$

where: ΔH_α = long-term secondary settlement
C'_α = modified secondary compression index
t_2 = ending time of the time period for which long-term settlement of the layer is desired
t_1 = starting time of the time period for which long-term settlement of the layer is desire
t_1 = 1 year
t_2 = 30 years

However, from the best available information and discussions with the project team members, it is considered that waste materials for this landfill will typically be granular soils, contaminated silty sands/sands. Therefore, a secondary settlement of the waste material was neglected in our analyses.

Final Cover Settlement

Since (1) the waste material and foundation soils are permeable and will experience an immediate primary consolidation settlement under applied load, and (2) foundation soil settlement resulting from the final cover will be minimal, the total final cover settlement will be due to the primary compression of the waste material only with the increase in effective vertical stresses resulting from the final cover system. The settlement equation presented above for the waste material settlement calculation was used for the final cover settlement estimates.

Tensile Strains

The effects of waste settlement on the final cover and foundation settlement on the liner system were evaluated as described below.

Tensile strains in the final cover and the liner were estimated by the following general equation:

$$\varepsilon_{tens} = L_o - \frac{L_f}{L_o}$$

where: ε_{tens} = strain in the cover/liner (tension is negative)
L_o = initial length of cover/liner between adjacent points
L_f = length of cover/liner between adjacent points after settlement

MATERIAL PARAMETERS

The waste materials for this landfill are assumed to be granular soils, contaminated silty sands/sands. Based on the available typical compression parameters for sandy soils and our experience for similar waste materials and project, a compression index ratio C_{ec} of 0.014, a recompression index ratio Cer of about one-third of Cec, the total unit weight of 120 pcf, and a pre-consolidation pressure σ'_p of 1,000 psf were selected for the presented analyses. Based on the available typical compression parameters for native silty sands/sands and our experience for similar materials, a constrained modulus Ms of about 850 ksf was used for the foundation settlement estimate.

Table 1. Material Properties

Cover System	γ, pcf	120
Waste	γ, pcf	120
	$C_{c\varepsilon}$	0.014
	$C_{r\varepsilon}$	0.004
	σ'_p, psf	1,000
Foundation Soils-Silty Sands/Sands (Medium to Very Dense)	Ms, ksf	850

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PROJECT: North Ranch SWMF – Settlement Analysis **PAGE:** 4 of 4

JOB NO.: 35187378 **DATE:** September, 2019 **COMP. BY:** DKK **CHECKED BY:** FOC

RESULTS

The foundation soil, waste, and final cover settlement estimates are presented in Tables 2, 3, and 4 respectively. The spreadsheet output that details settlement estimates for the foundation soil, waste, and final cover settlement are also included in Tables 2, 3, and 4, respectively.

SUMMARY AND CONCLUSIONS

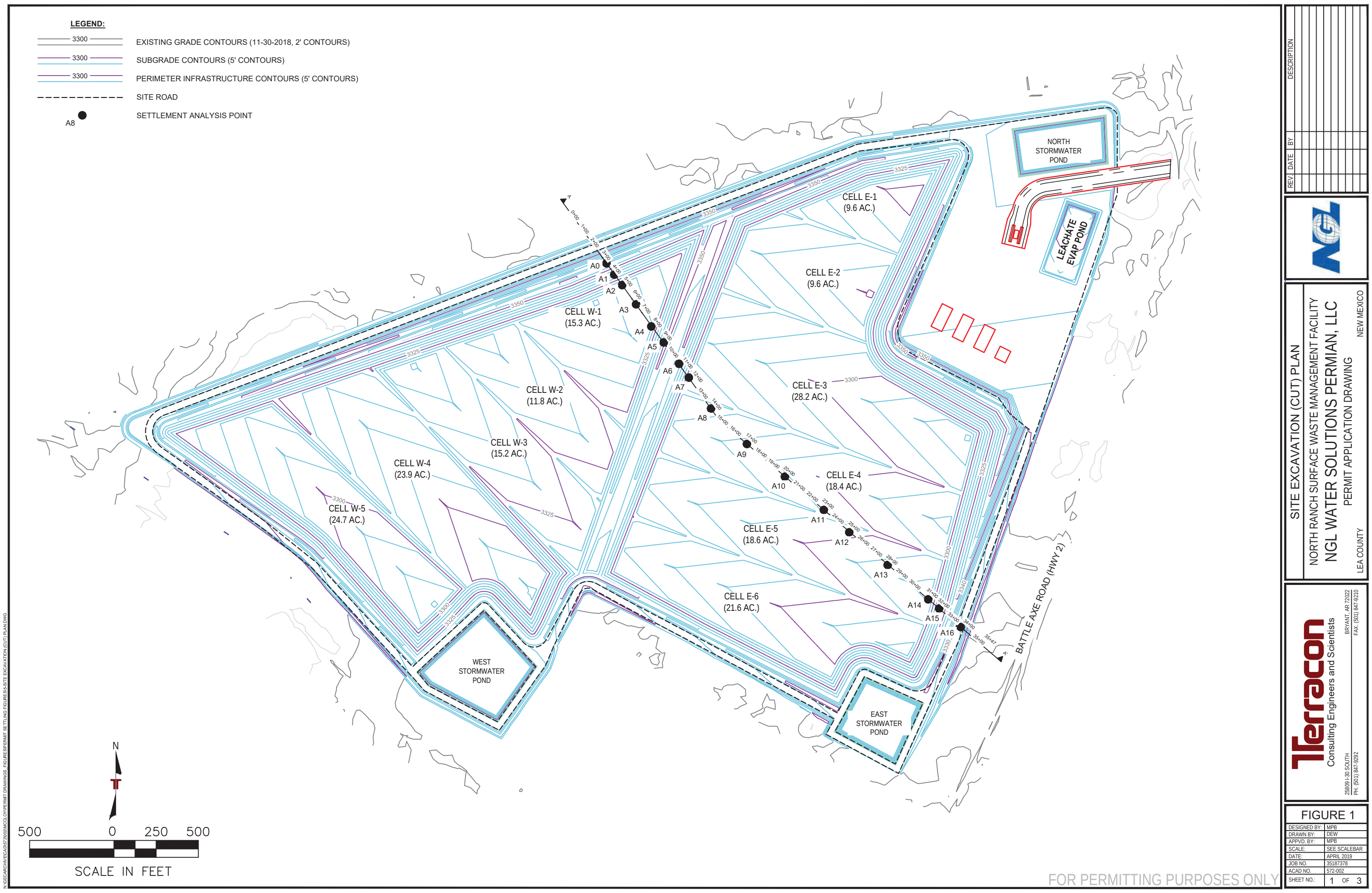
Based on our calculations, the foundation soils will settle about 1.8 feet (max.) near area (Station 10+00) where foundation (native) soil is thick (no excavation was planned near this area) and about 1.2 feet (max.) for the remaining area. The estimated settlements resulted in a maximum grade change of 0.6% near Station 10+00 and minimal grade change for the remaining area. The required 2.0% slope of the leachate collection system will not adversely be affected by the foundation settlements. Additionally, a maximum tensile stress on the liner was estimated to be 0.1%, which was less than the allowable strain on the geosynthetic liner system.

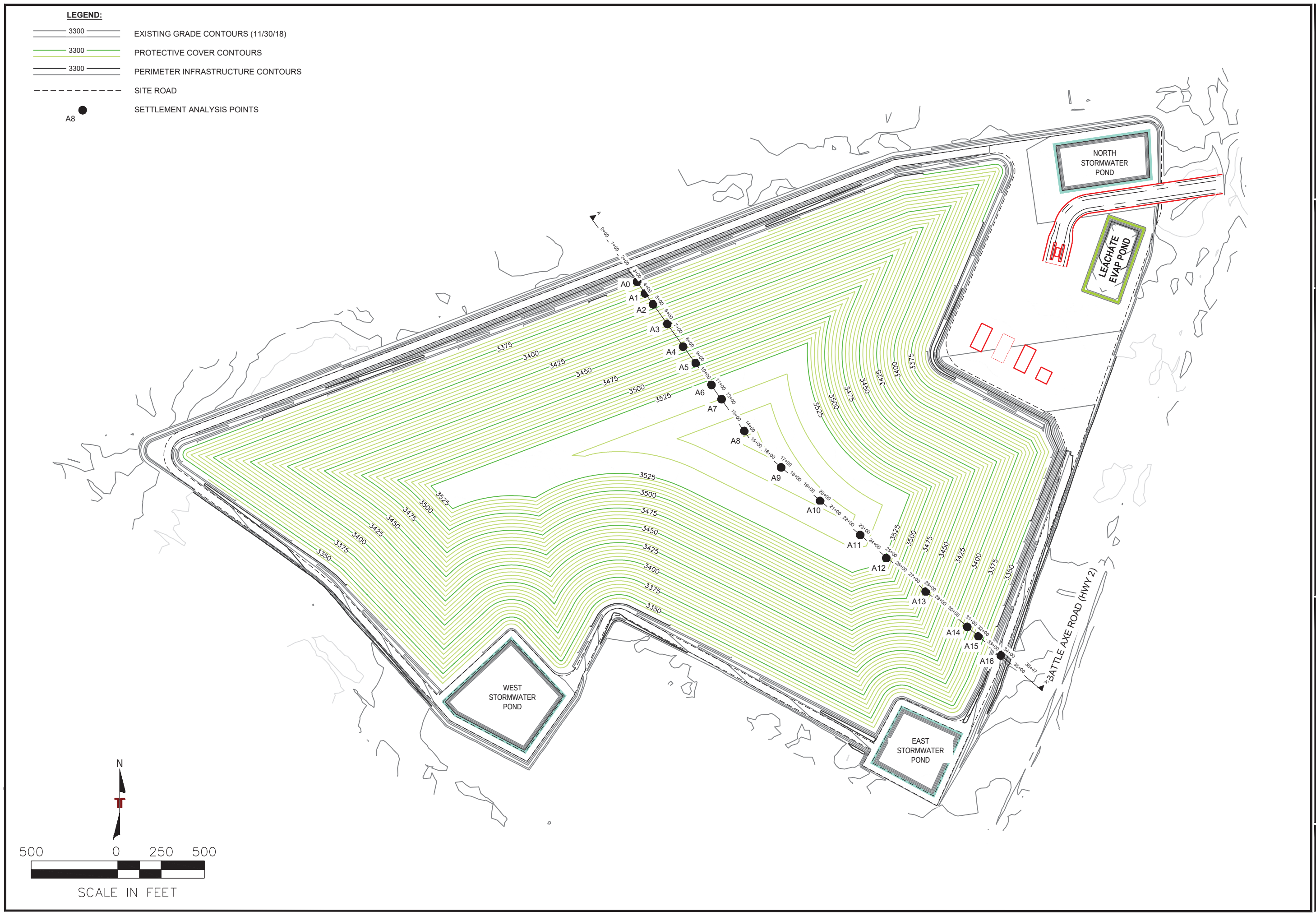
The final cover will settle on the order of 1 inch due to compression of waste material, resulting from the increase in effective stress due to the placement of the final cover system. Grade changes induced by differential waste settlement were estimated to be minimal and the final cover system will maintain positive drainage on the side slopes. Additionally, negligible tensile strains are expected to develop in the final cover system due to waste settlement.

REFERENCES

Holtz, R. D., and Kovacs, W. D. (1981) An Introduction to Geotechnical Engineering, Prentice-Hall Inc., Englewood Cliffs, N.J.

Qian, X., Koerner, R. M., and Gray, D. H. (2002) “Geotechnical Aspects of Landfill Design and Construction” Prentice Hall, Upper Saddle River, NJ


LEGEND:
EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
SUBGRADE CONTOURS (5' CONTOURS)
PERIMETER INFRASTRUCTURE CONTOURS (5' CONTOURS)
SITE ROAD
SETTLEMENT ANALYSIS POINT
NORTH STORMWATER POND
LEACHATE EVAP POND
CELL E-1 (9.6 AC.)
CELL E-2 (9.6 AC.)
CELL E-3 (28.2 AC.)
CELL E-4 (18.4 AC.)
CELL E-5 (18.6 AC.)
CELL E-6 (21.6 AC.)
CELL W-1 (15.3 AC.)
CELL W-2 (11.8 AC.)
CELL W-3 (15.2 AC.)
CELL W-4 (23.9 AC.)
CELL W-5 (24.7 AC.)
WEST STORMWATER POND
EAST STORMWATER POND
BATTLE AXE ROAD (HWY 2)
500 0 250 500
SCALE IN FEET
FOR PERMITTING PURPOSES ONLY
SITE EXCAVATION (CUT) PLAN
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WATER SOLUTIONS PERMIAN, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
FIGURE 1
SHEET NO.: 1 OF 3



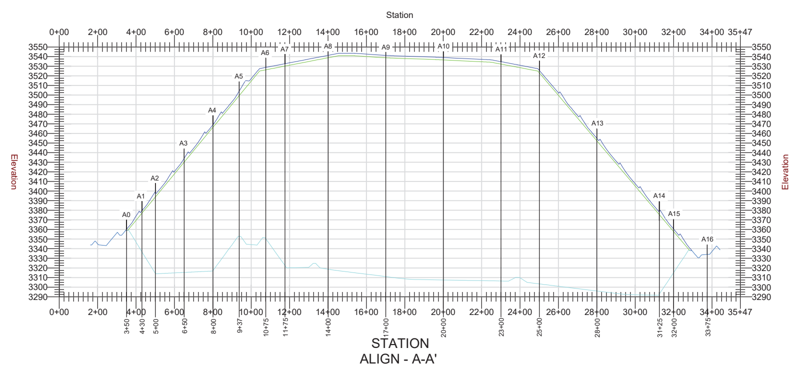
REV | DATE | BY | DESCRIPTION

TOP OF WASTE FINAL
PERMIT DRAWING
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 2

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	APRIL 2019
JOB NO.	572-002-35187378
ACAD NO.	
SHEET NO.:	2 OF 3



LEGEND:

- PROPOSED TOP OF FINAL COVER
- PROPOSED TOP OF WASTE
- PROPOSED TOP OF PROTECTIVE COVER
- PROPOSED TOP OF PERIMETER INFRASTRUCTURE
- PROPOSED INTERMEDIATE COVER
- A0 3+50 SETTLEMENT ANALYSIS POINTS

NOTES:

1. OPERATIONAL = WASTE PLUS ROUTINE AND INTERIM SOIL COVER.

SCALES:
1" = 500' (HORIZONTAL)
1" = 100' (VERTICAL)
VERTICAL EXAGGERATION = x 5

500 0 250 500
SCALE IN FEET

REV	DATE	BY	DESCRIPTION

FINAL GRADE CROSS-SECTIONS
PERMIT DRAWING
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

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FIGURE 3

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	APRIL 2019
JOB NO.	572-002-35187378
ACAD NO.	
SHEET NO.:	3 OF 3

TABLE 2 FOUNDATION SOIL SETTLEMENT CALCULATIONS

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+75
Linear Horizontal Distance (ft.)	350	430	500	650	800	937	1075	1175	1400	1700	2000	2300	2500	2800	3125	3200	3375
Final Cover Elevation (ft.)	3360	3380	3395	3430	3465	3500	3530	3530	3540	3540	3540	3533	3530	3450	3380	3360	3340
Final Cover Above Waste (ft.)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Final Waste Elevation (ft.)	3356.5	3376.5	3391.5	3426.5	3461.5	3496.5	3526.5	3526.5	3536.5	3536.5	3536.5	3529.5	3526.5	3446.5	3376.5	3356.5	3336.5
Clay Liner Thickness (ft.)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Top of Clay Liner Elevation (ft.)	3356.5	3334	3312	3312	3314	3350	3350	3320	3318	3308	3305	3302	3300	3295	3290	3315	3336.5
Waste Thickness (ft.)	0.0	42.5	79.5	114.5	147.5	146.5	176.5	206.5	218.5	228.5	231.5	227.5	226.5	151.5	86.5	41.5	0.0
Unit Weight of Final Cover (pcf)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Unit Weight of Waste (pcf)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Applied Pressure (psf)	540	5640	10080	14280	18240	18120	21720	25320	26760	27960	28320	27840	27720	18720	10920	5520	540
Founfation Bedrock Elevation (ft.)	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279	3279
Foundation-Sand Thickness (ft.)	76.5	54.0	32.0	32.0	34.0	70.0	70.0	40.0	38.0	28.0	25.0	22.0	20.0	15.0	10.0	35.0	56.5
Foundation- Sand Constrained Modulus (ksf)	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0
SETTLEMENT																	
Settlement (ft.)	0.0	0.4	0.4	0.5	0.7	1.5	1.8	1.2	1.2	0.9	0.8	0.7	0.7	0.3	0.1	0.2	0.0
Settlement (in.)	0.6	4.3	4.6	6.5	8.8	17.9	21.5	14.3	14.4	11.1	10.0	8.6	7.8	4.0	1.5	2.7	0.4
Differential Settlement (ft.)		0.3	0.0	0.2	0.2	0.8	0.3	-0.6	0.0	-0.3	-0.1	-0.1	-0.1	-0.3	-0.2	0.1	-0.2
GRADES AND STRAINS																	
Bottom of Clay Liner Elevation Prior to Settlement (ft.)	3355.5	3333.0	3311.0	3311.0	3313.0	3349.0	3349.0	3319.0	3317.0	3307.0	3304.0	3301.0	3299.0	3294.0	3289.0	3314.0	3335.5
Bottom of Clay Liner Elevation After settlement (ft.)	3355.5	3332.6	3310.6	3310.5	3312.3	3347.5	3347.2	3317.8	3315.8	3306.1	3303.2	3300.3	3298.3	3293.7	3288.9	3313.8	3335.5
Initial Liner Cover GeoMembrane Segment Length (ft.)		83.1	73.4	150.0	150.0	141.7	138.0	104.4	225.0	300.2	300.0	300.0	200.0	300.0	325.0	79.1	176.3
PostSettlement Final Cover GeoMemberane Segment Length (ft.)		83.2	73.4	150.0	150.0	141.5	138.0	104.2	225.0	300.2	300.0	300.0	200.0	300.0	325.0	79.0	176.3
Strain (+ Compression/- Tension)		-0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PreSettlement Slope (+ up/- down)		-28.1%	-31.4%	0.0%	1.3%	26.3%	0.0%	-30.0%	-0.9%	-3.3%	-1.0%	-1.0%	-1.0%	-1.7%	-1.5%	33.3%	12.3%
Post Settlement Slope (+ up/- down)		-28.5%	-31.5%	-0.1%	1.2%	25.7%	-0.2%	-29.4%	-0.9%	-3.2%	-1.0%	-1.0%	-1.0%	-1.6%	-1.5%	33.2%	12.4%
Grade Change (+ Steeper/- Milder)		0.4%	0.0%	0.1%	-0.1%	-0.6%	0.2%	-0.6%	0.0%	-0.1%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	0.1%

TABLE 3 WASTE SETTLEMENT CALCULATIONS

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+75
Linear Horizontal Distance (ft.)	350	430	500	650	800	937	1075	1175	1400	1700	2000	2300	2500	2800	3125	3200	3375
Final Cover Elevation (ft.)	3360	3380	3395	3430	3465	3500	3530	3530	3540	3540	3540	3533	3530	3450	3380	3360	3340
Final Cover Above Waste (ft.)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Final Waste Elevation (ft.)	3356.5	3376.5	3391.5	3426.5	3461.5	3496.5	3526.5	3526.5	3536.5	3536.5	3536.5	3529.5	3526.5	3446.5	3376.5	3356.5	3336.5
Top of Clay Liner (ft.)	3356.5	3334	3312	3312	3314	3350	3350	3320	3318	3308	3305	3302	3300	3295	3290	3315	3336.5
Waste Thickness (ft.)	0.0	42.5	79.5	114.5	147.5	146.5	176.5	206.5	218.5	228.5	231.5	227.5	226.5	151.5	86.5	41.5	0.0
Number of Layers	0	4	8	11	15	15	18	20	20	20	20	20	20	15	9	4	0
Layer Thickness (ft.)	0	11	10	10	10	10	10	10	11	11	12	11	11	10	10	10	0
Unit Weight of Final Cover (pcf)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Unit Weight of Waste (pcf)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Pre Consolidation Pressure (psf)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Modified Primary Compression Index	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Modified Recompression Index	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Modified Secondary Compression Index	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUB LAYER	1																
Top of Layer Elevation (ft.)		3376.5	3391.5	3426.5	3461.5	3496.5	3526.5	3526.5	3536.5	3536.5	3536.5	3529.5	3526.5	3446.5	3376.5	3356.5	
Bottom of Layer Elevation (ft.)		3365.9	3381.6	3416.1	3451.7	3486.7	3516.7	3516.2	3525.6	3525.1	3524.9	3518.1	3515.2	3436.4	3366.9	3346.1	
Layer Midpoint Elevation (ft.)		3371.2	3386.5	3421.3	3456.6	3491.6	3521.6	3521.3	3531.0	3530.8	3530.7	3523.8	3520.8	3441.5	3371.7	3351.3	
Initial Effective Stress (psf)		637.5	596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7	622.5	
Final Effective Stress (psf)		1057.5	1016.3	1044.5	1010.0	1006.0	1008.3	1039.5	1075.5	1105.5	1114.5	1102.5	1099.5	1026.0	996.7	1042.5	
Primary Settlement (ft.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Primary Settlement (in.)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	
SUB LAYER	2																
Top of Layer Elevation (ft.)		3365.9	3381.6	3416.1	3451.7	3486.7	3516.7	3516.2	3525.6	3525.1	3524.9	3518.1	3515.2	3436.4	3366.9	3346.1	
Bottom of Layer Elevation (ft.)		3355.3	3371.6	3405.7	3441.8	3477.0	3506.9	3505.9	3514.7	3513.7	3513.4	3506.8	3503.9	3426.3	3357.3	3335.8	
Layer Midpoint Elevation (ft.)		3360.6	3376.6	3410.9	3446.8	3481.9	3511.8	3511.0	3520.1	3519.4	3519.1	3512.4	3509.5	3431.4	3362.1	3340.9	
Initial Effective Stress (psf)		637.5	596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7	622.5	
Final Effective Stress (psf)		2332.5	2208.8	2293.6	2190.0	2178.0	2185.0	2278.5	2386.5	2476.5	2503.5	2467.5	2458.5	2238.0	2150.0	2287.5	
Primary Settlement (ft.)		0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	
Primary Settlement (in.)		0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.7	0.7	0.6	0.6	0.6	
SUB LAYER	3																
Top of Layer Elevation (ft.)		3355.3	3371.6	3405.7	3441.8	3477.0	3506.9	3505.9	3514.7	3513.7	3513.4	3506.8	3503.9	3426.3	3357.3	3335.8	
Bottom of Layer Elevation (ft.)		3344.6	3361.7	3395.3	3432.0	3467.2	3497.1	3495.5	3503.7	3502.2	3501.8	3495.4	3492.5	3416.2	3347.7	3325.4	
Layer Midpoint Elevation (ft.)		3349.9	3366.7	3400.5	3436.9	3472.1	3502.0	3500.7	3509.2	3507.9	3507.6	3501.1	3498.2	3421.3	3352.5	3330.6	
Initial Effective Stress (psf)		637.5	596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7	622.5	
Final Effective Stress (psf)		3607.5	3401.3	3542.7	3370.0	3350.0	3361.7	3517.5	3697.5	3847.5	3892.5	3832.5	3817.5	3450.0	3303.3	3532.5	
Primary Settlement (ft.)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Primary Settlement (in.)		1.0	0.9	0.9	0.9	0.8	0.9	0.9	1.0	1.1	1.1	1.0	1.0	0.9	0.8	0.9	
SUB LAYER	4																
Top of Layer Elevation (ft.)		3344.6	3361.7	3395.3	3432.0	3467.2	3497.1	3495.5	3503.7	3502.2	3501.8	3495.4	3492.5	3416.2	3347.7	3325.4	
Bottom of Layer Elevation (ft.)		3334.0	3351.8	3384.9	3422.2	3457.4	3487.3	3485.2	3492.8	3490.8	3490.2	3484.0	3481.2	3406.1	3338.1	3315.0	
Layer Midpoint Elevation (ft.)		3339.3	3356.7	3390.1	3427.1	3462.3	3492.2	3490.4	3498.3	3496.5	3496.0	3489.7	3486.9	3411.2	3342.9	3320.2	
Initial Effective Stress (psf)		637.5	596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7	622.5	
Final Effective Stress (psf)		4882.5	4593.8	4791.8	4550.0	4522.0	4538.3	4756.5	5008.5	5218.5	5281.5	5197.5	5176.5	4662.0	4456.7	4777.5	
Primary Settlement (ft.)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Primary Settlement (in.)		1.2	1.1	1.1	1.0	1.0	1.0	1.1	1.2	1.3	1.3	1.3	1.3	1.1	1.0	1.1	

TABLE 3 WASTE SETTLEMENT CALCULATIONS (CONTINUED)

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+75
SUB LAYER	5																
Top of Layer Elevation (ft.)			3351.8	3384.9	3422.2	3457.4	3487.3	3485.2	3492.8	3490.8	3490.2	3484.0	3481.2	3406.1	3338.1		
Bottom of Layer Elevation (ft.)			3341.8	3374.5	3412.3	3447.7	3477.5	3474.9	3481.9	3479.4	3478.6	3472.6	3469.9	3396.0	3328.4		
Layer Midpoint Elevation (ft.)			3346.8	3379.7	3417.3	3452.6	3482.4	3480.0	3487.3	3485.1	3484.4	3478.3	3475.5	3401.1	3333.3		
Initial Effective Stress (psf)			596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7		
Final Effective Stress (psf)			5786.3	6040.9	5730.0	5694.0	5715.0	5995.5	6319.5	6589.5	6670.5	6562.5	6535.5	5874.0	5610.0		
Primary Settlement (ft.)			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Primary Settlement (in.)			1.2	1.3	1.2	1.2	1.2	1.3	1.4	1.4	1.5	1.4	1.4	1.2	1.1		
SUB LAYER	6																
Top of Layer Elevation (ft.)			3341.8	3374.5	3412.3	3447.7	3477.5	3474.9	3481.9	3479.4	3478.6	3472.6	3469.9	3396.0	3328.4		
Bottom of Layer Elevation (ft.)			3331.9	3364.0	3402.5	3437.9	3467.7	3464.6	3471.0	3468.0	3467.1	3461.3	3458.6	3385.9	3318.8		
Layer Midpoint Elevation (ft.)			3336.8	3369.3	3407.4	3442.8	3472.6	3469.7	3476.4	3473.7	3472.8	3466.9	3464.2	3391.0	3323.6		
Initial Effective Stress (psf)			596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7		
Final Effective Stress (psf)			6978.8	7290.0	6910.0	6866.0	6891.7	7234.5	7630.5	7960.5	8059.5	7927.5	7894.5	7086.0	6763.3		
Primary Settlement (ft.)			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Primary Settlement (in.)			1.3	1.4	1.3	1.3	1.3	1.4	1.5	1.6	1.6	1.6	1.6	1.3	1.3		
SUB LAYER	7																
Top of Layer Elevation (ft.)			3331.9	3364.0	3402.5	3437.9	3467.7	3464.6	3471.0	3468.0	3467.1	3461.3	3458.6	3385.9	3318.8		
Bottom of Layer Elevation (ft.)			3321.9	3353.6	3392.7	3428.1	3457.9	3454.2	3460.0	3456.5	3455.5	3449.9	3447.2	3375.8	3309.2		
Layer Midpoint Elevation (ft.)			3326.9	3358.8	3397.6	3433.0	3462.8	3459.4	3465.5	3462.2	3461.3	3455.6	3452.9	3380.9	3314.0		
Initial Effective Stress (psf)			596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7		
Final Effective Stress (psf)			8171.3	8539.1	8090.0	8038.0	8068.3	8473.5	8941.5	9331.5	9448.5	9292.5	9253.5	8298.0	7916.7		
Primary Settlement (ft.)			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Primary Settlement (in.)			1.4	1.5	1.4	1.4	1.4	1.5	1.6	1.7	1.7	1.7	1.7	1.4	1.4		
SUB LAYER	8																
Top of Layer Elevation (ft.)			3321.9	3353.6	3392.7	3428.1	3457.9	3454.2	3460.0	3456.5	3455.5	3449.9	3447.2	3375.8	3309.2		
Bottom of Layer Elevation (ft.)			3312.0	3343.2	3382.8	3418.4	3448.1	3443.9	3449.1	3445.1	3443.9	3438.5	3435.9	3365.7	3299.6		
Layer Midpoint Elevation (ft.)			3317.0	3348.4	3387.8	3423.3	3453.0	3449.1	3454.6	3450.8	3449.7	3444.2	3441.6	3370.8	3304.4		
Initial Effective Stress (psf)			596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7		
Final Effective Stress (psf)			9363.8	9788.2	9270.0	9210.0	9245.0	9712.5	10252.5	10702.5	10837.5	10657.5	10612.5	9510.0	9070.0		
Primary Settlement (ft.)			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1		
Primary Settlement (in.)			1.5	1.6	1.5	1.5	1.5	1.6	1.7	1.8	1.8	1.8	1.8	1.5	1.4		
SUB LAYER	9																
Top of Layer Elevation (ft.)				3343.2	3382.8	3418.4	3448.1	3443.9	3449.1	3445.1	3443.9	3438.5	3435.9	3365.7	3299.6		
Bottom of Layer Elevation (ft.)				3332.8	3373.0	3408.6	3438.3	3433.6	3438.2	3433.7	3432.3	3427.1	3424.6	3355.6	3290.0		
Layer Midpoint Elevation (ft.)				3338.0	3377.9	3413.5	3443.2	3438.7	3443.6	3439.4	3438.1	3432.8	3430.2	3360.7	3294.8		
Initial Effective Stress (psf)				624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7		
Final Effective Stress (psf)				11037.3	10450.0	10382.0	10421.7	10951.5	11563.5	12073.5	12226.5	12022.5	11971.5	10722.0	10223.3		
Primary Settlement (ft.)				0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1		
Primary Settlement (in.)				1.7	1.6	1.5	1.5	1.6	1.8	1.9	1.9	1.9	1.8	1.6	1.5		
SUB LAYER	10																
Top of Layer Elevation (ft.)				3332.8	3373.0	3408.6	3438.3	3433.6	3438.2	3433.7	3432.3	3427.1	3424.6	3355.6			
Bottom of Layer Elevation (ft.)				3322.4	3363.2	3398.8	3428.4	3423.3	3427.3	3422.3	3420.8	3415.8	3413.3	3345.5			
Layer Midpoint Elevation (ft.)				3327.6	3368.1	3403.7	3433.3	3428.4	3432.7	3428.0	3426.5	3421.4	3418.9	3350.6			
Initial Effective Stress (psf)				624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0			
Final Effective Stress (psf)				12286.4	11630.0	11554.0	11598.3	12190.5	12874.5	13444.5	13615.5	13387.5	13330.5	11934.0			
Primary Settlement (ft.)				0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1			
Primary Settlement (in.)				1.7	1.6	1.6	1.6	1.7	1.8	1.9	2.0	1.9	1.9	1.7			

TABLE 3 WASTE SETTLEMENT CALCULATIONS (CONTINUED)

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+75
SUB LAYER	**11**																
Top of Layer Elevation (ft.)				3322.4	3363.2	3398.8	3428.4	3423.3	3427.3	3422.3	3420.8	3415.8	3413.3	3345.5			
Bottom of Layer Elevation (ft.)				3312.0	3353.3	3389.1	3418.6	3412.9	3416.3	3410.8	3409.2	3404.4	3401.9	3335.4			
Layer Midpoint Elevation (ft.)				3317.2	3358.3	3394.0	3423.5	3418.1	3421.8	3416.5	3415.0	3410.1	3407.6	3340.5			
Initial Effective Stress (psf)				624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0			
Final Effective Stress (psf)				13535.5	12810.0	12726.0	12775.0	13429.5	14185.5	14815.5	15004.5	14752.5	14689.5	13146.0			
Primary Settlement (ft.)				0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1			
Primary Settlement (in.)				1.8	1.7	1.7	1.7	1.8	1.9	2.0	2.0	2.0	2.0	1.7			
SUB LAYER	**12**																
Top of Layer Elevation (ft.)					3353.3	3389.1	3418.6	3412.9	3416.3	3410.8	3409.2	3404.4	3401.9	3335.4			
Bottom of Layer Elevation (ft.)					3343.5	3379.3	3408.8	3402.6	3405.4	3399.4	3397.6	3393.0	3390.6	3325.3			
Layer Midpoint Elevation (ft.)					3348.4	3384.2	3413.7	3407.8	3410.9	3405.1	3403.4	3398.7	3396.3	3330.4			
Initial Effective Stress (psf)					590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0			
Final Effective Stress (psf)					13990.0	13898.0	13951.7	14668.5	15496.5	16186.5	16393.5	16117.5	16048.5	14358.0			
Primary Settlement (ft.)					0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1			
Primary Settlement (in.)					1.7	1.7	1.7	1.8	2.0	2.1	2.1	2.1	2.1	1.8			
SUB LAYER	**13**																
Top of Layer Elevation (ft.)					3343.5	3379.3	3408.8	3402.6	3405.4	3399.4	3397.6	3393.0	3390.6	3325.3			
Bottom of Layer Elevation (ft.)					3333.7	3369.5	3399.0	3392.3	3394.5	3388.0	3386.0	3381.6	3379.3	3315.2			
Layer Midpoint Elevation (ft.)					3338.6	3374.4	3403.9	3397.4	3399.9	3393.7	3391.8	3387.3	3384.9	3320.3			
Initial Effective Stress (psf)					590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0			
Final Effective Stress (psf)					15170.0	15070.0	15128.3	15907.5	16807.5	17557.5	17782.5	17482.5	17407.5	15570.0			
Primary Settlement (ft.)					0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2			
Primary Settlement (in.)					1.8	1.8	1.8	1.9	2.0	2.1	2.2	2.1	2.1	1.8			
SUB LAYER	**14**																
Top of Layer Elevation (ft.)					3333.7	3369.5	3399.0	3392.3	3394.5	3388.0	3386.0	3381.6	3379.3	3315.2			
Bottom of Layer Elevation (ft.)					3323.8	3359.8	3389.2	3382.0	3383.6	3376.6	3374.5	3370.3	3368.0	3305.1			
Layer Midpoint Elevation (ft.)					3328.8	3364.7	3394.1	3387.1	3389.0	3382.3	3380.2	3375.9	3373.6	3310.2			
Initial Effective Stress (psf)					590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0			
Final Effective Stress (psf)					16350.0	16242.0	16305.0	17146.5	18118.5	18928.5	19171.5	18847.5	18766.5	16782.0			
Primary Settlement (ft.)					0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2			
Primary Settlement (in.)					1.8	1.8	1.8	1.9	2.1	2.2	2.2	2.2	2.2	1.9			
SUB LAYER	**15**																
Top of Layer Elevation (ft.)					3323.8	3359.8	3389.2	3382.0	3383.6	3376.6	3374.5	3370.3	3368.0	3305.1			
Bottom of Layer Elevation (ft.)					3314.0	3350.0	3379.4	3371.6	3372.6	3365.1	3362.9	3358.9	3356.6	3295.0			
Layer Midpoint Elevation (ft.)					3318.9	3354.9	3384.3	3376.8	3378.1	3370.8	3368.7	3364.6	3362.3	3300.1			
Initial Effective Stress (psf)					590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0			
Final Effective Stress (psf)					17530.0	17414.0	17481.7	18385.5	19429.5	20299.5	20560.5	20212.5	20125.5	17994.0			
Primary Settlement (ft.)					0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2			
Primary Settlement (in.)					1.9	1.9	1.9	2.0	2.1	2.2	2.3	2.2	2.2	1.9			
SUB LAYER	**16**																
Top of Layer Elevation (ft.)							3379.4	3371.6	3372.6	3365.1	3362.9	3358.9	3356.6				
Bottom of Layer Elevation (ft.)							3369.6	3361.3	3361.7	3353.7	3351.3	3347.5	3345.3				
Layer Midpoint Elevation (ft.)							3374.5	3366.5	3367.2	3359.4	3357.1	3353.2	3351.0				
Initial Effective Stress (psf)							588.3	619.5	655.5	685.5	694.5	682.5	679.5				
Final Effective Stress (psf)							18658.3	19624.5	20740.5	21670.5	21949.5	21577.5	21484.5				
Primary Settlement (ft.)							0.2	0.2	0.2	0.2	0.2	0.2	0.2				
Primary Settlement (in.)							1.9	2.0	2.2	2.3	2.3	2.3	2.3				

TABLE 3 WASTE SETTLEMENT CALCULATIONS (CONTINUED)

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+75
SUB LAYER	17																
Top of Layer Elevation (ft.)							3369.6	3361.3	3361.7	3353.7	3351.3	3347.5	3345.3				
Bottom of Layer Elevation (ft.)							3359.8	3351.0	3350.8	3342.3	3339.7	3336.1	3334.0				
Layer Midpoint Elevation (ft.)							3364.7	3356.1	3356.2	3348.0	3345.5	3341.8	3339.6				
Initial Effective Stress (psf)							588.3	619.5	655.5	685.5	694.5	682.5	679.5				
Final Effective Stress (psf)							19835.0	20863.5	22051.5	23041.5	23338.5	22942.5	22843.5				
Primary Settlement (ft.)							0.2	0.2	0.2	0.2	0.2	0.2	0.2				
Primary Settlement (in.)							1.9	2.1	2.2	2.3	2.4	2.3	2.3				
SUB LAYER	18																
Top of Layer Elevation (ft.)							3359.8	3351.0	3350.8	3342.3	3339.7	3336.1	3334.0				
Bottom of Layer Elevation (ft.)							3350.0	3340.7	3339.9	3330.9	3328.2	3324.8	3322.7				
Layer Midpoint Elevation (ft.)							3354.9	3345.8	3345.3	3336.6	3333.9	3330.4	3328.3				
Initial Effective Stress (psf)							588.3	619.5	655.5	685.5	694.5	682.5	679.5				
Final Effective Stress (psf)							21011.7	22102.5	23362.5	24412.5	24727.5	24307.5	24202.5				
Primary Settlement (ft.)							0.2	0.2	0.2	0.2	0.2	0.2	0.2				
Primary Settlement (in.)							2.0	2.1	2.2	2.4	2.4	2.4	2.3				
SUB LAYER	19																
Top of Layer Elevation (ft.)								3340.7	3339.9	3330.9	3328.2	3324.8	3322.7				
Bottom of Layer Elevation (ft.)								3330.3	3328.9	3319.4	3316.6	3313.4	3311.3				
Layer Midpoint Elevation (ft.)								3335.5	3334.4	3325.1	3322.4	3319.1	3317.0				
Initial Effective Stress (psf)								619.5	655.5	685.5	694.5	682.5	679.5				
Final Effective Stress (psf)								23341.5	24673.5	25783.5	26116.5	25672.5	25561.5				
Primary Settlement (ft.)								0.2	0.2	0.2	0.2	0.2	0.2				
Primary Settlement (in.)								2.1	2.3	2.4	2.4	2.4	2.4				
SUB LAYER	20																
Top of Layer Elevation (ft.)								3330.3	3328.9	3319.4	3316.6	3313.4	3311.3				
Bottom of Layer Elevation (ft.)								3320.0	3318.0	3308.0	3305.0	3302.0	3300.0				
Layer Midpoint Elevation (ft.)								3325.2	3323.5	3313.7	3310.8	3307.7	3305.7				
Initial Effective Stress (psf)								619.5	655.5	685.5	694.5	682.5	679.5				
Final Effective Stress (psf)								24580.5	25984.5	27154.5	27505.5	27037.5	26920.5				
Primary Settlement (ft.)								0.2	0.2	0.2	0.2	0.2	0.2				
Primary Settlement (in.)								2.2	2.3	2.4	2.5	2.4	2.4				
SETTLEMENT																	
Total Primary Settlement (in.)	0.0	2.9	8.1	13.8	20.0	19.8	25.7	31.8	34.1	36.0	36.6	35.8	35.6	20.7	9.2	2.8	0.0
Total Secondary Settlement (in.)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Settlement (in.)	0.0	2.9	8.1	13.8	20.0	19.8	25.7	31.8	34.1	36.0	36.6	35.8	35.6	20.7	9.2	2.8	0.0
Total Settlement (ft.)	0.0	0.2	0.7	1.1	1.7	1.7	2.1	2.6	2.8	3.0	3.1	3.0	3.0	1.7	0.8	0.2	0.0

TABLE 4 FINAL COVER SETTLEMENT CALCULATIONS

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+70
Linear Horizontal Distance (ft.)	350	430	500	650	800	937	1075	1175	1400	1700	2000	2300	2500	2800	3125	3200	3370
Final Cover Elevation (ft.)	3360	3380	3395	3430	3465	3500	3530	3530	3540	3540	3540	3533	3530	3450	3380	3363	3330
Final Cover Above Waste (ft.)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Final Waste Elevation (ft.)	3356.5	3376.5	3391.5	3426.5	3461.5	3496.5	3526.5	3526.5	3536.5	3536.5	3536.5	3529.5	3526.5	3446.5	3376.5	3359.5	3326.5
Top of Clay Liner (ft.)	3356.5	3334	3312	3312	3314	3350	3350	3320	3318	3308	3305	3302	3300	3295	3290	3315	3331.5
Waste Thickness (ft.)	0.0	42.5	79.5	114.5	147.5	146.5	176.5	206.5	218.5	228.5	231.5	227.5	226.5	151.5	86.5	44.5	-5.0
Number of Layers	0	4	8	11	15	15	18	20	20	20	20	20	20	15	9	4	0
Layer Thickness (ft.)	0	11	10	10	10	10	10	10	11	11	12	11	11	10	10	11	0
Unit Weight of Final Cover (pcf)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Unit Weight of Waste (pcf)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Pre Consolidation Pressure (psf)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Modified Primary Compression Index	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Modified Recompression Index	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Modified Secondary Compression Index	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUB LAYER									**1**								
Top of Layer Elevation (ft.)		3376.5	3391.5	3426.5	3461.5	3496.5	3526.5	3526.5	3536.5	3536.5	3536.5	3529.5	3526.5	3446.5	3376.5	3359.5	
Bottom of Layer Elevation (ft.)		3365.9	3381.6	3416.1	3451.7	3486.7	3516.7	3516.2	3525.6	3525.1	3524.9	3518.1	3515.2	3436.4	3366.9	3348.4	
Layer Midpoint Elevation (ft.)		3371.2	3386.5	3421.3	3456.6	3491.6	3521.6	3521.3	3531.0	3530.8	3530.7	3523.8	3520.8	3441.5	3371.7	3353.9	
Initial Effective Stress (psf)		637.5	596.3	624.5	590.0	586.0	588.3	619.5	655.5	685.5	694.5	682.5	679.5	606.0	576.7	667.5	
Final Effective Stress (psf)		1057.5	1016.3	1044.5	1010.0	1006.0	1008.3	1039.5	1075.5	1105.5	1114.5	1102.5	1099.5	1026.0	996.7	1087.5	
Primary Settlement (ft.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Primary Settlement (in.)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.2	
SUB LAYER									**2**								
Top of Layer Elevation (ft.)		3365.9	3381.6	3416.1	3451.7	3486.7	3516.7	3516.2	3525.6	3525.1	3524.9	3518.1	3515.2	3436.4	3366.9	3348.4	
Bottom of Layer Elevation (ft.)		3355.3	3371.6	3405.7	3441.8	3477.0	3506.9	3505.9	3514.7	3513.7	3513.4	3506.8	3503.9	3426.3	3357.3	3337.3	
Layer Midpoint Elevation (ft.)		3360.6	3376.6	3410.9	3446.8	3481.9	3511.8	3511.0	3520.1	3519.4	3519.1	3512.4	3509.5	3431.4	3362.1	3342.8	
Initial Effective Stress (psf)		1912.5	1788.8	1873.6	1770.0	1758.0	1765.0	1858.5	1966.5	2056.5	2083.5	2047.5	2038.5	1818.0	1730.0	2002.5	
Final Effective Stress (psf)		2332.5	2208.8	2293.6	2190.0	2178.0	2185.0	2278.5	2386.5	2476.5	2503.5	2467.5	2458.5	2238.0	2150.0	2422.5	
Primary Settlement (ft.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Primary Settlement (in.)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
SUB LAYER									**3**								
Top of Layer Elevation (ft.)		3355.3	3371.6	3405.7	3441.8	3477.0	3506.9	3505.9	3514.7	3513.7	3513.4	3506.8	3503.9	3426.3	3357.3	3337.3	
Bottom of Layer Elevation (ft.)		3344.6	3361.7	3395.3	3432.0	3467.2	3497.1	3495.5	3503.7	3502.2	3501.8	3495.4	3492.5	3416.2	3347.7	3326.1	
Layer Midpoint Elevation (ft.)		3349.9	3366.7	3400.5	3436.9	3472.1	3502.0	3500.7	3509.2	3507.9	3507.6	3501.1	3498.2	3421.3	3352.5	3331.7	
Initial Effective Stress (psf)		3187.5	2981.3	3122.7	2950.0	2930.0	2941.7	3097.5	3277.5	3427.5	3472.5	3412.5	3397.5	3030.0	2883.3	3337.5	
Final Effective Stress (psf)		3607.5	3401.3	3542.7	3370.0	3350.0	3361.7	3517.5	3697.5	3847.5	3892.5	3832.5	3817.5	3450.0	3303.3	3757.5	
Primary Settlement (ft.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Primary Settlement (in.)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	

TABLE 4 FINAL COVER SETTLEMENT CALCULATIONS (CONTINUED)

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+70
SUB LAYER									4								
Top of Layer Elevation (ft.)		3344.6	3361.7	3395.3	3432.0	3467.2	3497.1	3495.5	3503.7	3502.2	3501.8	3495.4	3492.5	3416.2	3347.7	3326.1	
Bottom of Layer Elevation (ft.)		3334.0	3351.8	3384.9	3422.2	3457.4	3487.3	3485.2	3492.8	3490.8	3490.2	3484.0	3481.2	3406.1	3338.1	3315.0	
Layer Midpoint Elevation (ft.)		3339.3	3356.7	3390.1	3427.1	3462.3	3492.2	3490.4	3498.3	3496.5	3496.0	3489.7	3486.9	3411.2	3342.9	3320.6	
Initial Effective Stress (psf)		4462.5	4173.8	4371.8	4130.0	4102.0	4118.3	4336.5	4588.5	4798.5	4861.5	4777.5	4756.5	4242.0	4036.7	4672.5	
Final Effective Stress (psf)		4882.5	4593.8	4791.8	4550.0	4522.0	4538.3	4756.5	5008.5	5218.5	5281.5	5197.5	5176.5	4662.0	4456.7	5092.5	
Primary Settlement (ft.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Primary Settlement (in.)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
SUB LAYER									5								
Top of Layer Elevation (ft.)			3351.8	3384.9	3422.2	3457.4	3487.3	3485.2	3492.8	3490.8	3490.2	3484.0	3481.2	3406.1	3338.1		
Bottom of Layer Elevation (ft.)			3341.8	3374.5	3412.3	3447.7	3477.5	3474.9	3481.9	3479.4	3478.6	3472.6	3469.9	3396.0	3328.4		
Layer Midpoint Elevation (ft.)			3346.8	3379.7	3417.3	3452.6	3482.4	3480.0	3487.3	3485.1	3484.4	3478.3	3475.5	3401.1	3333.3		
Initial Effective Stress (psf)			5366.3	5620.9	5310.0	5274.0	5295.0	5575.5	5899.5	6169.5	6250.5	6142.5	6115.5	5454.0	5190.0		
Final Effective Stress (psf)			5786.3	6040.9	5730.0	5694.0	5715.0	5995.5	6319.5	6589.5	6670.5	6562.5	6535.5	5874.0	5610.0		
Primary Settlement (ft.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Primary Settlement (in.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
SUB LAYER									6								
Top of Layer Elevation (ft.)			3341.8	3374.5	3412.3	3447.7	3477.5	3474.9	3481.9	3479.4	3478.6	3472.6	3469.9	3396.0	3328.4		
Bottom of Layer Elevation (ft.)			3331.9	3364.0	3402.5	3437.9	3467.7	3464.6	3471.0	3468.0	3467.1	3461.3	3458.6	3385.9	3318.8		
Layer Midpoint Elevation (ft.)			3336.8	3369.3	3407.4	3442.8	3472.6	3469.7	3476.4	3473.7	3472.8	3466.9	3464.2	3391.0	3323.6		
Initial Effective Stress (psf)			6558.8	6870.0	6490.0	6446.0	6471.7	6814.5	7210.5	7540.5	7639.5	7507.5	7474.5	6666.0	6343.3		
Final Effective Stress (psf)			6978.8	7290.0	6910.0	6866.0	6891.7	7234.5	7630.5	7960.5	8059.5	7927.5	7894.5	7086.0	6763.3		
Primary Settlement (ft.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Primary Settlement (in.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
SUB LAYER									7								
Top of Layer Elevation (ft.)			3331.9	3364.0	3402.5	3437.9	3467.7	3464.6	3471.0	3468.0	3467.1	3461.3	3458.6	3385.9	3318.8		
Bottom of Layer Elevation (ft.)			3321.9	3353.6	3392.7	3428.1	3457.9	3454.2	3460.0	3456.5	3455.5	3449.9	3447.2	3375.8	3309.2		
Layer Midpoint Elevation (ft.)			3326.9	3358.8	3397.6	3433.0	3462.8	3459.4	3465.5	3462.2	3461.3	3455.6	3452.9	3380.9	3314.0		
Initial Effective Stress (psf)			7751.3	8119.1	7670.0	7618.0	7648.3	8053.5	8521.5	8911.5	9028.5	8872.5	8833.5	7878.0	7496.7		
Final Effective Stress (psf)			8171.3	8539.1	8090.0	8038.0	8068.3	8473.5	8941.5	9331.5	9448.5	9292.5	9253.5	8298.0	7916.7		
Primary Settlement (ft.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Primary Settlement (in.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
SUB LAYER									8								
Top of Layer Elevation (ft.)			3321.9	3353.6	3392.7	3428.1	3457.9	3454.2	3460.0	3456.5	3455.5	3449.9	3447.2	3375.8	3309.2		
Bottom of Layer Elevation (ft.)			3312.0	3343.2	3382.8	3418.4	3448.1	3443.9	3449.1	3445.1	3443.9	3438.5	3435.9	3365.7	3299.6		
Layer Midpoint Elevation (ft.)			3317.0	3348.4	3387.8	3423.3	3453.0	3449.1	3454.6	3450.8	3449.7	3444.2	3441.6	3370.8	3304.4		
Initial Effective Stress (psf)			8943.8	9368.2	8850.0	8790.0	8825.0	9292.5	9832.5	10282.5	10417.5	10237.5	10192.5	9090.0	8650.0		
Final Effective Stress (psf)			9363.8	9788.2	9270.0	9210.0	9245.0	9712.5	10252.5	10702.5	10837.5	10657.5	10612.5	9510.0	9070.0		
Primary Settlement (ft.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Primary Settlement (in.)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

TABLE 4 FINAL COVER SETTLEMENT CALCULATIONS (CONTINUED)

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+70
SUB LAYER	9																
Top of Layer Elevation (ft.)				3343.2	3382.8	3418.4	3448.1	3443.9	3449.1	3445.1	3443.9	3438.5	3435.9	3365.7	3299.6		
Bottom of Layer Elevation (ft.)				3332.8	3373.0	3408.6	3438.3	3433.6	3438.2	3433.7	3432.3	3427.1	3424.6	3355.6	3290.0		
Layer Midpoint Elevation (ft.)				3338.0	3377.9	3413.5	3443.2	3438.7	3443.6	3439.4	3438.1	3432.8	3430.2	3360.7	3294.8		
Initial Effective Stress (psf)				10617.3	10030.0	9962.0	10001.7	10531.5	11143.5	11653.5	11806.5	11602.5	11551.5	10302.0	9803.3		
Final Effective Stress (psf)				11037.3	10450.0	10382.0	10421.7	10951.5	11563.5	12073.5	12226.5	12022.5	11971.5	10722.0	10223.3		
Primary Settlement (ft.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Primary Settlement (in.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
SUB LAYER	10																
Top of Layer Elevation (ft.)				3332.8	3373.0	3408.6	3438.3	3433.6	3438.2	3433.7	3432.3	3427.1	3424.6	3355.6			
Bottom of Layer Elevation (ft.)				3322.4	3363.2	3398.8	3428.4	3423.3	3427.3	3422.3	3420.8	3415.8	3413.3	3345.5			
Layer Midpoint Elevation (ft.)				3327.6	3368.1	3403.7	3433.3	3428.4	3432.7	3428.0	3426.5	3421.4	3418.9	3350.6			
Initial Effective Stress (psf)				11866.4	11210.0	11134.0	11178.3	11770.5	12454.5	13024.5	13195.5	12967.5	12910.5	11514.0			
Final Effective Stress (psf)				12286.4	11630.0	11554.0	11598.3	12190.5	12874.5	13444.5	13615.5	13387.5	13330.5	11934.0			
Primary Settlement (ft.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Primary Settlement (in.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SUB LAYER	11																
Top of Layer Elevation (ft.)				3322.4	3363.2	3398.8	3428.4	3423.3	3427.3	3422.3	3420.8	3415.8	3413.3	3345.5			
Bottom of Layer Elevation (ft.)				3312.0	3353.3	3389.1	3418.6	3412.9	3416.3	3410.8	3409.2	3404.4	3401.9	3335.4			
Layer Midpoint Elevation (ft.)				3317.2	3358.3	3394.0	3423.5	3418.1	3421.8	3416.5	3415.0	3410.1	3407.6	3340.5			
Initial Effective Stress (psf)				13115.5	12390.0	12306.0	12355.0	13009.5	13765.5	14395.5	14584.5	14332.5	14269.5	12726.0			
Final Effective Stress (psf)				13535.5	12810.0	12726.0	12775.0	13429.5	14185.5	14815.5	15004.5	14752.5	14689.5	13146.0			
Primary Settlement (ft.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Primary Settlement (in.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SUB LAYER	12																
Top of Layer Elevation (ft.)					3353.3	3389.1	3418.6	3412.9	3416.3	3410.8	3409.2	3404.4	3401.9	3335.4			
Bottom of Layer Elevation (ft.)					3343.5	3379.3	3408.8	3402.6	3405.4	3399.4	3397.6	3393.0	3390.6	3325.3			
Layer Midpoint Elevation (ft.)					3348.4	3384.2	3413.7	3407.8	3410.9	3405.1	3403.4	3398.7	3396.3	3330.4			
Initial Effective Stress (psf)					13570.0	13478.0	13531.7	14248.5	15076.5	15766.5	15973.5	15697.5	15628.5	13938.0			
Final Effective Stress (psf)					13990.0	13898.0	13951.7	14668.5	15496.5	16186.5	16393.5	16117.5	16048.5	14358.0			
Primary Settlement (ft.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Primary Settlement (in.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SUB LAYER	13																
Top of Layer Elevation (ft.)					3343.5	3379.3	3408.8	3402.6	3405.4	3399.4	3397.6	3393.0	3390.6	3325.3			
Bottom of Layer Elevation (ft.)					3333.7	3369.5	3399.0	3392.3	3394.5	3388.0	3386.0	3381.6	3379.3	3315.2			
Layer Midpoint Elevation (ft.)					3338.6	3374.4	3403.9	3397.4	3399.9	3393.7	3391.8	3387.3	3384.9	3320.3			
Initial Effective Stress (psf)					14750.0	14650.0	14708.3	15487.5	16387.5	17137.5	17362.5	17062.5	16987.5	15150.0			
Final Effective Stress (psf)					15170.0	15070.0	15128.3	15907.5	16807.5	17557.5	17782.5	17482.5	17407.5	15570.0			
Primary Settlement (ft.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Primary Settlement (in.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SUB LAYER	14																
Top of Layer Elevation (ft.)					3333.7	3369.5	3399.0	3392.3	3394.5	3388.0	3386.0	3381.6	3379.3	3315.2			
Bottom of Layer Elevation (ft.)					3323.8	3359.8	3389.2	3382.0	3383.6	3376.6	3374.5	3370.3	3368.0	3305.1			
Layer Midpoint Elevation (ft.)					3328.8	3364.7	3394.1	3387.1	3389.0	3382.3	3380.2	3375.9	3373.6	3310.2			
Initial Effective Stress (psf)					15930.0	15822.0	15885.0	16726.5	17698.5	18508.5	18751.5	18427.5	18346.5	16362.0			
Final Effective Stress (psf)					16350.0	16242.0	16305.0	17146.5	18118.5	18928.5	19171.5	18847.5	18766.5	16782.0			
Primary Settlement (ft.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Primary Settlement (in.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			

TABLE 4 FINAL COVER SETTLEMENT CALCULATIONS (CONTINUED)																	
Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+70
SUB LAYER									15								
Top of Layer Elevation (ft.)					3323.8	3359.8	3389.2	3382.0	3383.6	3376.6	3374.5	3370.3	3368.0	3305.1			
Bottom of Layer Elevation (ft.)					3314.0	3350.0	3379.4	3371.6	3372.6	3365.1	3362.9	3358.9	3356.6	3295.0			
Layer Midpoint Elevation (ft.)					3318.9	3354.9	3384.3	3376.8	3378.1	3370.8	3368.7	3364.6	3362.3	3300.1			
Initial Effective Stress (psf)					17110.0	16994.0	17061.7	17965.5	19009.5	19879.5	20140.5	19792.5	19705.5	17574.0			
Final Effective Stress (psf)					17530.0	17414.0	17481.7	18385.5	19429.5	20299.5	20560.5	20212.5	20125.5	17994.0			
Primary Settlement (ft.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Primary Settlement (in.)					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SUB LAYER									16								
Top of Layer Elevation (ft.)							3379.4	3371.6	3372.6	3365.1	3362.9	3358.9	3356.6				
Bottom of Layer Elevation (ft.)							3369.6	3361.3	3361.7	3353.7	3351.3	3347.5	3345.3				
Layer Midpoint Elevation (ft.)							3374.5	3366.5	3367.2	3359.4	3357.1	3353.2	3351.0				
Initial Effective Stress (psf)							18238.3	19204.5	20320.5	21250.5	21529.5	21157.5	21064.5				
Final Effective Stress (psf)							18658.3	19624.5	20740.5	21670.5	21949.5	21577.5	21484.5				
Primary Settlement (ft.)							0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Primary Settlement (in.)							0.0	0.0	0.0	0.0	0.0	0.0	0.0				
SUB LAYER									17								
Top of Layer Elevation (ft.)							3369.6	3361.3	3361.7	3353.7	3351.3	3347.5	3345.3				
Bottom of Layer Elevation (ft.)							3359.8	3351.0	3350.8	3342.3	3339.7	3336.1	3334.0				
Layer Midpoint Elevation (ft.)							3364.7	3356.1	3356.2	3348.0	3345.5	3341.8	3339.6				
Initial Effective Stress (psf)							19415.0	20443.5	21631.5	22621.5	22918.5	22522.5	22423.5				
Final Effective Stress (psf)							19835.0	20863.5	22051.5	23041.5	23338.5	22942.5	22843.5				
Primary Settlement (ft.)							0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Primary Settlement (in.)							0.0	0.0	0.0	0.0	0.0	0.0	0.0				
SUB LAYER									18								
Top of Layer Elevation (ft.)							3359.8	3351.0	3350.8	3342.3	3339.7	3336.1	3334.0				
Bottom of Layer Elevation (ft.)							3350.0	3340.7	3339.9	3330.9	3328.2	3324.8	3322.7				
Layer Midpoint Elevation (ft.)							3354.9	3345.8	3345.3	3336.6	3333.9	3330.4	3328.3				
Initial Effective Stress (psf)							20591.7	21682.5	22942.5	23992.5	24307.5	23887.5	23782.5				
Final Effective Stress (psf)							21011.7	22102.5	23362.5	24412.5	24727.5	24307.5	24202.5				
Primary Settlement (ft.)							0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Primary Settlement (in.)							0.0	0.0	0.0	0.0	0.0	0.0	0.0				
SUB LAYER									19								
Top of Layer Elevation (ft.)								3340.7	3339.9	3330.9	3328.2	3324.8	3322.7				
Bottom of Layer Elevation (ft.)								3330.3	3328.9	3319.4	3316.6	3313.4	3311.3				
Layer Midpoint Elevation (ft.)								3335.5	3334.4	3325.1	3322.4	3319.1	3317.0				
Initial Effective Stress (psf)								22921.5	24253.5	25363.5	25696.5	25252.5	25141.5				
Final Effective Stress (psf)								23341.5	24673.5	25783.5	26116.5	25672.5	25561.5				
Primary Settlement (ft.)								0.0	0.0	0.0	0.0	0.0	0.0				
Primary Settlement (in.)								0.0	0.0	0.0	0.0	0.0	0.0				

TABLE 4 FINAL COVER SETTLEMENT CALCULATIONS (CONTINUED)

Point	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
Station	3+50	4+30	5+00	6+50	8+00	9+37	10+75	11+75	14+00	17+00	20+00	23+00	25+00	28+00	31+25	32+00	33+70
SUB LAYER									20								
Top of Layer Elevation (ft.)								3330.3	3328.9	3319.4	3316.6	3313.4	3311.3				
Bottom of Layer Elevation (ft.)								3320.0	3318.0	3308.0	3305.0	3302.0	3300.0				
Layer Midpoint Elevation (ft.)								3325.2	3323.5	3313.7	3310.8	3307.7	3305.7				
Initial Effective Stress (psf)								24160.5	25564.5	26734.5	27085.5	26617.5	26500.5				
Final Effective Stress (psf)								24580.5	25984.5	27154.5	27505.5	27037.5	26920.5				
Primary Settlement (ft.)								0.0	0.0	0.0	0.0	0.0	0.0				
Primary Settlement (in.)								0.0	0.0	0.0	0.0	0.0	0.0				
SETTLEMENT																	
Total Primary Settlement (in.)	0.0	0.4	0.5	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.7	0.6	0.4	0.0
Total Secondary Settlement (in.)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Settlement (in.)	0.0	0.4	0.5	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.7	0.6	0.4	0.0
Total Settlement (ft.)	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Differential Settlement (ft.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRADES AND STRAINS																	
Final Waste Elevation Prior to Settlement (ft.)	3356.5	3376.5	3391.5	3426.5	3461.5	3496.5	3526.5	3526.5	3536.5	3536.5	3536.5	3529.5	3526.5	3446.5	3376.5	3359.5	3326.5
Final Waste Elevation After settlement (ft.)	3356.5	3376.5	3391.5	3426.4	3461.4	3496.4	3526.4	3526.4	3536.4	3536.4	3536.4	3529.4	3526.4	3446.4	3376.5	3359.5	3326.5
Initial Final Cover GeoMembrane Segment Length (ft.)	0.0	82.5	71.6	154.0	154.0	141.4	141.2	100.0	225.2	300.0	300.0	300.1	200.0	310.5	332.5	76.9	173.2
PostSettlement Final Cover GeoMemberane Segment	0.0	82.5	71.6	154.0	154.0	141.4	141.2	100.0	225.2	300.0	300.0	300.1	200.0	310.5	332.5	76.9	173.2
Strain (+ Compression/- Tension)		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PreSettlement Slope (+ up/- down)		25.0%	21.4%	23.3%	23.3%	25.5%	21.7%	0.0%	4.4%	0.0%	0.0%	-2.3%	-1.5%	-26.7%	-21.5%	-22.7%	-19.4%
Post Settlement Slope (+ up/- down)		25.0%	21.4%	23.3%	23.3%	25.5%	21.7%	0.0%	4.4%	0.0%	0.0%	-2.3%	-1.5%	-26.7%	-21.5%	-22.7%	-19.4%
Grade Change (+ Steeper/- Milder)		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Attachment E2

Liner Stress Due to Equipment Loads

PROJECT: North Ranch Surface Waste Management Facility
Tensile Stresses in Geosynthetics due to Equipment Loads

JOB NO.: 35187378 **DATE:** September 2019 **COMP. BY:** MPB

CALCULATIONS BY: Michael Paul Bradford, P.E.
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PURPOSE

In this calculation, tensile stresses exerted onto the base liner system by operational equipment is evaluated. This evaluation considers the worst case tensile stress condition to be exerted onto the uppermost geosynthetic layer, 200-mil geocomposite leachate drainage layer just below the 2-foot protective cover layer. This condition considers the during protective cover placement on the side slope walls. Once waste material begins being filled into a cell the tensile stresses on the geosynthetics becomes less. Stress below the uppermost geosynthetic will be distributed. In this scenario, a Caterpillar 657 scraper or equivalent is used to place protective soil layer up the side slope at a constant speed and a sufficient distance to accommodate an approximate 10-foot lift of waste placed on the landfill floor, or an unsupported slope (3:1) length of ~70-feet. Although it is highly unlikely and not recommended to allow scrapers on a slope for any reason due to its immense size and weight, it is being used to demonstrate a very conservative worst-case condition of liner performance.

METHOD OF ANALYSIS

Assumptions:

- Unit weight of protective soil = 120 lbs/ft^3 dry density
    - h_{lift} = 2 feet
    - Distribution Distance 70-ft
        - Unit Weight Distribution = W_s = 120 lbs/ft^3 x 2ft x 70 ft = 16,800 lb/ft

- Internal friction angle of protective soil = B = 23°

- Slope Angle = A = 18° (3:1)

- Equipment loading assuming a fully loaded Standard Tandem 657 Scraper:
    - Governing Front Axle Weight = 128,246 lbs (published by CAT)
    - Distributed weight per tire = 64,123 lbs

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Tensile Stresses in Geosynthetics due to Equipment Loads

JOB NO.: 35187378 DATE: September 2019 COMP. BY: MPB

- Tire width = 36 in = 3 feet
  - Unit Weight Distribution = W_b = 64,123 lbs / 3 ft = 23,374 lb/ft

- Tensile forces acting on geomembrane = $F_{soil} + F_{scraper}$:
  - Protective soil layer, F_{soil}
  - 657 scraper, $F_{scraper}$

- Total resisting forces = $F_{geomembrane}$
  - Geomembrane interface friction, $F_{geomembrane}$

Tensile forces acting on geomembrane:

$F_{soil} = h_{lift}$ (2) x (unit weight of protective soil) x (sin(slope angle))

F_{soil} = (2 ft) x (70 ft) x (120 lbs/ft^3) (sin(18°))

F_{soil} = 5,191 lbs/ft

$F_{Scraper}$ = [(scraperweight) / (width acting on geocomposite)] (sin(18°))

$F_{Scraper}$ = [(64,123lbs) / 3 ft] (sin(18°))

$F_{Scraper}$ = 6,605 lbs/ft

Total tensile force acting on geomembrane due to equipment and soil:

$F_{tensile}$= 5,191 lbs/ft + 1390 lbs/ft

$F_{membrane}$= 11,796 lbs/ft

Total resisting forces acting due to friction from geomembrane:

F_{resist} = (weight of protective soil + weight of scraper) (cos(slope angle)) (tan(interface friction angle))

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F_{resist} = [(2 ft)(70 ft)(120 lbs/ft3) + (64,123 lbs / 3 ft)] (cos 18°) (tan 23°)

F_{resist} = [(16,800 lb/ft) + (21,374 lbs/ft)] (cos 18°) (tan 21°)

F_{resist} = 13,936 lbs/ft

To summarize,

tensile force acting on the liner = 11,796 lbs/ft
resisting force acting on the liner = 13,936 lbs/ft.

See Diagram 1 below which represents the various forces acting on the liner in this scenario:

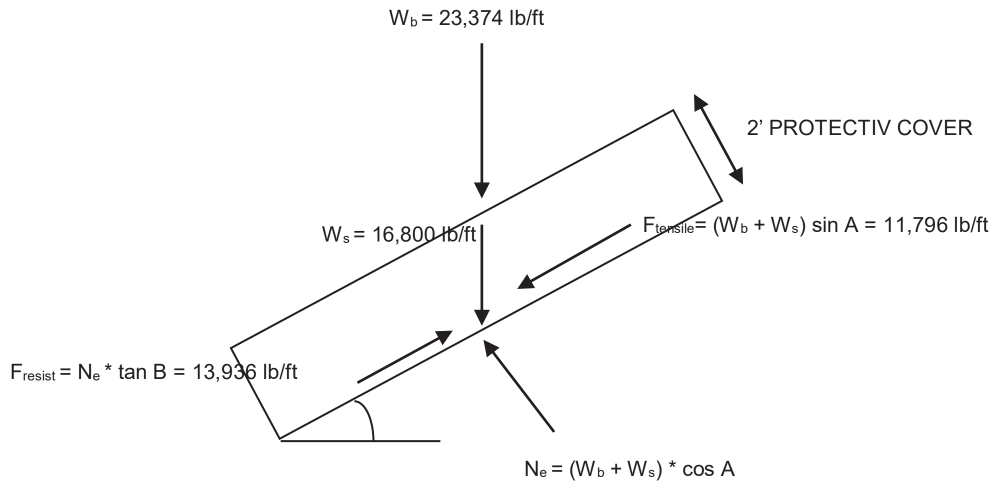

DIAGRAM 1. TENSILE FORCE DIAGRAM

As the resisting forces are greater than the tensile forces this indicates that the friction strength from the geomembrane is sufficient to counter tensile forces from the soil and equipment with a factor of safety of 1.2.

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Reference:

Sangeeta, Lewis P., and Hari D. Sharma, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation. New York: John Wiley and Sons. 1994. Print.

Gray, Donald, Robert M. Koerner, and Xian Quede, Geotechnical Aspects of Landfill Design and Construction. New York: Prentice Hall, 2002. Print.

Attachment E3
Anchor Trench Pullout

Made By: MPB	Date: 19-Mar	Sheet No.: 1 of 2
Checked By: FOC	Date: 19-Mar	Job No.: 35187378
Calculations for:	Anchor Trench Stability Analysis	

Objective:

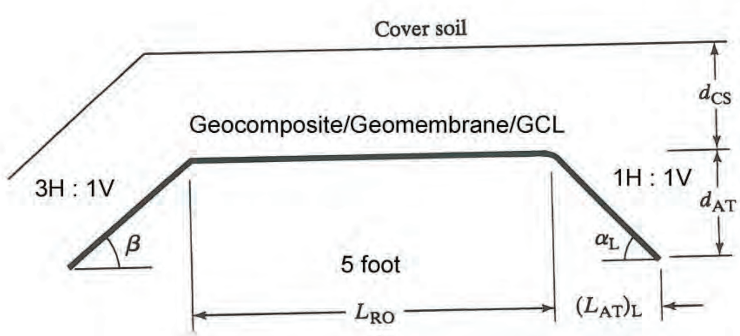
Determine the ability of the anchor trench to resist the weight of the geosynthetic components and to verify that the material will pull out of the anchor trench prior to geomembrane failure.

Assumptions:

- the anchor trench will have a 2 foot runout length
- anchor trench will be 2 foot deep
- the interior slope will be 3H : 1V or flatter
- the exterior slope will be 1H : 1V or flatter
- the deepest slope is approximately 62 foot deep (Phase 1, Cell E3)
- the composite liner system of future cells will consist of in-situ subgrade, a geosynthetic clay liner (GCL), a 60 mil HDPE geomembrane that is textured on both sides, a geocomposite with textile bonded on both sides, 60-mil HDPE geomembrane that is textured on both sides, a geocomposite with textile bonded on both sides, and a 2-foot soil protection layer.

Approach:

Calculations were performed in accordance with the procedures outline in the textbook "Geotechnical Aspects of Landfill Design and Construction" by Xued Qian, Robert Koerner, and Donald Gray, 2002, pp. 104-119.



Equation

$$T = \frac{\gamma_s \cdot d_{CS} \cdot L_{RO} \cdot \tan\delta_C + \gamma_s \cdot (d_{CS} + 0.5 \cdot d_{AT}) \cdot d_{AT} \cdot (\tan\delta_C + \tan\delta_F) \cdot (\cot\alpha_L + \cot\alpha_R)}{\cos\beta - \sin\beta \cdot \tan\delta_C}$$

T = geomembrane tensile force (i.e, anchor trench resistance force)
γ_s = unit weight of the cover and the backfill soil
d_{CS} = depth of cover soil
L_{RO} = runout length
$\tan\delta_C$ = tangent of the friction angle between the geosynthetic layers and the underlying soil
d_{AT} = anchor trench depth
$\tan\delta_F$ = tangent of the friction angle between the geosynthetic layers and the backfill soil
$\cot\alpha_L$ = cotangent of the left bottom angle of V-shaped anchor trench
$\cot\alpha_R$ = cotangent of the right bottom angle of V-shaped anchor trench
$\cos\beta$ = cosine of the sideslope angle
$\sin\beta$ = sine of the sideslope angle
L_t = Liner thickness

Terracon

Made By: MPB	Date: 19-Mar	Sheet No.: 2 of 2
Checked By:	Date:	Job No.: 35187378
Calculations for: Anchor Trench Stability Analysis		

γ_s = 120 pcf
d_{CS} = 2 foot
L_{RO} = 2 foot
$\tan\delta_C$ = Tan (18°) = 0.3249
d_{AT} = 2.0 foot
$\tan\delta_F$ = Tan (18°) = 0.3249
$\cot\alpha_L$ = cot (45°) = 1
$\cot\alpha_R$ = Assume 0 to be conservative 0
$\cos\beta$ = cos (18.4°) = 0.9489
$\sin\beta$ = sine (18.4°) = 0.3156
L_t = 0.06 inches

Calculations:

$$T = \frac{\gamma_s \cdot d_{CS} \cdot L_{RO} \cdot \tan\delta_C + \gamma_s \cdot (d_{CS} + 0.5 \cdot d_{AT}) \cdot d_{AT} \cdot (\tan\delta_C + \tan\delta_F) \cdot (\cot\alpha_L + \cot\alpha_R)}{\cos\beta - \sin\beta \cdot \tan\delta_C}$$

T = 737.0 lb./ft.

T = 1023.7 lb./in.^{2}

Ultimate Strength (lb./in.^{2})	>	Anchor Trench Resistance Capacity (lb./in.^{2})	>	Allowable Strength (lb./in.^{2})
2100		1023.7		840

Note:
The ultimate strength is based off of material properties for standard 60 mil HDPE material. The allowable strength was calculated by dividing the ultimate strength by a 2.5 safety factor.

Summary

The results of the calculations indicate that the design anchor resistance capacity between the yield stress and the allowable stress of the geosynthetic layer system. Therefore, the anchor trench dimensions are acceptable. This assumes that the protective cover is being properly placed on the slopes using low groundpressure equipment and the equipment is backfilling up the slope.

Attachment E4

Geocomposite Compression and Hydraulic Performance

PROJECT: North Ranch Surface Waste Management Facility
Geocomposite Performance Under Overburden Compression

JOB NO.: 35187378 **DATE:** April 2019 **COMP. BY:** MPB

CALCULATIONS BY:

Michael Paul Bradford, P.E.
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

PURPOSE

In this calculation, the compression under the waste overburden and the resulting transmissivity of the geocomposite leachate drainage and leak detection layers are evaluated. A 200-mil geonet composite will be used in the base liner system for both leachate collection and leak detection. The site's leachate collection was modeled using the HELP Model in Attachment D of **Appendix J** of the Facility Permit Application. The HELP Model uses a hydraulic conductivity of 10 cm/sec for the estimated geocomposite flow rate. The geocomposite will compress under the immense weight of the overlying waste.

METHOD OF ANALYSIS

Assumptions:

- 200-mil geonet or 0.2 inches thick
- Unit weight of waste y_w = 74 pcf, assuming a nominal operational density of 2000 lb/cubic yard
- Unit weight of soil y_s = 120 pcf
- Maximum height of waste over geocomposite = 230.5 feet, assume 2' protective cover, and 3.5' final cover soils
- 50% compressibility at 20,000 psf

Thickness (t)

$t_o = t_i + (t_c - t_i)((P_o - P_i)/(P_t - P_i))$

Where:

to = thickness after loading
tc = thickness of geonet at 20,000 psf = 0.1 inch
t_i = initial thickness = 0.2 inch
P_O = loading on geocomposite
= (230.5 ft)(74 pcf)+(5.5 ft)(120 pcf) = 17,720 lbs/ft2
P_i = initial loading
P_t = total compressibility

$t_o = t_i + (t_c - t_i)((P_o - P_i)/(P_t - P_i))$

PROJECT: North Ranch Surface Waste Management Facility
Geocomposite Performance Under Overburden Compression

JOB NO.: 35187378 **DATE:** April 2019 **COMP. BY:** MPB

$t_o = 0.2 + (0.1 – 0.2)*((17,720 – 0) / (20,000 – 0))$

$t_o = 0.11$ inch or 0.28 cm

A factor of safety was assumed to be 1.5 to account for geotextile intrusion, creep deformation, chemical clogging, and biological clogging.

Transmissivity (T)

$T_{FS} = T/FS$

Where:

T_{FS} = transmissivity with factor of safety (m^2/s)

T = transmissivity of geocomposite (m^2/s), *$1x10^{-4}$ m^2/s as published by GSE for 200-mil FabriNet*

FS = 1.5

$T_{FS} = (1x10^{-4}\ m^2/s) / (1.5)$

$T_{FS} = 6.67x10^{-5}\ m^2/s$ or .667 $cm^{2/}s$

Applying the estimated compressed thickness from above to the geocomposite's transmissivity, a new hydraulic conductivity value is calculated.

$K = T_{FS} / t$

$K = (.667\ cm^{2/}s) / (0.28\ cm)$

$K = 2.38$ cm/s

Summary

NMAC **19.15.36.14.C(3)** requires that the leak detection layer have a minimum hydraulic conductivity of $1x10^{-5}$ cm/s and NMAC **19.15.36.14.C(3)** requires that the leachate collection and recovery system have a minimum hydraulic conductivity of $1x10^{-2}$ cm/s. Therefore, even under full height waste compression, the proposed 200-mil geocomposite alternative layers will have hydraulic conductivity of 2.38 cm/s, far exceeding the required minimum performance criteria. To be conservative, the HELP modeling provided in **Attachment D** of **Appendix J** of the Facility Permit Application has assumed a hydraulic conductivity of 1 cm/s for the geocomposite components of the base liner system.

PROJECT: North Ranch Surface Waste Management Facility
Geocomposite Performance Under Overburden Compression

JOB NO.: 35187378 **DATE:** April 2019 **COMP. BY:** MPB

Reference:
Bachus, Robert, Mengjia Li, Dhani Narejo, Richard Thiel, and Te-Yang Soong, GSE Drainage Design Manual. GSE Environmental, June 2007. Web. 3 May 2016.
<https://www.gseworld.com/content/documents/product-sheets/Drainage_Design_Manual.pdf>

Attachment F

Leachate Pipe Design Calculations

TERRACON CONSULTANTS, INC.			
CALCULATIONS BY:	Michael Bradford, P.E.	**DATE:**	4/1/2019
CHECKED BY:	Owen Carpenter, P.G., P.E.	**DATE:**	4/1/2019
FACILITY: North Ranch Surface Waste Management Facility			
PROJECT: 35187378 - Permit Application			
CLIENT: NGL Water Solutions Permian, LLC			

LEACHATE COLLECTION PIPE DESIGN

INTRODUCTION:

The purpose of these calculations is to evaluate the performance of the leachate collection system proposed design at the North Ranch Surface Waste Management Facility in Lea County, New Mexico. The function of the leachate collection system is to convey leachate that is collected in the drainage layer to the leachate collection sump. In order for the system to be effective, it has to convey this liquids and withstand the loads that will be applied from the overlying waste.

PIPE SIZE:

In the design of a leachate collection pipe, the capacity of the proposed pipe should be greater than the flow rate estimated from the HELP Model. The required flow rate used to determine the pipe size can be calculated using the following equation:

Qreqd = qmax x Acell

Where:

Qreqd = required leachate leachate flow rate (ft^3/sec)
qmax = maximum unit area leachate production, (in/day (from HELP Model))
Acell = cell area served by a leachate collection, (Acres)

Note: In reviewing the HELP Model data corresponding to this Permit Modification Application, the peak daily rate for a 30 year period was obtained.

Cell E-3 is the largest cell at the Landfill. The following calculations use the geometry of this cell.

qmax =	0.208	**in/acre/day**
Acell =	28.2	**acres**
Qreqd =	**0.246**	**ft^3/sec**

Once the required leachate flow rate, pipe slope, and material of the pipe are known, the size of pipe can be determined by a trial-and-error procedure using Manning's equation. To determine the suitable pipe size, a pipe size is assumed first to calculate the flow rate using Manning's equation The calculated flow rate from Manning's equation must be greater than or equal to the required leachate flow rate. Manning's Equation (in U.S. Units) is as follows:

$$Q = (1.486*A*rh^{2/3}*S^{1/2})/n$$

Where:

Q = flow rate of pipe (ft^3/sec)
n = Manning's roughness coefficient (+/- 0.011 for HDPE pipe)
A = Area in flow (ft^2)
S = slope of the pipe (%)
rh = hydraulic radius (in)

Header Line Pipe Selected :

6" diameter SDR 17 HDPE Pipe

STEP 1: CALCULATE AREA OF PIPE

$$A = \pi*Di^2 / 4$$

Where:

A = area of flow (in^2)
Di = inside diameter of pipe (in)

Di = Do - 2t

Where:

Do = Outside Diameter of Pipe (in)
t = wall thickness (in)

t = Do/SDR

Where:

SDR = Outside Diameter of Pipe

Do =	6.625	**inches**
SDR =	17	
t =	**0.390**	**inches**
Di =	**5.85**	**inches**
A =	**0.186**	**ft^2**

STEP 2: CALCULATE HYDRAULIC RADIUS

rh = Di / 4

Where:

rh = hydraulic radius of pipe (in)
Di = inside diameter of pipe (in)

Di =	5.85	**inches**
rh =	**1.46**	**inches**

STEP 3: CALCULATE FLOW RATE

$$Q = (1.486*A*rh^{2/3}*S^{1/2})/n$$

A =	0.186	**ft^2**
rh =	1.46	**inches**
S =	0.01	**ft/ft**
n =	0.011	**for Smooth HDPE Pipe**
Q =	**0.62**	**ft^3/sec**
Qreqd =	**0.246**	**ft^3/sec**
FS =	**2.51**	

Because Q is greater than Qreqd,. a 6" diameter SDR 17 HDPE pipe is adequate to convey the expected peak leachate flow conditions.

PIPE PERFORATIONS:

The most important parameter for determining the size and distribution of slots or perforations in the leachate collection pipes is the maximum leachate inflow per unit length of pipe. The maximum leachate inflow per unit length of pipe, which mainly depends on the maximum unit area of leachate production and the maximum servicing unit area per foot of pipe can be calculated from the equation:

Qin = qmax x Aunit

Where:

Qin = maximum leachate inflow per unit length of pipe, (ft^3/sec/ft)

qmax = maximum unit area leachate production, ($ft^3/sec/ft^2$)

STEP 1: CALCULATE MAXIMUM UNIT AREA

Aunit = Lhmax x dw

Where:

LHmax = Sum of drainage lengths on both sides of pipe for the largest cell

dw = unit width at the area of the maximum horizontal distance of leachate flow

LHmax =	1652.00	**feet**
dw	1	**feet**
Aunit	**1652.00**	**ft^2**

STEP 2: CALCULATE MAXIMUM LEACHATE INFLOW

$$Q_{in} = q_{max} \times A_{unit}$$

Aunit	1652.00	**ft^2**
qmax	5.036E-07	**$ft^3/sec/ft^2$**
Qin	**8.319E-04**	**ft^3/sec**

STEP 3: CACULATE INFLOW CAPACITY OF EACH ORFICE

The inflow capacity per orifice can be calculated from the Bernoulli equation based on the size of the orifice as follows:

$$Qb = C \times Ab \times (2 \times g \times dh)^{0.5}$$

Where:

Qb = inflow capacity per orifice (or slot) (ft^3/sec)
C = discharge coefficient (use 0.62)
Ab = cross-sectional area of a slot or hole on the selected perforated pipe
g = gravitational constant (use 32.2 ft/sec^2)
dh = liquid head (in)

STEP 4: CALCULATE CROSS SECTIONAL AREA OF ORFICE

$$Ab = \pi \times dhole^2 / 4$$

A 3/8 inch orifice was chosen for the perforation size

Where:

Ab = cross sectional area of orifice (in^2)
dhole = perforation size (in)

dhole =	**0.375**	**inches**
Ab =	**7.670E-04**	**ft^2**

STEP 5: CALCULATE INFLOW CAPACITY OF EACH ORIFICE

C=	0.62	**ft^2**
Ab=	7.670E-04	**inches**
g =	32.2	**ft/sec^2**
dh =	1	**ft**
Qb =	**3.816E-03**	**$ft^{3/}sec$**

Once the maximum leachate inflow rate per unit length of pipe and the inflow capacity per opening are known, the number of the perforated holes per unit length of pipe can be calculated using the equation:

$$N = Qin/Qb$$

Where:

N = number of perforations per foot of pipe

Qin=	8.32E-04	**$ft^{3/}sec$**
Qb=	3.816E-03	**$ft^{3/}sec$**
N =	**0.218**	**holes per foot of pipe**

STEP 5: SPACING OF HOLE PATTERN ALONG PIPE

Assuming 3 holes at each location spaced around the circumference at 120 degrees would result in a hole spacing of:

SP = 3/N

Where:

SP = number of perforations per X feet of pipe

SP =	**14**

A perforation every 14 feet would be sufficient. A spacing of less than 14 feet is acceptable. Although 3 holes spaced on a 120 degree off-set would allow for one line of perforations every 60 feet, the standard perforation pattern is 3 perforations every foot that is offset by 6 inches (See Permit Drawings for the typical leachate collection piping perforations).

Gravel Bedding Materials Around Perforated Piping:

When perforated pipes are bedded in gravel, no unplugged ends should be used. In addition, the gravel bedding should be coarse enough not to enter the holes (or slots). The USEPA (1983) recommends that the 85% particle size for the gravel be greater then the hole size by a factor F. The F factor varies from 1.2 to 2.0. A factor of 1.5 was chosen for the proposed Landfill. When specifying gravel bedding materials for cell construction, the following gradation criteria should be considered:

dhole=	0.375	**inches**
F=	1.5	
d85 =	**0.563**	**inches**

Therefore the d85 for the gravel bedding should be 0.563 inches or greater.

DEFORMATION AND STABILITY OF LEACHATE COLLECTION PIPE:

All components of the leachate collection and removal system must have sufficient strength to support the weight of the overlying waste, cover system, and post-closure loadings, as well as the stresses from operating equipment. The component that is the most vulnerable to compressive strength failure is the drainage layer piping. Leachate collection and removal system piping can fail by excessive deflection, which may lead to buckling or collapsing.

RING DEFLECTION:

Ring deflection occurs when large vertical pressures are applied to the pipe/gravel bedding systems. Ring deflection is a horizontal over-deflection that results in a reversal of the curvature of the pipe wall. The following formula, commonly known as the Modified Iowa formula, can be used to estimate ring deflection (Spangler and Handy, 1973; Moser, 1990).

DX = (DL*K*Wc*r3) / (E*I+0.061*E'*r3)

Where:

DX = horizontal deflection, in
K = bedding constant (assume 0.1) (Qian et al)
DL= deflection lag factor (assume 1) (Qian Et al)
Wc = vertical load per unit length of pipe, lb/in^2
r = mean radius of the pipe (in)
E = elastic modulus of the pipe material (psi)(see attached worksheet)
I = moment of inertia of the pipe wall per unit length in^4/in
t = thickness of pipe, in
E' = soil reaction modulus (psi)

Based on guidance from Chevron (1993), an allowable ring deflection of 7% is acceptable.

STEP 1: STRESS PER UNIT LENGTH OF PIPE

σvl = Σ Dl x γl

σvl =vertical load on pipe (psf)
Dl = depth of layer (ft)
γl = unit weight of layer (pcf)

Layer	γl	Dl	γl x Dl
	(pcf)	(ft)	(psf)
1	120	2	240
2	100	78	7800
3	120	2.5	300
		σvl =	8340

psf

STEP 2: CALCULATE VERTICAL LOAD

Wc = σvl * Do

σvl =	57.92	**psi**
Do=	6.625	**in**
Wc=	**383.70**	**lb/in**

STEP 3: CALCULATE MEAN RADIUS OF PIPE

$$Rm = (Do-t)/2$$

Where:

Rm = Mean radius of pipe (in)

Do=	6.625	**inches**
t=	0.390	**inches**
Rm =	**3.118**	**inches**

STEP 4: CALCULATE MOMENT OF INERTIA OF PIPE

$$I = t^3/12$$

t=	0.39	**inches**
I =	**0.00493**	**inches**

STEP 5: CALCULATE RING DEFLECTION

$$DX = (DL*K*Wc*r3\ ) / (E*I+0.061*E'*r3)$$

DL=	1.00	
K=	0.10	
Wc=	383.70	**psf**
r=	3.12	**inches**
E=	23,000.00	**psi**
I=	0.00	**in^4/in**
E'	3,000.00	**psi**
Dx =	**0.20547**	**inches**
ΔDx =	**3.10**	Ring deflection is acceptable

WALL BUCKLING:

Wall buckling can occur because of insufficient pipe stiffness. Mosher (1990) noted that as the higher the SDR (more flexible) the more unstable the wall structure will be in resisting buckling. Meyerhof and Baike (1963) develop the following formula for estimating the critical buckling pressure in a circular conduit.

$$Pcr = 2 *[(E'/(1-\mu^2))*(E*I/r^3)]^{0.5}$$

Where:

Pcr = critical buckling pressure (lb/in)
μ = poissons ratio of pipe material
E'= soil reaction modulus ($lb/in^{2)}$
E = elastic modulus of the pipe material (lb/in^2)
I = moment of inertia of the pipe wall per unit length (in^4/in)
r = mean radius of the pipe (in)

STEP 1: CALCULATE ACTUAL VERTICAL STRESS

$$Ptp = WC/Do$$

Ptp= actual vertical stress on pipe (psf)

STEP 2: STRESS PER UNIT LENGTH OF PIPE

$$P_{cr} = 2 * [(E'/(1-\mu^2)) * (E * I/r^3)]^{0.5}$$

E'	3,000.00	**psi**
μ=	0.30	
E=	23,000.00	**psi**
r=	3.12	**inches**
I=	0.004932	**inches**
Pcr =	**222.18**	**lb/in^2**
Ptp =	**57.92**	**lb/in^2**
FS =	**4**	Pipe critical buckling has a suitable factor of safety

WALL CRUSHING:

When external pressures exceed the compressive strength of the pipe wall crushing will occur. The factor safety against wall crushing can estimated by the following equation:

$$FSwc = 2 * \sigma y / ((SDR - 1) * \sigma max)$$

Where:

FSwc = Factor of safety against wall crushing
σy = compressive yield strength of pipe (psi)
σmax= maximum stress applied to the pipe (psi)
SDR = standard dimension ratio of the pipe

σy =	230400	**psi**
SDR =	17	
σmax =	8340	

FSwc =	**3.45**	Pipe wall crushing has a suitable factor of safety

EXCESSIVE BENDING STRAIN:

A pipe will deflect under external loading. As a result of this deflection bending strains are induced in the pipe. These strains can be calculated by the following equation (Mosher 1990):

$$\acute{\varepsilon}b = f\,d * t * \Delta y / Do^2$$

Where:

έb =Bending Strain %
***f*d** = deformation shape factor (assume 6)
Δy = vertical deflection (in)
Do = outside diameter of pipe

***f*d =**	6
Do =	6.625
t =	0.39
Δy =	0.21
έb =	**1.09**

Chevron (1994) recommends a maximum allowable bending strain between 1.5 to 2.25% for fd=6 depending on the quality of bedding around the pipe. This pipe has been designed for the worst case scenario, therefore a bending strain of 1.09 %, which is less than the maximum allowable, is acceptable.

TERRACON CONSULTANTS, INC.

CALCULATIONS BY: Kyle Jackson
CHECKED BY: Mike Bradford, P.E
FACILITY: North Ranch SWMF
PROJECT: 35187378
CLIENT: NGL Waste

LEACHATE COLLECTION PIPE DESIGN

INTRODUCTION:

The purpose of these calculations is to evaluate the performance of the leachate collection system proposed design at the North Ranch SWMF. The function of the leachate collection system is to convey leachate that is collected in the drainage layer to the leachate collection sump. In order to for the system to be effective, it has to be convey these liquids and withstand the loads that will be applied from the overlying waste.

PIPE SIZE:

In the design of a leachate collection pipe, the capacity of the proposed pipe should be greater than the flow rate estimated from the HELP Model. The required flow rate used to determine the pipe size can be calculated using the following equation:

$$Q_{reqd} = q_{max} \times A_{cell}$$

Where:

Q_{reqd} = required leachate leachate flow rate (ft^3/sec)
q_{max} = maximum unit area leachate production, (in/day (from HELP Model))
A_{cell} = cell area served by a leachate collection, (Acres)

Note: In reviewing the HELP Model data corresponding to this Permit Modification Application, the peak daily rate for a 30 year period was obtained from Scenario 1 which corresponds to a n open case with 10 feet of waste and 6 inches of daily cover. Scenario 1 uses a reduction factor for the transmissivity of the geocomposite.

Cell 1 is the largest cell at the Landfill. The following calculations use the geometry of this cell.

qmax =	0.479	**in/day**
Acell =	10	**acres**
Qreqd =	**0.201**	**ft^3/sec**

Once the required leachate flow rate, pipe slope, and material of the pipe are known, the size of pipe can be determined by a trial-and-error procedure using Manning's equation. To determine the suitable pipe size, a pipe size is assumed first to calculate the flow rate using Manning's equation The calculated flow rate from Manning's equation must be greater than or equal to the required leachate flow rate. Manning's Equation (in U.S. Units) is as follows:

$$Q = (1.486 * A * rh^{2/3} * S^{1/2})/n$$

Where:

Q = flow rate of pipe (ft^3/sec)
n = Manning's roughness coefficient (+/- 0.011 for HDPE pipe)
A = Area in flow (ft^2)
S = slope of the pipe (%)
rh = hydraulic radius (in)

Header Line Pipe Selected :

6" diameter SDR 17 HDPE Pipe

STEP 1: CALCULATE AREA OF PIPE

$$A = \pi * Di^2 / 4$$

Where:

A = area of flow (in^2)
Di = inside diameter of pipe (in)

Di = Do - 2t

Where:

Do = Outside Diameter of Pipe (in)
t = wall thickness (in)

t = Do/SDR

Where:

SDR = Outside Diameter of Pipe

Do =	6.625	**inches**
SDR =	17	
t =	**0.390**	**inches**
Di =	**5.85**	**inches**
A =	**0.186**	**ft^2**

STEP 2: CALCULATE HYDRAULIC RADIUS

rh = Di / 4

Where:

rh = hydraulic radius of pipe (in)
Di = inside diameter of pipe (in)

Di =	5.85	**inches**
rh =	**1.46**	**inches**

STEP 3: CALCULATE FLOW RATE

$$Q = (1.486 * A * rh^{2/3} * S^{1/2})/n$$

A =	0.186	**ft^2**
rh =	1.46	**inches**
S =	0.02	**ft/ft**
n =	0.011	**for Smooth HDPE Pipe**
Q =	**0.87**	**ft^3/sec**
Qreqd =	**0.201**	**ft^3/sec**
FS =	**4.35**	

Because Q is greater than Qreqd,. a 6" diameter SDR 17 HDPE pipe is adequate to convey the expected peak leachate flow conditions.

PIPE PERFORATIONS:

The most important parameter for determining the size and distribution of slots or perforations in the leachate collection pipes is the maximum leachate inflow per unit length of pipe. The maximum leachate inflow per unit length of pipe, which mainly depends on the maximum unit area of leachate production and the maxmum servicing unit area per foot of pipe can be calculated from the equation:

$$Qin = qmax \times Aunit$$

Where:

Qin = maximum leachate inflow per unit length of pipe, (ft^3/sec/ft)
qmax = maximum unit area leachate production, ($ft^3/sec/ft^2$)

STEP 1: CALCULATE MAXIMUM UNIT AREA

$$Aunit = Lhmax \times dw$$

Where:

LHmax = Sum of drainage lengths on both sides of pipe for the largest cell
dw = unit width at the area of the maximum horizontal distance of leachate flow

LHmax =	434.00	**feet**
dw	1	**feet**
Aunit	**434.00**	**ft^2**

STEP 2: CALCULATE MAXIMUM LEACHATE INFLOW

$$Qin = qmax \times Aunit$$

Aunit	434.00	**ft^2**
qmax	4.616E-07	**ft/sec**
Qin	**2.003E-04**	**ft^3/sec**

STEP 3: CACULATE INFLOW CAPACITY OF EACH ORFICE

The inflow capacity per orifice can be calculated from the Bernouli equation
based on the size of the orfice as follows:

$$Qb = C \times Ab \times (2 \times g \times dh)^{0.5}$$

Where:

Qb = inflow capacity per orifice (or slot) (ft^3/sec)
C = discharge coefficient (use 0.62)
Ab = cross-sectional area of a slot or hole on the selected perforated pipe
g = gravitational constant (use 32.2 ft/sec^2)
dh = liquid head (in)

STEP 4: CALCULATE CROSS SECTIONAL AREA OF ORFICE

$$Ab = \pi \times dhole^2 / 4$$

A 3/8 inch orifice was choosen for the perforation size

Where:

Ab = cross sectional area of orfice (in^2)
dhole = perforation size (in)

dhole =	**0.375**	**inches**
Ab =	**7.670E-04**	**ft^2**

STEP 5: CALCULATE INFLOW CAPACITY OF EACH ORFICE

C=	0.62	**ft^2**
Ab=	7.670E-04	**inches**
g =	32.2	**ft/sec^2**
dh =	1	**ft**
Qb =	**3.816E-03**	**$ft^{3/}sec$**

Once the maximum leachate inflow rate per unit length of pipe and the inflow capacity per opening are known, the number of the perforated holes per unit length of pipe can be calculated using the equation:

$$N = Qin/Qb$$

Where:

N = number of perforations per foot of pipe

Qin=	2.00E-04	**$ft^{3/}sec$**
Qb=	3.816E-03	**$ft^{3/}sec$**
N =	**0.052**	**holes per foot of pipe**

STEP 5: SPACING OF HOLE PATTERN ALONG PIPE

Assuming 3 holes at each location spaced around the circumference at 120 degrees would result in a hole spacing of:

SP = 1.3/N

Where:

SP = number of perforations per foot of pipe

SP =	24.764	**1 hole per every X feet of pipe**

A perforation every 25 feet would be sufficient. A spacing is less than 25 is acceptable.

Gravel Bedding Materials Around Perforated Piping:

When perforated pipes are bedded in gravel, no unplugged ends should be used. In addition, the gravel bedding should be coarse enough not to enter the holes (or slots). The USEPA (1983) recommends that the 85% particle size for the gravel be greater then the holesize by a factor F. The F factor varies from 1.2 to 2.0 A factor of 1.5 was chosen for the Landfill. When specifying gravel bedding materials for cell construction, the following gradation criteria should be considered:

dhole=	0.375	**inches**
F=	1.5	
d85 =	**0.563**	**inches**

Therefore the d85 for the gravel bedding should be 0.563 inches or greater.

DEFORMATION AND STABILITY OF LEACHATE COLLECTION PIPE:

All components of the leachate collection and removal system must have sufficient strength to support the weight of the overlying waste, cover system, and post-closure loadings, as well as the stresses from operating equipment. The componentthat is the most vulnerable to compressive strength failure is the drainage layer piping. Leachate collection and removal system piping can fail by excessive deflection, which may lead to buckling or collapsing.

RING DEFLECTION:

Ring deflection occurs when large vertical pressures are applied to the pipe/gravel bedding systems. Ring deflection is a horizontal over-deflection that results in a reversal of the curvature of the pipe wall. The following formula, commomly known as the Modified Iowa formula, can be used to estimate ring deflection (Spangler and Handy, 1973; Moser, 1990).

DX = (DL*K*Wc*r3) / (E*I+0.061*E'*r3)

Where:

DX = horizontal deflection, in
K = bedding constant (assume 0.1) (Qian et al)
DL= deflection lag factor (assume 1) (Qian Et al)
Wc = vertical load per unit length of pipe, lb/in^2
r = mean radius of the pipe (in)
E = elastic modulus of the pipe material (psi)(see attached worksheet)
I = moment of inertia of the pipe wall per unit length in^4/in
t = thickness of pipe, in
E' = soil reaction modulus (psi)

Based on guidance from Chevron (1993), an allowable ring deflection of 7% is acceptable.

STEP 1: STRESS PER UNIT LENGTH OF PIPE

σvl = Σ Dl x γl

σvl =vertical load on pipe (psf)
Dl = depth of layer (ft)
γl = unit weight of layer (pcf)

Layer	γl	Dl	γl x Dl
	(pcf)	(ft)	(psf)
1	120	3	360
2	70	90	6300
3	120	1	120
		σvl =	6780

psf

STEP 2:	CALCULATE VERTICAL LOAD

$$Wc = \sigma vl * Do$$

σvl =	47.08	**psi**
Do=	6.625	**in**
Wc=	**311.93**	**lb/in**

STEP 3:	CALCULATE MEAN RADIUS OF PIPE

$$Rm = (Do-t)/2$$

Where:

Rm = Mean radius of pipe (in)

Do=	6.625	**inches**
t=	0.390	**inches**
Rm =	**3.118**	**inches**

STEP 4:	CALCULATE MOMENT OF INERTIA OF PIPE

$$I = t^3/12$$

t=	0.39	**inches**
I =	**0.00493**	**inches**

STEP 5: CALCULATE RING DEFLECTION

DX = (DL*K*Wc*r3) / (E*I+0.061*E'*r3)

DL=	1.00	
K=	0.10	
Wc=	311.93	**psf**
r=	3.12	**inches**
E=	23,000.00	**psi**
I=	0.00	**in^4/in**
E'	3,000.00	**psi**
Dx =	**0.16704**	**inches**
ΔDx =	**2.52**	Ring deflection is acceptable

WALL BUCKLING:

Wall buckling can occur because of insufficient pipe stiffness. Mosher (1990) noted that as the higher the SDR (more flexible) the more unstable the wall structure will be in resisting buckling. Meyerhof and Baike (1963) develop the following formula for estimating the critical buckling presure in a circular conduit.

$$Pcr = 2 *[(E'/(1-\mu^2))*(E*I/r^3)]^{0.5}$$

Where:

Pcr = critical buckling pressure (lb/in)
μ = poissons ratio of pipe material
E'= soil reaction modulus ($lb/in^{2)}$
E = elastic modulus of the pipe material (lb/in^2)
I = moment of inertia of the pipe wall per unit length (in^4/in)
r = mean radius of the pipe (in)

STEP 1: CACAULATE ACTUAL VERTICAL STRESS

$$Ptp = WC/Do$$

Ptp= actual vertical stress on pipe (psf)

STEP 2: STRESS PER UNIT LENGTH OF PIPE

$$Pcr = 2 *[(E'/(1-\mu^2))*(E*I/r^3)]^{0.5}$$

E'	3,000.00	**psi**
μ=	0.30	
E=	23,000.00	**psi**
r=	3.12	**inches**
I=	0.004932	**inches**
Pcr =	**222.18**	**lb/in^2**
Ptp =	**47.08**	**lb/in^2**
FS =	**5**	Pipe critical buckling has a suitable factor of safety

WALL CRUSHING:

When external pressures exceed the compressive streength of the pipe wall crushing will occur. The factor safety agains wall crushing can estimated by the following equation:

$$FSwc = 2 *\sigma y / ((SDR - 1)*\sigma max)$$

Where:

FSwc = Factor of safety against wall crushing
σy = compressive yied strength of pipe (psi)
σmax= maximum stress applied to the pipe (psi)
SDR = standard dimension ratio of the pipe

σy =	230400	**psi**
SDR =	17	
σmax =	6780	
FSwc =	**4.25**	Pipe wall crushing has a suitable factor of safety

EXCESSIVE BENDING STRAIN:

A pipe will deflect under external loading. As a result of this deflection bending strains are induced in the pipe. These strains can be calculated by the following equation (Mosher 199(

$$\acute{\varepsilon}b = f\,d * t * \Delta y / Do^2$$

Where:

έb =Bending Strain %
***f*d** = deformation shape factor (assume 6)
Δy = vertical deflection (in)
Do = outside diameter of pipe

***f*d =**	6
Do =	6.625
t =	0.39
Δy =	0.17
έb =	**0.89**

Chevron (1994) reccomends an allowable bending strain between 1.5 to 2.25% for *f*d = 6
Therefore bending strain is acceptable.

Attachment G

Slope Stability Analysis

Volume 3 of 3

Slope Stability Analysis

North Ranch Surface Waste Management Facility
Lea County, New Mexico

Revised September 2019
Project No. 35187378

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
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TABLE OF CONTENTS

1.0 INTRODUCTION

Terracon has completed Stability analyses for the proposed NGL Waste Services, LLC (NGL) North Ranch Surface Waste Management Facility (Facility) located in Lea County, New Mexico. The main purpose of this report is to present a slope stability analyses for the critical cross-sections located in the landfill for the final cover system, the top of waste, the top of protective cover, and the top of geosynthetic layer of the base liner system.

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See **EXHIBIT A**, **FIGURE A-1**, Site Layout Plan
Critical Cross Sections	See **EXHIBIT B**, **FIGURE B-1**, Cross Section Phase I and Phase II

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The facility is in Lea County, New Mexico
Existing improvements	Greenfield Facility - add Surface Waste Management System
Current ground cover	--

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

The subsurface information and the laboratory test results used in Terracon's analysis were obtained from the documents 'Terracon GeoReport" dated January 25, 2019. The subsurface profile is typically comprised of poorly graded sands, caliche lenses, and sandstone. The borings were terminated at 165 feet below ground surface with no groundwater encountered.

4.0 CRITICAL SECTIONS AND LINER CONFIGURATIONS

Two critical cross sections were analyzed as part of this slope stability analysis. The locations of the cross-sections are shown on **FIGURE B-1** attached in **EXHIBIT B**. The cross-sections were selected because they represented the landfill's maximum height of the waste and the steepest slope of the fill. The top and the bottom liner configurations are summarized below.

Configuration No. 1	
Final Cover System (From top to bottom)	• 12" Thick Vegetation/Erosion Layer • 36" Thick Protective Cover Layer • 12" Thick Interim Cover
Bottom Liner System (From top to bottom)	• 2' Thick Protective Cover Layer • Double-Sided Geocomposite • 60-mil Double Sided Textured HDPE Liner • Double-Sided Geocomposite • 60-mil Double Sided Textured HDPE Liner • Reinforced Geosynthetic Clay Liner (GCL) • 6" Prepared Subgrade

4.1 Material Properties

Table 4.1 below presents the strength parameters used for the slope stability analyses for all the conditions analyzed (effective stress). These parameters were selected based on review of the subsurface data and laboratory tests were obtained from the document 'Terracon GeoReport" dated January 25, 2019 and on our experience with similar soils and materials where test results were not available for site-specific materials.

Table 4.1 Material Properties Summary

Soil/Material Type	Unit Weight	Effective Strength Parameters	
	(pcf)	C (psf)	ϕ (degrees)
60 mil textured HDPE	65	25	21
Compacted Subgrade	120	100	23
Double Sided Geocomposite	40	100	17
Poorly Graded Sand	120	25	22
Protective Cover	110	0	23
Sandstone	120	25	23
Vegetated Soil Layer	100	100	15
Waste	70	0	28

5.0 ANALYSIS SUMMARY

5.1 General Discussion

The computer program SLOPE/W® 2018 (R2) developed by Geo-Slope International was used to evaluate stability of the landfill. This program has several methods available that allow the user to model both circular and block-type failure surfaces (modes). The stability analysis is typically characterized by its calculated factor of safety against failure. The factor of safety may be generally defined as the ratio of the resisting forces to the driving forces. A factor of safety of 1.0 indicates the resisting forces are in equilibrium with the driving forces; therefore, the higher the safety factor, the more stable the slope. Further discussion of the trial failure modes that were analyzed is provided below.

In the program SLOPE/W®, the Morgenstern-Price method with half-sine function was selected to calculate the factor of safety. The Morgenstern-Price method is similar to the Spencer method but allows for various user-specified interslice force functions. The block method function was specified to locate the critical slip surface, and then optimization of the failure plane was performed by the software to "probe" the possibility of a lower safety factor. The soil parameters used for this project are in the **Table 4.1**. The safety factor is shown on the respective cross-section and in the adjoining SLOPE/W analysis in **EXHIBIT C**.

5.2 Results of Static Analyses

The stability analyses were performed by inputting shear strength, friction angles, and unit weight parameters into SLOPE/W®. The long-term stability conditions were considered for these analyses. Figures showing the failure plane and the corresponding factor of safety are presented in **EXHIBIT C**. The factor of safety shown on the graphical plot corresponds to the optimized failure surface.

5.2.1 Stability of the North Ranch Facility

Stability analyses were performed for the final cover system, the top of waste, the top of protective cover, and the top of geosynthetic layer for Phase I and Phase II cross sections. The cross-sections for the landfill were taken at the critical sections. A circular failure was used to describe the lowest factors of safety for the waste stability. **Table 5.1** below summarizes the results of the slope stability analysis for the different phases of construction.

Table 5.1 Final Fill Slope Stability Summary
Final Cover Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.4	1.5
Phase II (circular)	2.2	1.5

Top of Waste Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.4	1.5
Phase II (circular)	2.3	1.5

As noted in **Table 5.1,** the calculated factors of safety for the proposed configurations exceeded the minimum allowable factor of safety established.

The North Ranch Facility is not located in a seismic impact zone since the maximum horizontal acceleration in lithified material at the facility is less than 0.1g (See **EXHIBIT D**). Therefore, a seismic analysis is not required.

A stability run was also performed to confirm the factor of safety for the interim conditions when the landfill has the protective cover in place and with the geosynthetic layers prior to placing the protective cover in **EXHIBIT C**. Table 5.2 summarizes the stability of the cut slopes in relation to the base liner system

Table 5.2 Cut Slope and Base Liner Stability Summary
Top of Protective Cover Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.0	1.5
Phase II (circular)	1.6	1.5

Top of Geosynthetic Layer Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.0	1.5
Phase II (circular)	1.6	1.5

6.0 GENERAL COMMENTS

The analyses and any recommendations presented in this report are based upon the subsurface information obtained from the report prepared by Terracon GeoReport" dated January 25, 2019 and from other information discussed in this report. This report does not reflect variations that may occur due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided. Provisions to verify strength of utilized soil and geosynthetic materials and interfaces may be added as part of the construction quality assurance process as applicable.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices. No warranties, express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. If changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

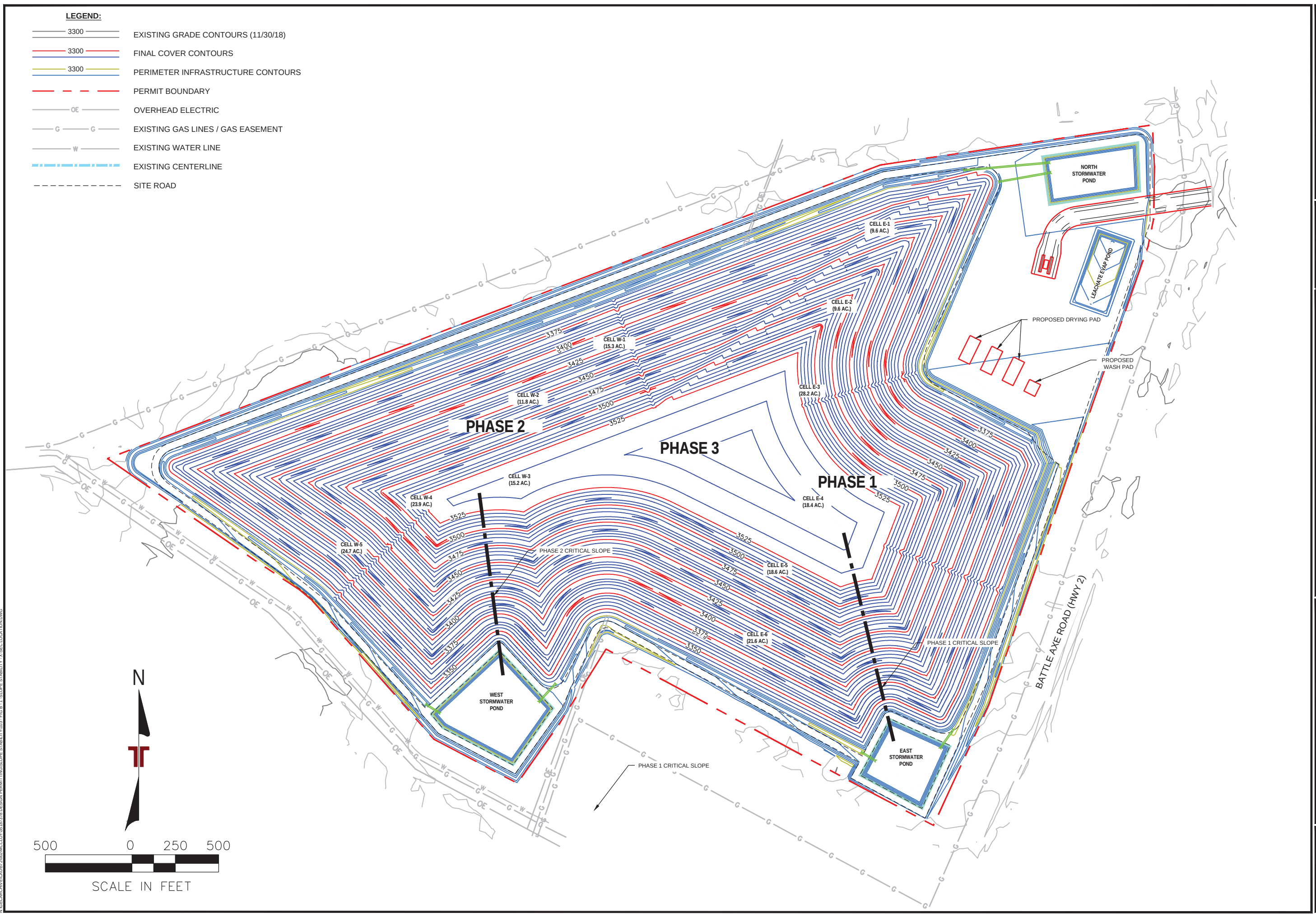
EXHIBIT A
LOCATION DIAGRAM


LEGEND:
PERMIT BOUNDARY AND SECURITY FENCELINE
BOREHOLE LOCATIONS
NGL PROPERTY LINE
CELL BOUNDARIES
SITE ROAD
SITE ENTRANCE
NORTH STORMWATER POND
LEACHATE EVAP POND
BH 1
BH 2
BH 3
BH 4
BH 5
BH 7
BH
CELL E-1 (9.6 AC.)
CELL E-2 (9.6 AC.)
CELL E-3 (28.2 AC.)
CELL E-4 (18.4 AC.)
CELL E-5 (18.6 AC.)
CELL E-6 (21.6 AC.)
CELL W-1 (15.3 AC.)
CELL W-2 (11.8 AC.)
CELL W-3 (15.2 AC.)
CELL W-4 (23.9 AC.)
CELL W-5 (24.7 AC.)
PHASE 1
PHASE 2
PHASE 3
WEST STORMWATER POND
EAST STORMWATER POND
BATTLE AXE ROAD (HWY 2)
2
N
SCALE IN FEET
REV. DATE BY DESCRIPTION
SITE LAYOUT PLAN
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY
ARKANSAS
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH
PH. (501) 847-9292
BRYANT, AR 72022
FAX. (501) 847-9210
FIGURE A-1
DESIGNED BY: MPB
DRAWN BY: TLB
APPVD. BY: DCM
SCALE: 1" = 500'
DATE: 03/28/2019
JOB NO. 572-002-3518737
ACAD NO. 102
SHEET NO.: - OF -

Received by OCD: 8/14/2024 8:18:23 PM

EXHIBIT B
CROSS SECTIONS

Released to Imaging: 9/20/2024 1:54:53 PM



CRITICAL SLOPE LOCATIONS
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY ARKANSAS

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FIGURE B-1

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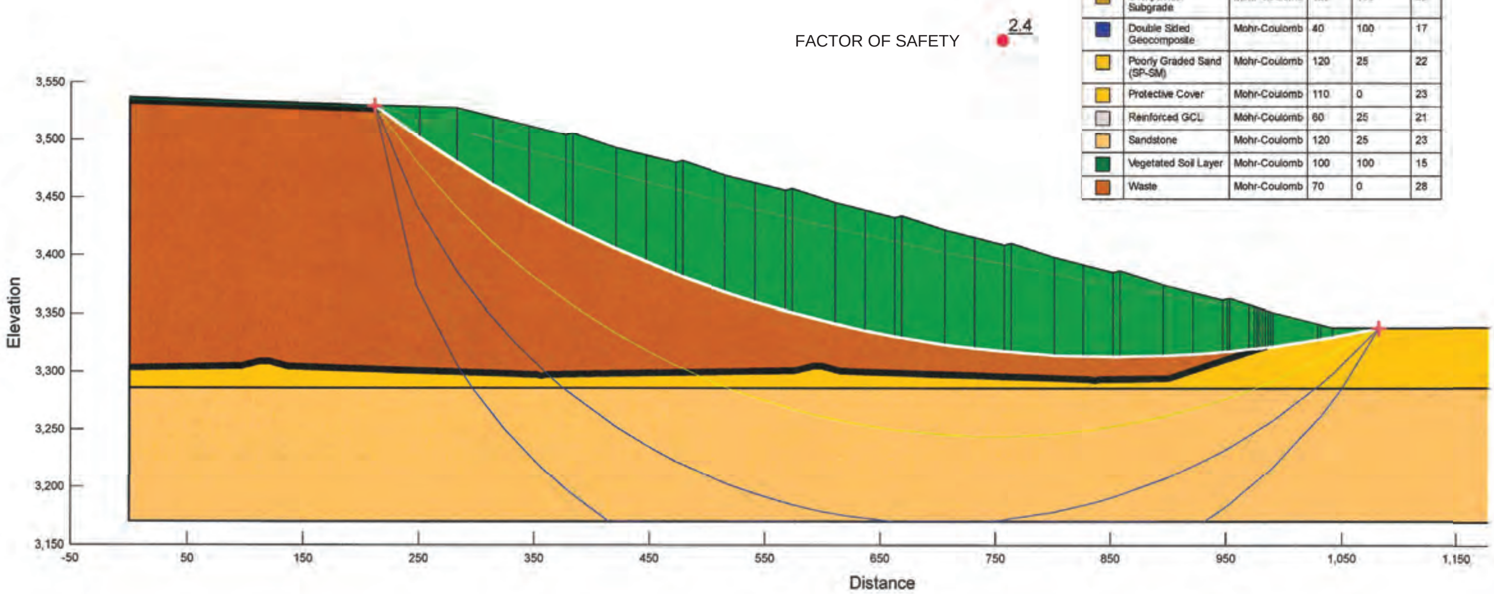
EXHIBIT C
CRITICAL FAILURE SURFACE FIGURES



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	60-mil Textured HDPE (Both Sides)	Mohr-Coulomb	60	25	21
	Compacted Subgrade	Mohr-Coulomb	120	100	23
	Double Sided Geocomposite	Mohr-Coulomb	40	100	17
	Poorly Graded Sand (SP-SM)	Mohr-Coulomb	120	25	22
	Protective Cover	Mohr-Coulomb	110	0	23
	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23
	Vegetated Soil Layer	Mohr-Coulomb	100	100	15
	Waste	Mohr-Coulomb	70	0	28

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PHASE I - FINAL COVER
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE C-1

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Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
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	Compacted Subgrade	Mohr-Coulomb	120	100	23
	Double Sided Geocomposite	Mohr-Coulomb	40	100	17
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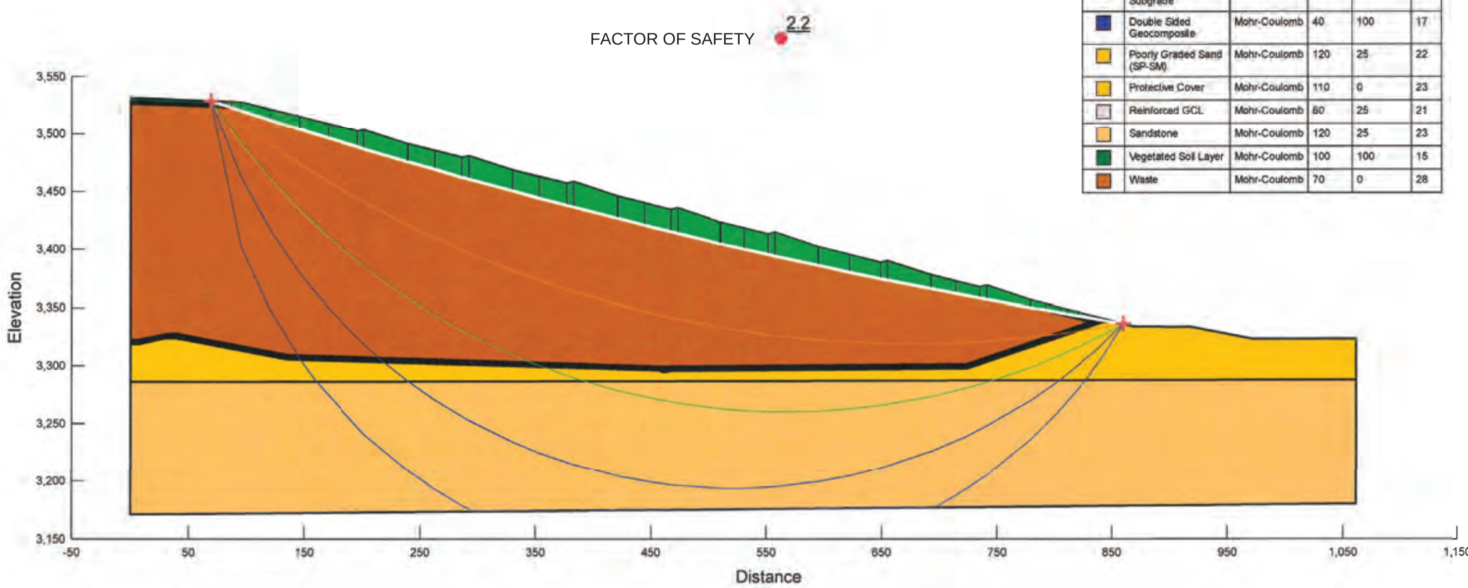
	Protective Cover	Mohr-Coulomb	110	0	23
	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23
	Vegetated Soil Layer	Mohr-Coulomb	100	100	15
	Waste	Mohr-Coulomb	70	0	28



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PHASE II - FINAL COVER
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE C-2

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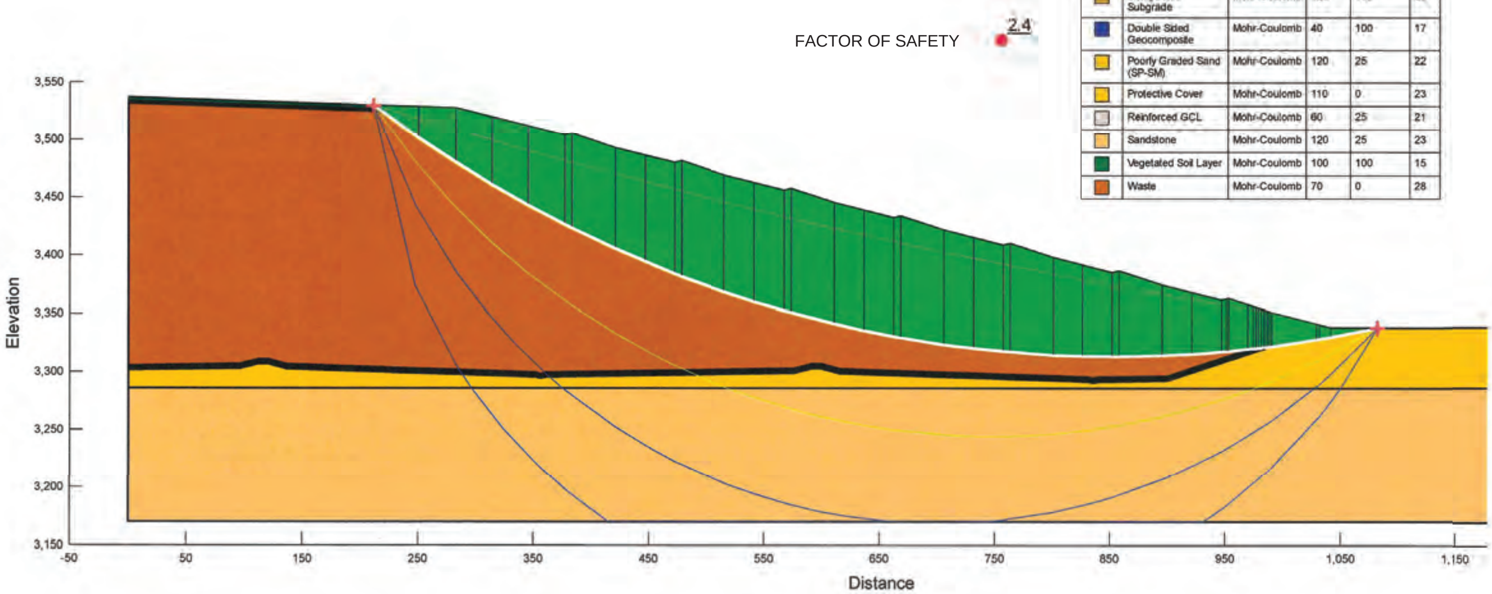

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
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	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23
	Vegetated Soil Layer	Mohr-Coulomb	100	100	15
	Waste	Mohr-Coulomb	70	0	28

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PHASE I - TOP OF WASTE

SLOPE STABILITY ANALYSIS

SURFACE WASTE MANAGEMENT FACILITY

NORTH RANCH

LEA COUNTY   NEW MEXICO

FIGURE C-3

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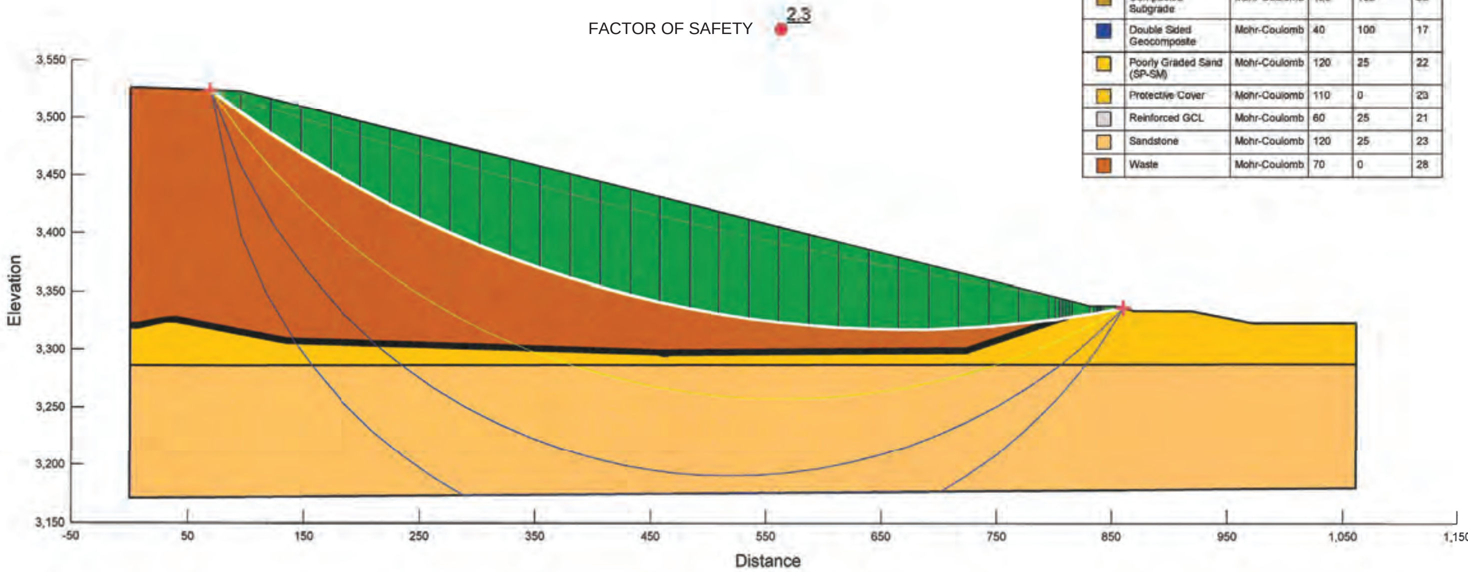
JOB NO.	572-002-35187378
ACAD NO.	101
SHEET NO.:	- OF -



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
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	Compacted Subgrade	Mohr-Coulomb	120	100	23
	Double Sided Geocomposite	Mohr-Coulomb	40	100	17
	Poorly Graded Sand (SP-SM)	Mohr-Coulomb	120	25	22
	Protective Cover	Mohr-Coulomb	110	0	23
	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23
	Waste	Mohr-Coulomb	70	0	28

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PHASE II - TOP OF WASTE
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE C-4

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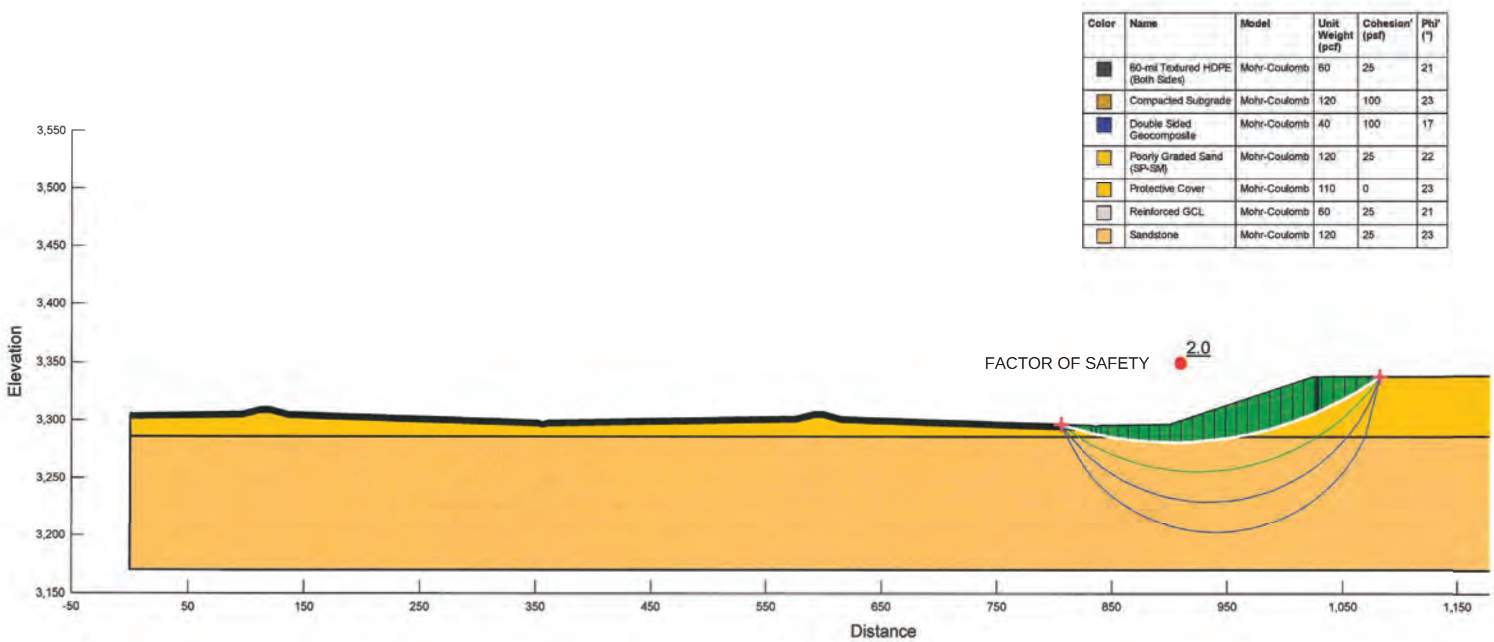

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
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	Compacted Subgrade	Mohr-Coulomb	120	100	23
	Double Sided Geocomposite	Mohr-Coulomb	40	100	17
	Poorly Graded Sand (SP-SM)	Mohr-Coulomb	120	25	22
	Protective Cover	Mohr-Coulomb	110	0	23
	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23

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PHASE I - TOP OF PROTECTIVE COVER
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE C-5

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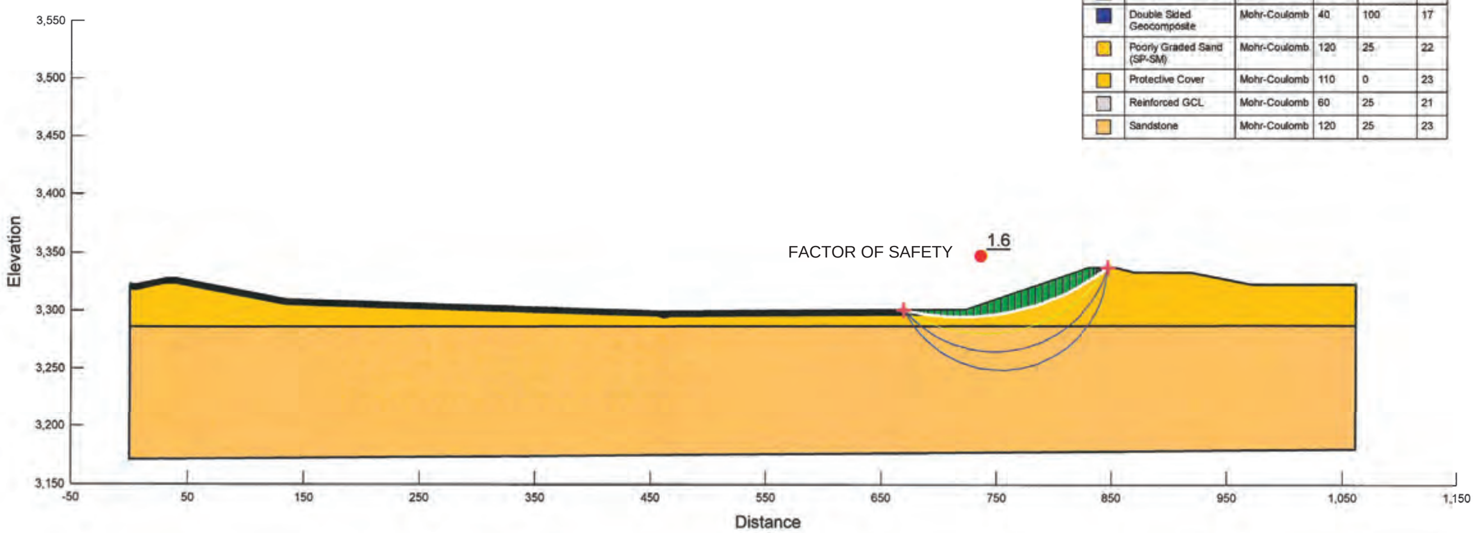
Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	60-mil Textured HDPE (Both Sides)	Mohr-Coulomb	60	25	21
	Compacted Subgrade	Mohr-Coulomb	120	100	23
	Double Sided Geocomposite	Mohr-Coulomb	40	100	17
	Poorly Graded Sand (SP-SM)	Mohr-Coulomb	120	25	22
	Protective Cover	Mohr-Coulomb	110	0	23
	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23



N:\GECARCHIVE\CAD\572\002\MCCLOY\35187378 DESIGN PERMITTING\SLOPE STABILITY\101 NORTH RANCH SLOPE STABILITY.DWG

REV.	DATE	BY	DESCRIPTION

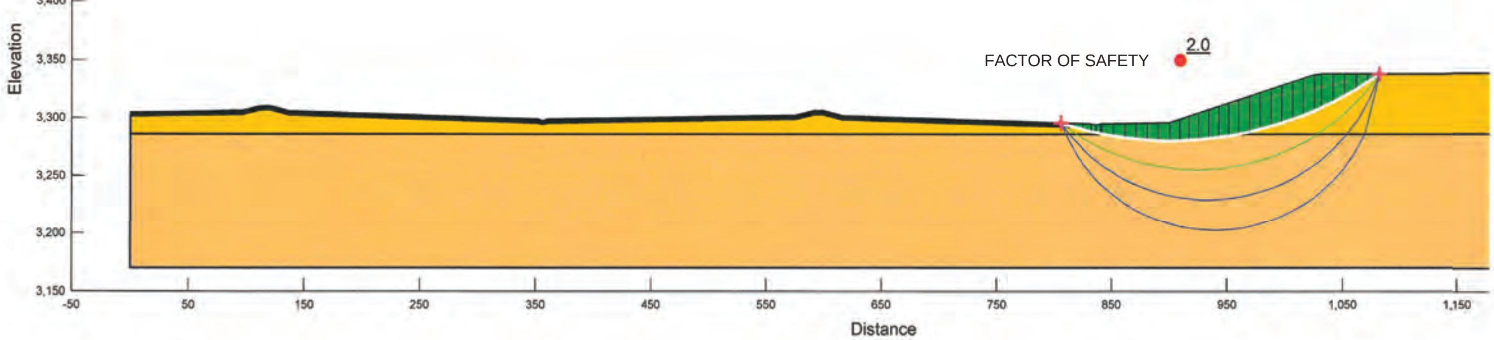
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

PHASE II - TOP OF PROTECTIVE COVER
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE C-6

DESIGNED BY:	MPB
DRAWN BY:	TLB
APPVD. BY:	DCM
SCALE:	N.T.S.
DATE:	03/28/2019
JOB NO.	572-002-35187378
ACAD NO.	101
SHEET NO.:	- OF -

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	60-mil Textured HDPE (Both Sides)	Mohr-Coulomb	60	25	21
	Compacted Subgrade	Mohr-Coulomb	120	100	23
	Double Sided Geocomposite	Mohr-Coulomb	40	100	17
	Poorly Graded Sand (SP-SM)	Mohr-Coulomb	120	25	22
	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23



REV.	DATE	BY	DESCRIPTION

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PHASE I - TOP OF GEOSYNTHETICS
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE C-7

DESIGNED BY:	MPB
DRAWN BY:	TLB
APPVD. BY:	DCM
SCALE:	N.T.S.
DATE:	03/28/2019
JOB NO.	572-002-35187378
ACAD NO.	101
SHEET NO.:	- OF -

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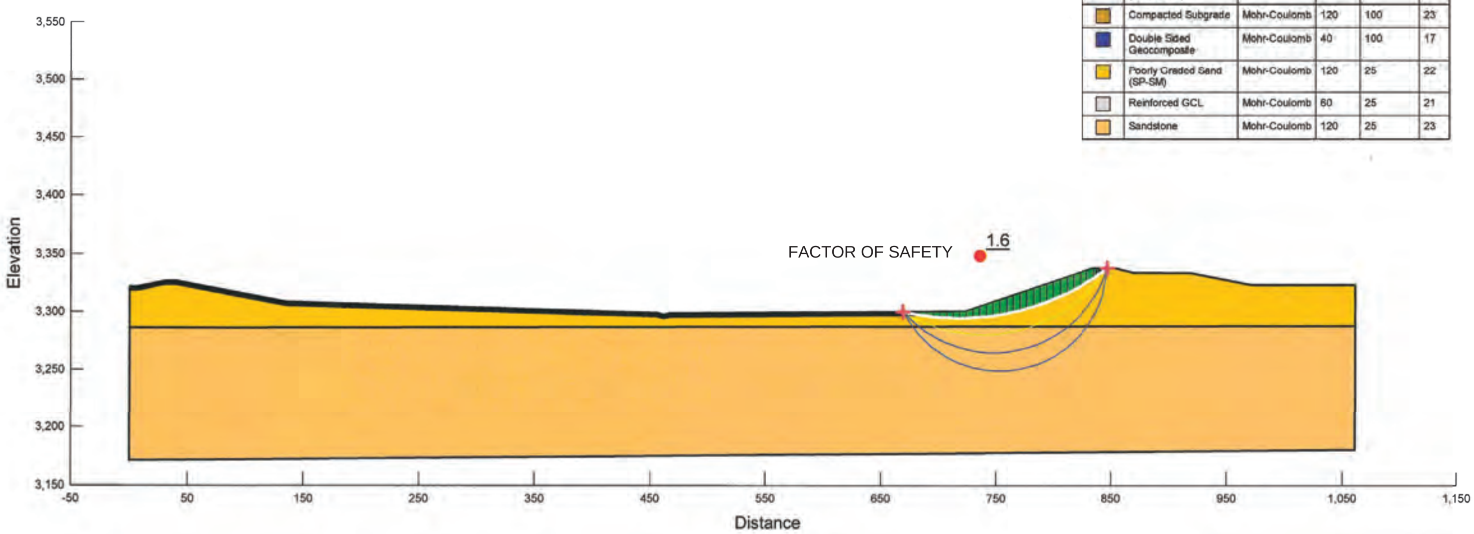

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	60-mil Textured HDPE (Both Sides)	Mohr-Coulomb	60	25	21
	Compacted Subgrade	Mohr-Coulomb	120	100	23
	Double Sided Geocomposite	Mohr-Coulomb	40	100	17
	Poorly Graded Sand (SP-SM)	Mohr-Coulomb	120	25	22
	Reinforced GCL	Mohr-Coulomb	60	25	21
	Sandstone	Mohr-Coulomb	120	25	23

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REV.	DATE	BY	DESCRIPTION

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Consulting Engineers and Scientists
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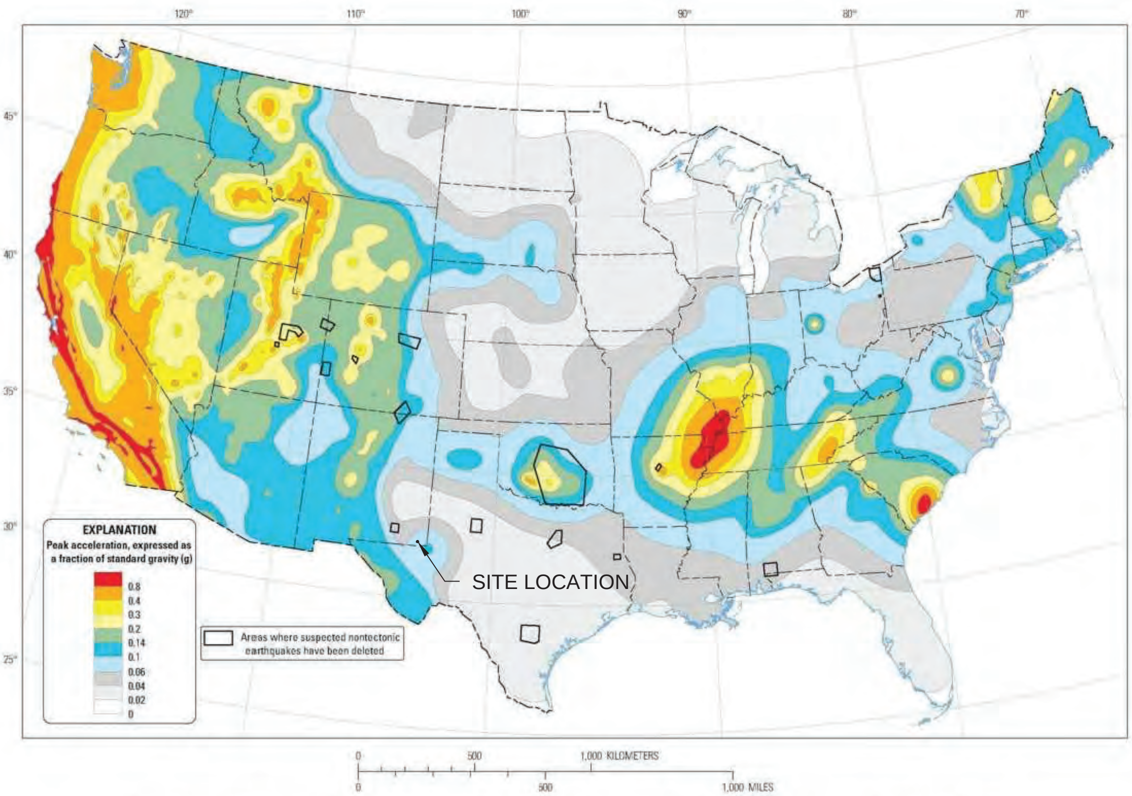
PHASE II - TOP OF GEOSYNTHETICS
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE C-8

DESIGNED BY:	MPB
DRAWN BY:	TLB
APPVD. BY:	DCM
SCALE:	N.T.S.
DATE:	03/28/2019
JOB NO.	572-002-35187378
ACAD NO.	101
SHEET NO.:	- OF -

EXHIBIT D
SEISMIC MAP



Two-percent probability of exceedance in 50 years map of peak ground acceleration

REV.	DATE	BY	DESCRIPTION

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Consulting Engineers and Scientists
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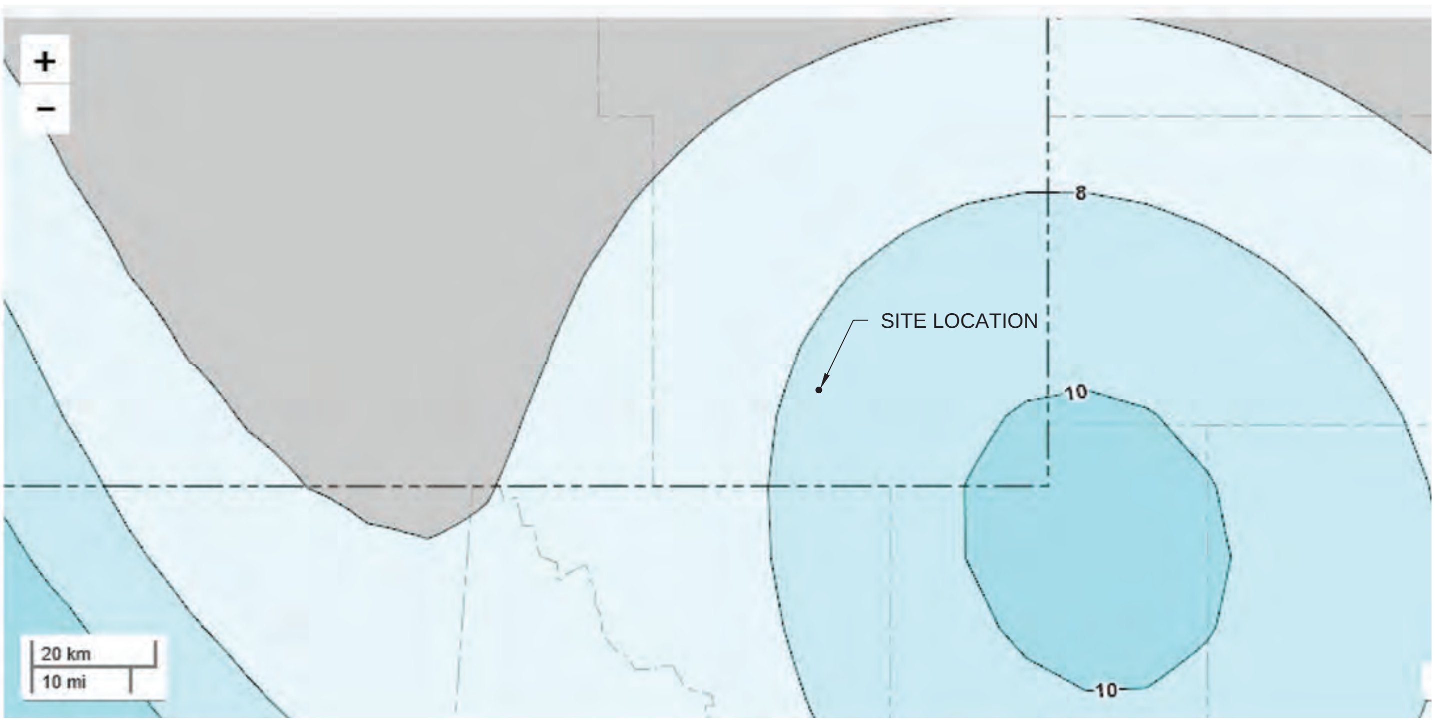
NATIONAL SEISMIC HAZARD MAP
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE D-1

DESIGNED BY:	TLB
DRAWN BY:	TLB
APPVD. BY:	DCM
SCALE:	N.T.S
DATE:	03/28/2019
JOB NO.	572-002-35187378
ACAD NO.	104
SHEET NO.:	- OF -

N:\GEC\ARCHIVE\CAD\572\002\MCCLOY\35187378 DESIGN PERMITTING\SLOPE STABILITY\104 FIG D - 1- NATIONAL SEISMIC HAZARD MAP.DWG



TWO-PERCENT PROBABILITY OF EXCEEDANCE IN 50 YEARS MAP OF PEAK GROUND ACCELERATION

REV.	DATE	BY	DESCRIPTION

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NATIONAL SEISMIC HAZARD MAP
SLOPE STABILITY ANALYSIS
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

FIGURE D-2

DESIGNED BY:	TLB
DRAWN BY:	TLB
APPVD. BY:	DCM
SCALE:	N.T.S
DATE:	03/28/2019
JOB NO.	572-002-35187378
ACAD NO.	104
SHEET NO.:	- OF -

N:\GECARCHIVE\CAD\572\002\MCCLOY\35187378 DESIGN PERMITTING\SLOPE STABILITY\104 FIG D - 1- NATIONAL SEISMIC HAZARD MAP.DWG

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014

Spectral Period

Peak ground acceleration

Latitude

Decimal degrees

32.145188

Time Horizon

Return period in years

2475

Longitude

Decimal degrees, negative values for western long…

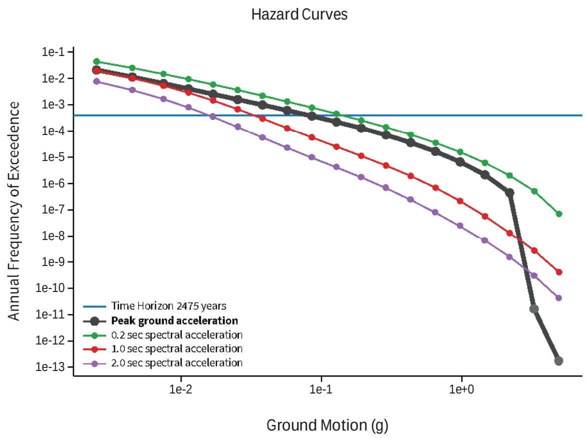
-103.46194

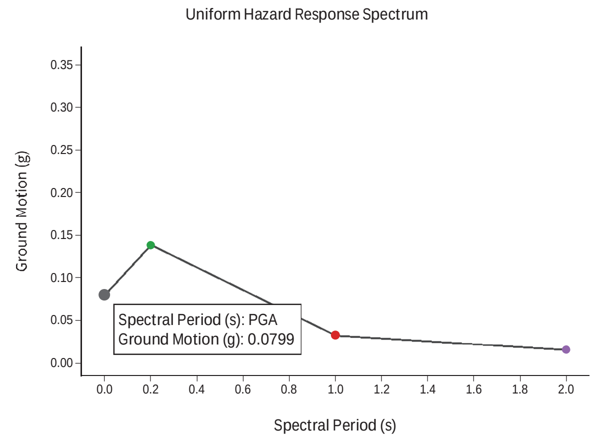
Site Class

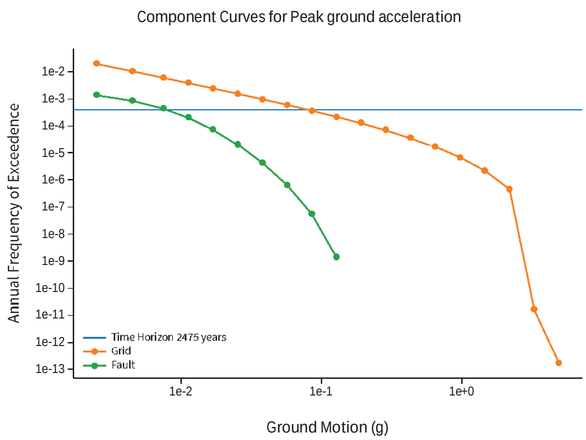
760 m/s (B/C boundary)

Received by OCD: 8/14/2024 8:18:23 PM

Hazard Curve







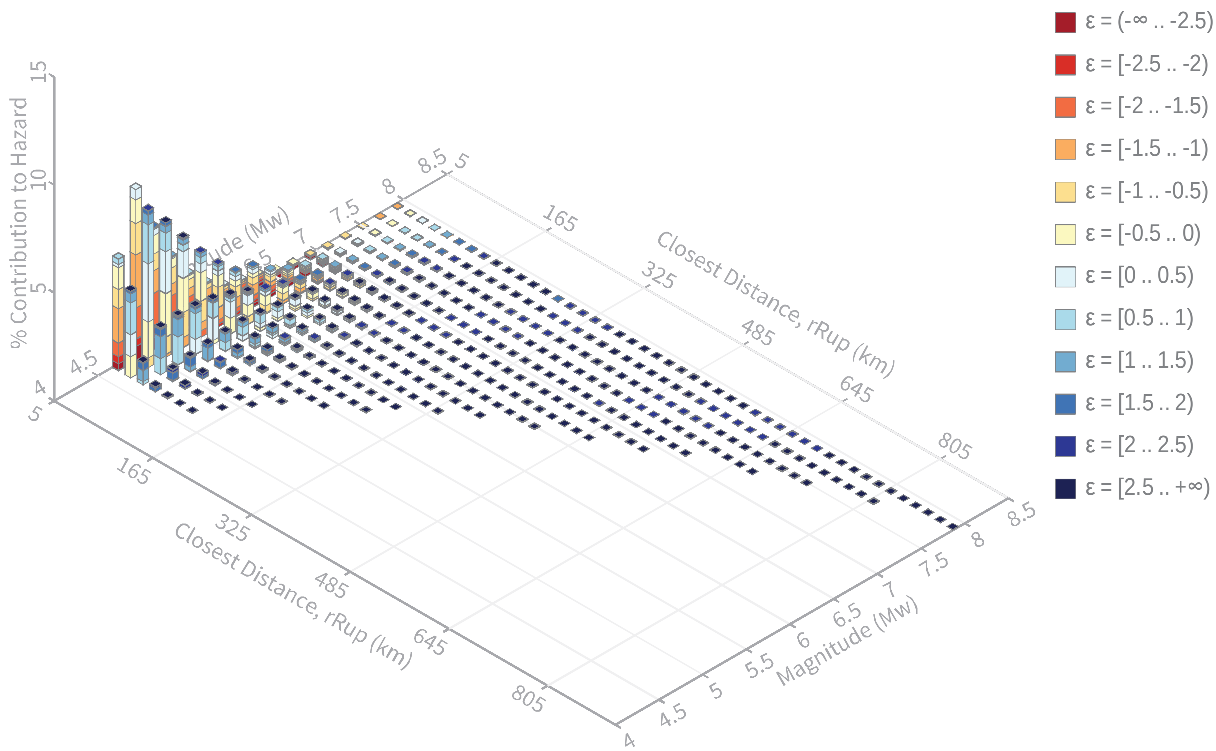
View Raw Data

Released to Imaging: 9/20/2024 1:54:53 PM

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.079945618 g

Recovered targets

Return period: 2478.3733 yrs
Exceedance rate: 0.00040349046 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 1.63 %

Mean (for all sources)

r: 38.68 km
m: 5.45
ε_0: -0.3 σ

Mode (largest r - m bin)

r: 13.68 km
m: 4.9
ε_0: -1.18 σ
Contribution: 7.92 %

Mode (largest ε_0 bin)

Deaggregation ontributors

ource et ↳ ource	T pe	r	m	ε0	lon	lat	a	
SSCn i ed Smoothing one 1 (opt)	Grid							29.71
PointSource inite: -103.462, 32.303		17.97	5.19	-0.97	103.462	32.303	0.00	4.33
PointSource inite: -103.462, 32.213		8.91	5.13	-2.15	103.462	32.213	0.00	3.77
PointSource inite: -103.462, 32.393		27.56	5.29	-0.31	103.462	32.393	0.00	3.52
PointSource inite: -103.462, 32.348		22.74	5.24	-0.59	103.462	32.348	0.00	2.70
PointSource inite: -103.462, 32.437		32.38	5.34	-0.09	103.462	32.437	0.00	2.58
PointSource inite: -103.462, 32.482		37.20	5.40	0.09	103.462	32.482	0.00	2.29
PointSource inite: -103.462, 32.527		42.02	5.46	0.24	103.462	32.527	0.00	1.92
PointSource inite: -103.462, 32.617		51.62	5.58	0.46	103.462	32.617	0.00	1.28
PointSource inite: -103.462, 32.258		13.30	5.15	-1.48	103.462	32.258	0.00	1.28
USGS i ed Smoothing one 1 (opt)	Grid							29.71
PointSource inite: -103.462, 32.303		17.97	5.19	-0.97	103.462	32.303	0.00	4.33
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PointSource inite: -103.462, 32.393		27.56	5.29	-0.31	103.462	32.393	0.00	3.52
PointSource inite: -103.462, 32.348		22.74	5.24	-0.59	103.462	32.348	0.00	2.70
PointSource inite: -103.462, 32.437		32.38	5.34	-0.09	103.462	32.437	0.00	2.58
PointSource inite: -103.462, 32.482		37.20	5.40	0.09	103.462	32.482	0.00	2.29
PointSource inite: -103.462, 32.527		42.02	5.46	0.24	103.462	32.527	0.00	1.92
PointSource inite: -103.462, 32.617		51.62	5.58	0.46	103.462	32.617	0.00	1.28
PointSource inite: -103.462, 32.258		13.30	5.15	-1.48	103.462	32.258	0.00	1.28
SSCn Adaptive Smoothing one 1 (opt)	Grid							17.97
PointSource inite: -103.462, 32.303		17.97	5.19	-0.97	103.462	32.303	0.00	2.24
PointSource inite: -103.462, 32.393		27.56	5.29	-0.31	103.462	32.393	0.00	1.94
PointSource inite: -103.462, 32.213		8.91	5.13	-2.15	103.462	32.213	0.00	1.93
PointSource inite: -103.462, 32.348		22.74	5.24	-0.59	103.462	32.348	0.00	1.47
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PointSource inite: -103.462, 32.482		37.20	5.40	0.09	103.462	32.482	0.00	1.34
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USGS Adaptive Smoothing one 1 (opt)	Grid							17.97
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PointSource inite: -103.462, 32.393		27.56	5.29	-0.31	103.462	32.393	0.00	1.94
PointSource inite: -103.462, 32.213		8.91	5.13	-2.15	103.462	32.213	0.00	1.93
PointSource inite: -103.462, 32.348		22.74	5.24	-0.59	103.462	32.348	0.00	1.47
PointSource inite: -103.462, 32.437		32.38	5.34	-0.09	103.462	32.437	0.00	1.38
PointSource inite: -103.462, 32.482		37.20	5.40	0.09	103.462	32.482	0.00	1.34
PointSource inite: -103.462, 32.527		42.02	5.46	0.24	103.462	32.527	0.00	1.16
E Tmap 2014 adSm.ch.in (opt)	Grid							2.30
E Tmap 2014 adSm.gr.in (opt)	Grid							1.15

Attachment H

Construction Quality Assurance Plan

Construction Quality Assurance Plan

North Ranch Surface Waste Management Facility
Lea County, New Mexico

September 2019
Project No. 35187378

Prepared for:

NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:

Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

TABLE OF CONTENTS

LIST OF TABLES

EXIBITS

SECTION 1
GENERAL

1.0 INTRODUCTION

The purpose of this document is to present a Quality Assurance and Quality Control Plan (QA/QC Plan) for the North Ranch Surface Waste Management Facility an up stream oil and gas exploration and production waste disposal facility. This plan is prepared in general accordance with New Mexico Administrative Code (NMAC) 19.15.36.14.D as it pertains to Landfill liner construction and NMAC 19.15.36.17.B as it pertains to evaporation pond liner construction to ensure excavations and liners used in the facility operations are designed, constructed, installed, and maintained properly. The QA/QC Plan describes procedures for the installation and maintenance of the soil and geosynthetic components used in the composite liners system as specified by the facility design plans.

CQA of the selection, evaluation, treatment, placement, and compaction of soils for earthwork, low-permeability soil liners, granular drainage systems, and final cover layers is included in the scope of this plan. CQA applicable to manufacturing, fabricating, shipping, handling, and installing of all geosynthetics is also included. This CQA Plan does not address design guidelines, installation specifications, or selection of soils, geomembranes, and other geosynthetics (which include chemical compatibility between geosynthetics and contained material). In particular, this document addresses the requirements for CQA monitoring, testing and documentation of activities related to the production, construction, and installation of landfill lining systems, leachate collection systems, and cover systems. When applicable and deemed appropriate by the New Mexico Oil Conservation Division (NMOCD), deviations from this plan must be consistent with changes in applicable State and Federal Regulations, Facility Permit Conditions, and/or accepted practices in the field of Engineering.

The CQA Plan includes references to test procedures and standards of the American Society for Testing and Materials (ASTM), Corps of Engineers (COE), the Federal Test Method Standards (FTMS), the Geosynthetic Research Institute (GRI), and current industry practice.

1. Generic Construction Quality Assurance Plan for the Lining and Cover Systems; Geosyntec Consultants; September 1992;
2. ASTM Standards and Other Specifications and Test Methods on the Quality Assurance of Landfill Liner Systems; ASTM; 1916 Race Street; Philadelphia, PA 19103; 1994;
3. “New Mexico Administrative Code, Title 19 Chapter 15, Part 36, Surface Waste Management Facilities”; Effective February 14, 2007;
4. Waste Containment Facilities-Guidance for Construction, Quality Assurance and Quality Control of Liner and Cover Systems; David E. Daniel and Robert M. Koerner; 1995.
5. Geosynthetic Research Institute Test Methods and Standards; Latest versions as of the date of this CQA Plan.

2.0 DEFINITIONS RELATED TO CQA

This section describes CQA associated with the construction of liner and cover systems and defines terminology used throughout this document. **EXHIBIT A** provides detailed definitions for common quality assurance and landfill terminology used in this document.

2.1 Construction Quality Assurance and Construction Quality Control

This CQA Plan is devoted to Construction Quality Assurance and Construction Quality Control. In the context of this CQA Plan, Construction Quality Assurance and Construction Quality Control are defined as follows:

Construction Quality Assurance (CQA) - A planned and systematic pattern of all means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

Construction Quality Control (CQC) - Those actions which provide a means to measure and control the characteristics of an item or service to contractual and regulatory requirements.

2.2 Use of the Terms in This Plan

In the context of this plan:

1. CQA refers to means and actions employed by the CQA Consultant to assure conformity of the lining and cover system component production and installation with this CQA Plan, the Project Plans, and the Project Specifications. CQA is provided by a party independent from production and installation.
2. CQC refers to those actions taken by Manufacturers, Fabricators, Installers, or the CQC Firm to insure that the materials and the workmanship meet the requirements of the Project Plans and Specifications.

3.0 CQA AND CQC PARTIES

This section summarizes the CQA parties that will be involved in any liner/cover system installation corresponding to the proposed Landfill and Evaporation Pond.

3.1 Description of CQA Parties

The following section summarizes the CQA Parties who will be either directly or indirectly involved in the construction/installation associated with the bottom liner or final cover system corresponding to the proposed Landfill and Leachate Evaporation Pond. Where applicable, proposed Landfill Operator and/or Owner will be responsible for insuring that each of the Parties selected have the necessary experience and qualifications associated with bottom liner and final cover system installations. In addition, each party shall be aware of its obligations and responsibilities as defined in this plan. Depending on the size and/or scope of the project, a person or firm may act as more than one of the parties listed below, as long as third party and conflict of interest matters are addressed.

3.1.1 Owner

The Owner owns and/or is responsible for the facility, including components constructed and governed by the scope of this document. The Owner is responsible for managing all aspects of the project including planning, cost control, design, permitting, regulatory liaison, contract acquisitions, construction oversight, quality control, and certification. Unless otherwise noted, the proposed Landfill and Leachate Evaporation Pond will be the owner of any liner/final cover system constructed in association with the Landfill. The proposed Landfill Operator and/or Owner will be responsible for negotiating contracts between other CQA Parties, and for insuring that qualified agencies, firms, contractors, etc. are selected who will satisfy the requirements of this CQA Plan and who will be responsible for insuring that the project is completed in accordance with applicable Project Plans, Specifications, Regulations, and within established cost constraints.

3.1.2 Project Manager

The Project Manager is the official representative of the Owner. The Project Manager, along with the Design Engineer, will be the central point of contact for the Owner and CQA Consultant. Depending on the size or scope of the Project, the Project Manager may be a 3rd Party Firm or Agency contracted directly with the Owner to oversee the Project. In some situations, the Project Manager may act jointly as the Project Manager and Design Engineer. The Owner and/or Project Manager shall carefully consider the size and scope of the project when determining whether it is necessary to have separate individuals to fill the role of Design Engineer and Project Manager. Although not specifically required in the NMAC, it is highly recommended and is industry best practice that the Design Engineer and/or CQA Manager be represented as a firm/agency independent of the Owner (i.e., 3rd Party). While considering this, the Design Engineer and/or CQA Manager shall have no corporate ties, which could be construed as a conflict of interest.

3.1.3 Design Engineer

The Design Engineer is responsible for the design of the liner and/or cover systems, and for the preparation of the Project Plans and Specifications. The Design Engineer may be an employee of the Owner/Operator or a 3rd Party firm or agency hired by the Owner/Operator.

3.1.4 CQA Consultant

The CQA Consultant is directly responsible for verifying that construction materials, practices, and procedures, are consistent with the requirements of this plan, the project specifications, plans, and applicable regulations. The CQA Consultant will work directly with the CQC Firm and/or labs in order to efficiently manage all aspects of project quality assurance. The CQA Consultant shall be an independent 3rd Party firm or agency with no direct corporate ties to the Owner, which may be construed as a conflict of interest.

3.1.4.1 CQA Certifying Engineer

The CQA Certifying Engineer is a party, independent from the Owner, Manufacturer, Fabricator, and Installer, that is responsible for the overall observation, testing and documentation activities related to the CQA of the earthwork at the site and the production and installation of the geosynthetic components of the lining and cover systems, i.e., the geotextiles and geocomposite on this facility. The CQA Certifying Engineer also is responsible for issuing a certification report, sealed by a Registered Professional Engineer associated with the installation of the liner and collection system. Depending on the size and/or scope of the Project, the CQA Certifying Engineer may also serve as the CQA Consultant, and/or CQA Manager.

3.1.4.2 CQA Manager

The CQA Manager reports to the Certifying Engineer and is responsible for observing, testing and documenting activities related to the CQA of the earthwork at the site and the production and installation of the geosynthetic components of the lining and cover systems, i.e., the geomembranes, geotextiles, and geocomposites on this facility.

3.1.4.3 CQA Monitor

The CQA Monitor reports to the CQA Manager and/or the Certifying Engineer and is responsible for observing, testing and documenting activities related to the CQA of the earthwork at the site and the production and installation of the geosynthetic components of the lining and cover systems, i.e., the geomembranes, geotextiles, and geocomposites on this facility.

3.1.4.4 Soils Testing Laboratory

The Soils CQC Firm is responsible for conducting tests in the field and in the laboratory on samples of soils associated with liner and cover system installations. The Owner or the General Contractor may retain the third party CQA Firm.

3.1.4.5 Geosynthetics Laboratory

The Geosynthetics Laboratory is a party, independent from the Owner, Manufacturer, Fabricator, and Installer, that is responsible for conducting tests on samples of geosynthetics taken from the site. The Geosynthetics Laboratory testing services cannot be provided by any party involved with the manufacture, fabrication, or installation of any of the geosynthetic components. The geosynthetics installer, if deemed acceptable by the CQA consultant, may perform the CQC field-testing. The CQA consultant shall be present during all such testing. In no case shall the geosynthetics installer or subcontractor conduct laboratory testing for conformance or destructive analysis. A firm independent of the geosynthetics installer shall conduct this analysis.

3.1.4.6 CQA Surveyor

The CQA Surveyor is a party that is independent from the Contractor that is responsible for surveying the subgrade and liner during construction.

3.1.5 General Contractor

The General Contractor is responsible for construction of the bottom liner and final cover systems. The General Contractor may perform directly or subcontract out various elements of the construction, including subgrade preparation, geosynthetics, and soil placement. The General Contractor may also be responsible for other construction at the Facility either directly or indirectly related to the waste disposal area.

3.1.6 Soils Contractor

The Soils Contractor excavates and/or delivers soil material to the General Contractor and/or project site. Depending on the size and/or scope of the Project, the General Contractor may also serve as the Soils Contractor.

3.1.7 Geosynthetics Manufacturer

The Geosynthetics (Geomembrane, Geotextile, Geosynthetic Clay, Geonets or Geocomposites) Manufacturer (Manufacturer) is responsible for the production of geomembranes or geonet rolls from resin. The geosynthetics manufacturer may also produce geosynthetic clay liners from bentonite and/or geotextile rolls from resin fibers.

3.1.8 Geosynthetics Installer

The Geosynthetics Installer (Installer) is responsible for field handling, storing, placing, seaming, loading, and other aspects of the geosynthetics installation. The Installer may also be responsible for transportation of these materials to the site and for construction of the anchor trenches if so defined in the project specifications.

3.1.9 Geosynthetics Transporter

The Transporter transports the geosynthetics, including rolls of geotextiles, geocomposites, and geonets between the Manufacturer and the site; or between the Manufacturer and the Fabricator, and/or between the Fabricator and the site.

3.2 Qualifications of the Parties

The following qualifications shall be required of all parties involved with the design, manufacture, fabrication, installation, transportation, and CQA of all lining and cover system materials to be utilized at the Landfill.

3.2.1 Project Manager

The selection of the Project Manager is the responsibility of the Owner. Qualifications for this position are determined by the Owner independently of the CQA Plan and will be based on the objectives and constraints of the Project as determined by the Owner.

3.2.2 Design Engineer

The Design Engineer shall be a qualified professional engineer with registration in the State of New Mexico. The Design Engineer shall have demonstrated experience associated with previous similar solid waste/hazardous waste projects. In particular, the Design Engineer shall have a history which demonstrates familiarity with geosynthetics and/or soils, as appropriate, including detailed design and construction methods commonly used in the field of Civil and/or Sanitary Engineering.

3.2.3 CQA Consultant

The CQA Consultant shall be a designated firm or agency independent of the Owner with demonstrated knowledge and experience with geosynthetics and soil liner/cover systems. The CQA Consultant is responsible for the CQA Manager, CQA Monitors, Soils Testing Laboratory, Geosynthetics Laboratory, and CQA Surveyor.

The CQA Consultant shall be a well-established engineering firm incorporated (or otherwise registered) in the United States. The CQA Consultant shall be experienced in providing CQA services for soils, including low-permeability and high-permeability soils. The CQA Consultant shall be experienced in the preparation of quality assurance documentation including quality assurance forms, reports, certifications, and manuals.

In addition, the CQA Consultant shall provide the following in writing, if required, to the Owner before entering into contractual agreements with the Owner:

1. Corporate background and information; and
2. Quality assurance capabilities:
   - a summary of the firm's experience with soils;
   - a summary of the firm's experience in quality assurance, including installation quality assurance of soils;
   - a summary of the CQA documentation and methods used by the firm, including sample CQA forms, reports, certifications, and manuals prepared by the firm;
   - a summary of the firm's experience with geosynthetics, including geomembranes, geocomposites, geonets, and geotextiles;
   - a summary of the firm's experience in quality assurance, including installation quality assurance of geomembranes, geocomposites, geonets, and geotextiles; and
   - a summary of CQA documentation and methods used by the firm, including sample CQA forms, reports, certifications, and manuals prepared by the firm.

In addition, the CQA Consultant shall provide the following in writing, if required, to the Owner before beginning work on this project:

1. Resumes of personnel to be involved in the project including the CQA Certifying Engineer, CQA Manager, and CQA Monitors;

2. Proof of Professional Engineering registration in the project state of the engineer to be designated the CQA Certifying Engineer; and

3. Proof of quality assurance experience of the CQA personnel with emphasis on geomembranes, geocomposites, geonets, and geotextiles.

3.2.3.1 CQA Certifying Engineer

The CQA Certifying Engineer shall represent a designated firm or agency, independent of the Owner, with demonstrated knowledge and experience with geosynthetics and soil liner/cover systems. The CQA Certifying Engineer shall be a New Mexico Registered Professional Engineer who will be responsible for preparing and sealing a certification report upon the successful completion of the project.

Third Party CQA Firm – An independent third party shall provide Construction quality assurance (CQA). If the certifying firm or individuals have any relationship with the owner or operator of the facility, which could be interpreted as a conflict (such as belonging to a firm under the same corporate umbrella), these shall be disclosed in advance of the construction.

Required Presence – A qualified member of the CQA firm shall be present at the site continuously during liner or final cover barrier construction. The professional certifying the construction shall at a minimum visit the site at least once prior to construction, once during construction and once after construction is substantially completed unless such visits are not practical. Additional visits by the professional certifying the construction shall be required if additional visits are prescribed in the approved Quality Assurance Plan or if site conditions warrant.

3.2.3.2 Soils Testing Laboratory

The Soils Testing Laboratory shall have experience in soils testing, meet all regulatory requirements, and have demonstrated experience utilizing the standards specified in this Plan. The Soils Testing Laboratory shall be capable of providing test results in accordance with the test methods described in the specifications. **The Soils Testing Laboratory shall be capable of providing a minimum of ten flexible wall permeability test results in six (6) days or less**.

3.2.3.3 Geosynthetics Laboratory

The Geosynthetics Laboratory shall have experience in testing geosynthetics and be familiar with American Society for Testing and Materials (ASTM), National Sanitation Foundation (NSF), and Geosynthetic Research Institute (GRI) test methods and standards. The Geosynthetics CQC Firm shall be capable of providing destructive test results within 24 hours of receipt of samples and shall maintain that standard throughout the installation.

3.2.4 Soils Supplier

Qualifications of the soils supplier are specific to the construction contract. The soils supplier shall have a demonstrated history of providing soils with consistent properties (when applicable).

3.2.5 Earthwork Contractor

Qualifications of the Earthwork Contractor are specific to the construction contract. The Earthwork Contractor shall have a demonstrated history of successful earthwork construction. In particular, the Contractor shall have successfully completed liner or cover systems for solid waste, hazardous waste, or surface water containment. Documentation of this experience shall be submitted with the Contractor's Bid to the Owner or Project Manager.

3.2.6 Geosynthetics Installer

The Geosynthetics Installer shall be trained and qualified to install geosynthetics. Prior to confirmation of any contractual agreements, the Geosynthetic Installer shall provide the Project Manager with the following written information:

1. Corporate background and information;
2. Installation capabilities;
3. Equipment and personnel;
4. Daily anticipated production;
5. Quality control manual for installation;

3.2.7 Transporter

All personnel responsible for the loading, transport and unloading of the geosynthetics must be aware of the consequences of damage to the geosynthetics, and be familiar with the handling and transport constraints required by the Manufacturer and/or Fabricator.

3.3 Duties of the CQA Personnel

In this CQA Plan, the roles of the CQA Certifying Engineer, CQA Manager, Soils CQA Monitor, and Geosynthetics CQA Monitor are described separately. Individuals or consultants may be responsible for each particular aspect of the liner/cover system construction.

1. The CQA Manager, who depending on the size and/or scope of the project may direct CQA activities from the offices of the CQA Consultant's firm and visit the site periodically; The CQA Manager may designate CQA Monitors depending on the size and/or scope of the project to oversee certain aspects of the project. The CQA Monitors will report directly to the CQA Manager.
2. The CQA Monitors will be on site during all aspects of construction pertaining to the liner/cover system installation.

As described in earlier sections, the CQA Manager may also serve as the Soils CQA Monitor and the Geosynthetics CQA Monitor depending on the size and/or scope of the project. It is likely that a CQA Manager will be designated for both the Soils and Geosynthetics components of the liner/cover system installation on large projects.

3.3.1 CQA Certifying Engineer

The CQA Certifying Engineer will be responsible for:

1. Review of all project related designs, plans, and specifications;
2. Reviews all other site-specific documentation, including bid documents, proposed layouts, soils and groundwater investigation reports, and for geosynthetics, the manufacturer's and installer's literature;
3. Attends the resolution meetings;
4. Administers the CQA program (i.e., assigns and manages all CQA personnel, reviews all field reports, and provides engineering review of all CQA related issues);
5. Provides quality control of the CQA personnel, including site visits;
6. Reviews all changes to the design, plans, and specifications; and
7. Prepares/approves the final certification report, including a review of the Record Drawing(s).

3.3.2 CQA Manager

The CQA Manager may also be the CQA Monitor depending on the size and/or scope of the project and will be responsible for:

1. Familiarizes self and/or all CQA Monitors with the site and the project requirements;
2. Manages the daily activities of the CQA Monitors;
3. Attending CQA-related meetings (resolution, pre-construction, daily, weekly, etc.);
4. Prepares or oversees the ongoing preparation of the Record Drawings(s);
5. Assigns locations for testing and sampling;
6. Reviews results of laboratory testing and makes appropriate recommendations;
7. Reviews all CQA Monitors' daily reports and logs;
8. Reports to the Project Manager, and logs in his daily field report any relevant observations reported by the CQA Monitors;
9. Prepares daily report;
10. Prepares weekly summary of CQA activities; and

11. Delegate's responsibilities to a senior CQA Monitor whenever absent from the site while operations are ongoing.

In addition, the CQA Manager shall be responsible for insuring:

1. Periodically checks stockpile or borrow pit sources for variability of the soils, and insures that conformance testing is carried out;
2. Establishes additional test requirements beyond those in the specifications, where necessary to confirm permeability or density requirements;
3. May perform site visit and review of manufacturing plant facilities (as deemed necessary), methods, and quality control;
4. Reviews all Supplier, Manufacturer, and Installer certifications and documentation and makes appropriate recommendations;
5. Reviews the Installer's personnel qualifications for conformance with those pre-approved for work on site; and
6. Notes any on-site activities that could result in damage to the geosynthetics.

3.3.3 CQA Monitors

The duties of the CQA Monitors include, as assigned by the CQA Certifying Engineer and/or CQA Manager: monitoring, logging, and/or documenting all appropriate operations. The duties to be performed, and operations to be monitored by the Soils CQA Monitors include:

1. Soils delivery, dumping, and placement;
2. Soils moisture content, and moisture conditioning, if required;
3. Compaction of soils, and in situ testing of compacted density and moisture content;
4. Collection of samples for laboratory testing for moisture/density relationships, permeability; and other testing as outlined in the specifications;
5. Operations to protect completed areas before the covering materials are placed;
6. Measurement of loose and compacted lift thickness;
7. Verification of bonding between lifts;
8. Observation of equipment type, number of passes and equipment contact pressure;
9. Examination of the soil surface for signs of excessive wetting, desiccation, or other disturbance prior to placement of any cover materials; and
10. Scarification, rewetting, recompaction, or proof rolling required to repair deteriorated areas; and
11. Reports any unresolved deviations from the CQA Plan to the CQA Manager.

The operations to be monitored by the Geosynthetics CQA Monitors, for all geosynthetics include:

1. Material delivery and "spotting";
2. Unloading and on-site transport and storage;
3. Marking samples for conformance testing;
4. Sampling for conformance testing by the Geosynthetics CQC Firm;
5. All placement operations;
6. Condition of panels as placed;
7. All joining and/or seaming operations; and
8. Repair operations.

All CQA Monitors shall take note of on-site activities that could result in damage to the soils or geosynthetics components of the lining system. Any observations so noted shall be reported as soon as possible to the CQA Manager.

4.0 SITE AND PROJECT CONTROL

In order to coordinate various aspects of the construction project and develop time frames for completion of the project, various project coordination meetings will be required associated with all liner/cover system installations. The Owner will be responsible for organizing or selecting a representative to organize the various project coordination meetings. A person shall be designated at the beginning of all meetings to document and transmit the minutes to all parties.

4.1 Resolution Meeting

Following the completion of the design, plans, and specifications for the project, a Resolution Meeting shall be held. This meeting shall include all parties then involved, including the Owner, Project Manager, and Design Engineer. This meeting may be combined with the pre-construction meeting depending on the size and scope of the project.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems, which might cause difficulties and delays in construction, and present the CQA Plan to all the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all. The first part of the Resolution Meeting may be devoted to a review of the design drawings and specifications for completeness and clarity. This is different from the peer review of the design, including design calculations, which shall have been carried out previously. This meeting shall include all of the following activities:

1. Communicate to all parties any relevant documents;

2. Review critical design details of the project;
3. Review the seam layout drawing provided by the Designer, the Fabricator, or the Installer;
4. Review the project-specific CQA Plan;
5. Make any appropriate modifications to the CQA Plan to insure that it specifies all CQA activities that are necessary (within the context of the regulatory agency approval if necessary);
6. Make any appropriate modifications to the design criteria, plans, and specifications so that the fulfillment of all design specifications or performance standards can be determined through the implementation of the site-specific CQA Plan;
7. Reach a consensus on the CQA Plan and quality control procedures, especially on methods of determining the acceptability of the soils and geosynthetics comprising the lining system;
8. Assign the responsibilities of each party;
9. Decide the number of soil density testing units to be maintained on site;
10. Establish work area security and safety protocol;
11. Select testing equipment and review protocols for testing and placement of soil materials;
12. Confirm the methods for documenting and reporting, and for distributing documents and reports; and
13. Confirm the lines of authority and communication.

4.2 Pre-Construction Meeting

A Pre-Construction Meeting shall be held at the site. At a minimum, the Owner, Project Manager, Design Engineer, CQA Manager, Earthwork Contractor, and Geosynthetics Installer shall attend the meeting. If deemed appropriate by the Project Manager, the Pre-Construction Meeting may be separated into two separate meetings; one for the Earthwork Contractor and one for the Geosynthetics Installer.

Specific topics considered for this meeting include:

1. Make any appropriate modifications to the CQA Plan (within the context of regulatory agency approval as necessary);
2. Review the responsibilities of each party;
3. Review lines of authority and communication;
4. Review methods for documenting and reporting, and for distributing documents and reports;

5. Establish protocols for testing;
6. Establish protocols for handling deficiencies, repairs, and retesting;
7. Review the time schedule for all operations;
8. Conduct a site walk-around to verify that earthwork construction is proceeding on schedule, and to review material storage locations;
9. Establish soil stockpiling locations; and

4.3 Progress Meetings

Periodic progress meetings shall be held between the Soils and Geosynthetics CQA Monitors, the Installer's superintendent, the Project Manager, and any other concerned parties. These meetings shall discuss current progress, planned activities for the next period, and any new business or revisions to the work. The CQA Monitors shall log any problems, decisions, or questions arising at this meeting in their daily reports. Any matter requiring action, which is raised in this meeting, shall be reported to the appropriate parties. The CQA Monitor's logs shall be submitted to the CQA Manager for inclusion in the Certification Report if deemed pertinent and appropriate.

4.4 Problem or Work Deficiency Meetings

A special meeting shall be held when and if a problem or deficiency is present or likely to occur. At a minimum, the affected contractor, the Project Manager, and the appropriate CQA Manager(s) shall attend the meeting. If the problem requires a design modification, the Design Engineer shall also be present. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

1. Define and discuss the problem or deficiency;
2. Review alternative solutions; and
3. Implement an action plan to resolve the problem or deficiency.

4.5 Project Control Visits

4.5.1 Periodic Visits

Periodically, the CQA Manager, and the Certifying Engineer(s) shall visit the construction site. This visit shall be coordinated with a similar visit by the Design Engineer when appropriate. The professional certifying the construction shall at a minimum visit the site at least once prior to construction, once during construction and once after construction is substantially completed, unless such visits are not practical. Additional visits by the professional certifying the construction shall be required if additional visits are prescribed in the approved Quality Assurance Plan or if site conditions warrant. The Project Manager and/or Owner may also inform state regulatory officials of these designated inspection dates if deemed appropriate.

4.5.2 Manufacturing Plant Visits

A representative of the Owner, Project Manager, Design Engineer, or CQA Manager may carry out a geosynthetic manufacturing plant visit in order to verify manufacturing practices or quality control procedures. These visits be arranged on an "as needed" basis if deemed appropriate by the Project Manager. Project specific plant visits for the manufacture and fabrication of the geosynthetics (geomembranes, geotextiles, geocomposites, and geonets) are optional. These plant visits shall be carried out at the discretion of the Owner, by the Owner, or his designated alternate.

SECTION 2
SURVEYING CONSTRUCTION QUALITY ASSURANCE

1.0 INTRODUCTION

Surveying of lines and reference elevations is conducted on an ongoing basis during the construction of the compacted soil liner materials, synthetic layers, and leachate collection system components. Accurate surveying is essential to insure that the liner/cover and hydraulic transport systems function as designed. The Contractor will be responsible for establishing grade control and the preparation of accurate record drawings (as built). The CQA Consultant will be responsible for reviewing all surveying activity performed by the Contractor to insure that construction adheres to the Project Plans and Specifications.

2.0 SURVEY CONTROL

At least one permanent elevation benchmark and at least two horizontal control benchmarks will be established for the project in a location convenient for reference during construction. The reference control points will be consistent with State Plane Coordinates and the established facility grid/survey coordinate system. The vertical and horizontal control for the benchmarks shall be established within normal land surveying standards. All initial survey controls either are in place as of the date of this writing, or will be established by the Design Engineer prior to execution of the Project.

3.0 LINES AND GRADES

The following surfaces shall be surveyed by the Contractor and verified by the CQA Consultant to document the lines and grades achieved during placement and compaction.

1. For the berms and other earthworks:
   - original grade surface;
   - compacted surface of cut slopes; and
   - finished grade surface.
2. For the compacted soil liners:
   - original contours;
   - prepared subgrade surface; and
   - finished compacted soil liner surface.
3. For the soil cover materials:
   - prepared surface; and
   - finished soil cover surface.

In addition, the lateral and vertical extent of all synthetic components as well as critical leachate collection system components shall be provided on the record drawings for future reference (if necessary).

4.0 FREQUENCY AND SPACING

All surveying shall be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. Any surveying conducted by the CQA team, is to be conducted as a check on the Contractor, but is not intended to alleviate the Contractor from his/her responsibilities for insuring that all construction is within the required grades and lines shown in the project plans and specifications.

The following minimum spacing's and locations shall be provided for survey points:

1. All "flat" surfaces, such as the base of the landfill, with gradients less than 10 percent, shall be surveyed on a square grid not wider spaced than 100 feet;
2. On all slopes greater than 10 percent, a square grid not wider than 100 feet shall be used, but in any case, a line at the crest, midpoint, and toe of the slope shall be taken;
3. A line of survey points no further than 100 feet apart must be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope);
4. A line of survey points no further than 100 feet apart must be taken at the invert of any pipes or other appurtenances to the liner;
5. At the corners and midpoints of the top and bottom of all sumps;
6. At the midpoint of the crest of the outside berms; and
7. At appropriate spacing to define geosynthetics panel layouts.

5.0 DOCUMENTATION

The Surveying CQA Managing Engineer shall retain copies of all field survey notes provided. The findings from the field surveys shall be documented on a set of Survey Record (As Built) Drawings.

The Record Drawings shall include the following information when applicable:

1. Site Layout Drawing showing:
   a. Layout of Prepared Area in Relation to Permitted Boundaries;
   b. Property boundaries and/or corners;
   c. Monitoring wells and piezometers (if scale permits);

d. Leachate risers, manholes and collection piping related to the specific cell and/or construction;

e. Limits of existing/future oil field waste disposal areas and limits of liner or final cover barrier;

f. Labeling and Miscellaneous Information:

- Descriptions of what each line style represents;
- Drawing scale;
- Legend; and
- North Arrow.

g. Existing Contours (prior to construction activity corresponding to this project);

h. A key map showing the location of the construction related to the permitted design, along with an identification of areas previously constructed and areas yet to be constructed;

i. If necessary to document leachate head level compliance, the report shall also indicate the lowest point of the liner constructed not including leachate trenches and sumps;

j. In addition, the certifying professional shall make a statement that the cell was constructed in accordance with the permit drawings and narrative. The report shall also include a list of any deviations from the permitted drawings, if they exist, and any reasons for the deviations; and

k. Any other features deemed significant.

2. Subgrade Drawing showing:

a. Prepared Subgrade Surface (Plan View);

b. The limits of excavation including all slopes;

c. The location of slope breaks, leachate sump and trenches, berms; and

d. Any other features deemed significant.

3. Top of Liner System showing:

a. The top and bottom of liner or final cover elevations referenced to the site grid coordinate system at 100’ intervals;

b. The location and elevation of slope breaks, leachate piping, leachate sump and trenches, berms; and any other features which are material to the disposal area construction; and

c. Any other features deemed significant.

4. Top of Drainage Layers or Liner Protection Layers showing:

a. If a granular blanket is utilized in the design, top of blanket elevation shall be identified at 100’ intervals;

b. The location of slope breaks, leachate sump and trenches, berms; and any other features which are material to the disposal area construction; and

c. Any other features deemed significant.

5. Top of Waste

   a. Verify top of waste elevations are at or below permitted elevations prior to placing final cover. The elevations shall be referenced to the site grid coordinate system at 100' intervals.

6. Top of Final Cover Layers showing:

   a. The top and bottom of the vegetative support/topsoil layers referenced to the site grid coordinate system at 100' intervals;

   b. The location of slope breaks, trenches, berms; and trenches, berms; and any other features which are material to the disposal area construction; and

   c. Any other features deemed significant.

   d. NOTE: Depth verification may be required due to possible settlement of waste during construction of the final cover system.

The Contractor will be responsible for submitting these record drawings (as-builts) if applicable to the CQA Consultant for review. The applicable record drawings are to be included in the Certification Report along with the CQA Consultant's Certifying Engineer's seal. The report shall then be submitted to the Design Engineer and Owner for review prior to being submitted to the NMOCD.

SECTION 3
CONSTRUCTION QUALITY ASSURANCE INVOLVING SOILS

1.0 INTRODUCTION

This CQA document covers five types of soil that are used in the construction of an industrial landfill liner and/or cover system. The following types of soil layers will be used in some form in the construction of liner and cover systems corresponding to the proposed landfill and leachate evaporation pond.

1. Subgrade Surface;
2. Drainage layers or media (free-draining, high-permeability soils, usually clean sand or gravel);
3. Liner Protective Cover Layers; and
4. Topsoil (soil demonstrating the ability to support plant growth).

2.0 SOIL MATERIALS SPECIFICATIONS

Except when otherwise noted in the Project Specifications or Plans, soil materials to be utilized in each component of the liner system shall conform to the following minimum materials specifications.

2.1 Subgrade Surface

The subgrade soils require treatment in the form of compaction or recompaction, prior to the placement of any of the lining system materials. This supporting layer is comprised of natural in-place materials, so this document will only address the compaction criteria. If the subgrade is disturbed, through undercutting of unsuitable material etc.; the subgrade is to be replaced, moisture conditioned, and compacted to the standards established in the Project Specifications. When possible, the subgrade surface shall be relatively smooth and free of non angular rocks, sticks, or other debris in excess of ½-inch in maximum dimension which could compromise the liner system. The subgrade will not require any subgrade compaction testing as the contractor shall excavate down to subgrade. If material is over excavated, testing shall be determined by CQA Firm.

The upper portion of the subgrade can be damaged by excess moisture (causing softening) and insufficient moisture (causing desiccation and shrinkage), or by freezing. These conditions are normally not discovered until after the design phase of the project. At a minimum, the Soils CQA Monitor shall determine the suitability of the subgrade for fill placement by one or more of the following methods:

1. Continuous visual inspection during proof-rolling;
2. Pocket penetrometer or Torvane shear tests in suspect soil areas; and
3. Other tests identified in **TABLE 3**.

The main requirement for the subgrade is it must have sufficient compaction and strength to enable the placement of liner. The subgrade also must be stable to prevent large differential settlements that would be conducive to damage of the liner system or the pooling of leachate.

2.2 Drainage Layers

Materials to be utilized in the construction of lateral drainage layers, particularly in leachate collection systems shall be comprised of clean washed river sand or gravel with a minimum hydraulic conductivity as specified and as determined utilizing the Hydrologic Evaluation of Landfill Performance (HELP, Version 3.0) Model. The hydraulic conductivity value shall be determined by the Design Engineer and made a part of the Project Specifications. These drainage materials shall consist of clean sands and/or gravel or other permeable material classified as SW, SP, GW, or GP that contains less than 10% (by dry weight) passing the US. No. 200 sieve with 100% (by dry weight) passing the 3" sieve. Gravel placed in sumps and around perforated pipes shall be classified as GW, GP, or GW-GM with no more than 10% passing the No.200 sieve. The frequencies and criteria for preconstruction and construction testing of the appropriate drainage materials are shown on **TABLE 3**. Testing shall be performed on off-site borrow sources or on-site stockpiles. Drainage geocomposites may be utilized in place of a soil drainage layer as long as the material and installation requirements of Section 5 are adhered to.

The installer shall insure that all soil materials such as sand and gravel are placed in such a manner as to insure that no damage occurs to the geomembrane liner and that no excess tensile stresses occur in the geomembrane. The following details will be followed during construction of the drainage media system.

1. A geotextile or other cushion approved by the designer will be installed between the drainage media and the geomembrane if any of the following conditions are met:
   - The drainage layer material contains angular aggregate; and/or
   - The drainage layer contains aggregate over 1 inch in nominal size as determined by a gradation test (ASTM D422);
2. A minimum of 12 inches of drainage media will be maintained between the dozer and the geomembrane at all times and thicker layers are required for heavier dozers (Larger than a D6). Typical minimum thicknesses used for the ground pressure exerted by the equipment is described in **TABLE 1**.
3. In areas of heavy traffic such as access ramps, the thickness shall be at least 2 to 3 feet. This material can be common protective cover or the material used for the drainage media.

2.3 Protective Cover Layers

The protective cover materials above the lining system and primary leachate collection system components are to be as follows: The protective cover materials used to protect the leachate collection system, shall consist of fine grained sandy soils, gravels or geosynthetic cushion materials as per the Project Specifications. Protective cover in the cover system (frost protection layer) shall consist of native soils with no particles over 1 inch in nominal size and shall be placed in accordance with standard construction practices.

2.4 Vegetative Soil Layer

Vegetative soil cover material shall be of quality to support vegetative growth and shall be placed in accordance with standard construction practices. No lab or field testing specifications are required for the installation of the vegetative soil layer beyond permeability testing discussed in **Section 2.5**. This layer will be installed at a minimum 6-inch thick layer as the uppermost layer of the final cover system

2.5 Intermediate and Final Cover Materials

Soil materials from borrow areas or stockpiles to be utilized for final cover system, (intermediate cover, infiltration barrier, and erosion/vegetation layers) must be tested for permeability prior to construction. Soils with a permeability of $1x10^{-5}$ cm/s or less shall be constructed as defined in the Closure and Post Closure Care Plan (**Appendix H** of the Permit Narrative). Soils with high permeabilities must be re-evaluated using the HELP model to determine required thickness to achieve 0.0 inches of percolation through the lower most layer.

2.5 Soils Testing

2.5.1 Test Methods

All testing used to evaluate the suitability or conformance of soils materials shall be carried out in accordance with the current versions of the corresponding American Society for Testing and Materials (ASTM) test procedures. The test methods indicated in **TABLES 2** and **3** are to be utilized for evaluating soil materials (when applicable) for adherence to the project specifications and the materials standards specified in this CQA Plan. All pre-construction and construction testing shall be performed at the frequency given in the **TABLES 2** and **3**.

2.5.2 Soils Testing Requirements

All soils testing shall be conducted under the direct supervision of the Soils CQA Consultant and/or qualified Soils CQC Firm. Nuclear densometer methods shall be used for field density testing in all cases. The drive cylinder (ASTM D2937) test or other approved method shall be used in cases of uncertainty, or as a check of the machine calibration. The Soils CQA Consultant and/or CQA Manager shall resolve any conflict over the results.

The test frequencies presented in **TABLES 2** and **3** are specified as minimum test frequencies. The CQA Manager or Soils CQA Consultant can increase the actual frequency of testing required as necessary in order to insure adequate quality control associated with all soil liner/cover systems. For example, the actual test frequencies may be increased in order to consider local soil variability (if applicable).

3.0 GEOSYNTHETIC CLAY LINERS

3.1 Manufacturing

The Geosynthetic Clay Liner (GCL), shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and shall comply with all of the criteria listed in this Section. Reinforced GCL must be used as designated by the Engineer.

Acceptable reinforced GCL products are Bentomat® ST, as manufactured by CETCO, 1350 West Shure Drive, Arlington Heights, Illinois 60004 USA (847-392-5800), or an engineer-approved equal.

The reinforced GCL and its components shall be tested for the properties shown in **TABLE 4**.

The reinforced GCL shall have 10,000 hour test data for large-scale constant-load (creep) shear testing under hydrated conditions. The constant shear load shall be 0.56 kN and the normal load shall be 1.1 kN.

The minimum acceptable dimensions of full-size GCL panels shall be 150 feet (45.7 m) in length. Short rolls [(those manufactured to a length greater than 70 feet (21 m) but less than a full-length roll)] may be supplied at a rate no greater than 3 per truckload or 3 rolls every 36,000 square feet (3,500 square meters) of GCL, whichever is less.

A 6-inch (150 mm) overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

The GCL manufacturer shall provide the Project Manager or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

A. Certificates of analysis for the bentonite clay used in GCL production stating the parameters swell index and fluid loss.
B. Manufacturer's test data for finished GCL product(s) of bentonite mass/area, GCL tensile strength and GCL peel strength (reinforced only).
C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

These conformance tests shall be performed in accordance with the test methods specified on **TABLE 4**. Other conformance tests may be required by the project specifications.

Manufacturer's Quality control tests must be performed in accordance with the test methods and frequency's specified in **TABLE 4**.

The CQA Consultant shall examine all manufacturer's certifications to insure that the property values listed on the certifications meet or exceed those specified by the project specifications and the measurements of properties by the manufacturer are properly documented, test methods acceptable and the certificates have been provided at the specified frequency properly identifying the rolls related to testing. Any deviations shall be reported to the Project Manager.

3.2 Roll Label Requirements

The GCL manufacturer shall identify all rolls with the following:

A. Manufacturer's name
B. Product identification
C. Lot number
D. Roll number
E Roll Dimensions (length, width, and weight)

The CQA Monitor shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

3.3 Shipping, Handling, and Storage

The GCL rolls shall be wrapped in polyethylene sheets or otherwise protected against dust and dirt during shipping and storage. The wrapping shall be removed just prior to the deployment of the rolls.

The manufacturer shall be responsible for initial loading the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor, Installer or other designated party.

A visual inspection of each roll shall be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging shall be marked and set aside for further inspection. The packaging shall be repaired prior to being placed in storage.

The party responsible for unloading the GCL shall contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

Storage of the GCL rolls shall be the responsibility of the installer. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well drained. Rolls shall be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls shall be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four). All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

3.4 Conformance Testing

3.4.1 Testing Requirements

Upon delivery of the rolls of GCL, the CQA Consultant shall take conformance samples of the GCL, to ensure conformance to both the design specifications and the list of Manufacturer guaranteed properties. **TABLE 4** presents the conformance testing requirements.

3.4.2 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first linear meter (three feet). The geosynthetic testing laboratory shall be contacted to determine the sampling size necessary for laboratory testing of the GCL.

3.4.3 Test Results

The CQA Monitor shall examine all results from laboratory conformance testing and shall report any non-conformance to the Project Manager. Any lots not meeting conformance testing specifications will result in the rejection of the lot.

3.5 Installation of the GCL

3.5.1 Earthwork

The Installer shall take whatever steps are necessary to insure that any underling layers are not damaged during the placement of the GCL or that the GCL is damaged in any way, which shall include but is not limited to the following conditions.

Any earthen surface upon which the GCL is installed shall be prepared and compacted in accordance with the project specifications and drawings. The surface shall be smooth, firm, and unyielding, and free of:

A. Vegetation.
B. Construction Debris.
C. Sticks.
D. Sharp rocks (1/2 inch maximum dimension, non-angular)
E. Void spaces.

F. Ice.
G. Abrupt elevation changes.
H. Standing water.
I. Cracks larger than one-quarter inch (6 mm) in width.
J. Any other foreign matter that could contact the GCL.

Subgrade surfaces consisting of granular soils or gravel shall be inspected due to their large void fraction and puncture potential. Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12 mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor. Prior to the placement of all GCL panels, the Installer shall certify in writing that the soil subgrade is acceptable and meets the manufacturer approved installation conditions.

It shall be the Installer's responsibility thereafter to indicate to the Design Engineer changes in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.

At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated or an equivalent runout shall be utilized in accordance with the project plans and specifications and as approved by the CQA Inspector. When utilizing an anchor trench design, the trench shall be excavated and approved by the CQA Inspector prior to GCL placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

The CQA Monitor will note any deficiencies or non-compliance and report it to the Project Manager.

3.5.2 GCL Placement

GCL rolls shall be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging shall be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) shall be in accordance with the Design Engineer's recommendations.

Equipment, which could damage the GCL, shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

The GCL panels shall be placed parallel to the direction of the slope.

All GCL panels shall lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.

Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The Design Engineer, CQA inspector, and GCL supplier shall be consulted for specific guidance if premature hydration occurs.

3.5.3 Anchorage

As directed by the project drawings and specifications, the ends of the GCL rolls shall be placed in an anchor trench at the top of the slope or an equivalent run out design shall be utilized. When utilizing an anchor trench design, the front edge of the trench shall be rounded so as to eliminate any sharp corners. Loose soil shall be removed from the floor of the trench. The GCL shall cover the entire trench floor but not extend up the rear trench wall.

3.5.4 Seaming

The GCL seams are constructed by overlapping their adjacent edges. Care shall be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required for reinforced GCL. All GCL shall be installed according to the manufacturer's recommendations.

The minimum dimension of the longitudinal overlap shall be 6 inches (150 mm). End-of-roll overlapped seams shall be similarly constructed, but the minimum overlap shall measure 24 inches (600 mm).

Seams at the ends of the panels shall be constructed such that they are shingled downhill in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

Bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the 6-inch (150-mm) line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).

3.5.5 Detail Work

The GCL shall be sealed around penetrations and embedded structures embedded in accordance with the design drawings and the GCL Manufacturer.

Cutting the GCL shall be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.5.6 Damage Repair

If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic shall be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

3.5.7 Cover Placement

If soil cover is to be placed in direct contact, cover soils shall be free of angular stones or other foreign matter that could damage the GCL. Cover soils shall be approved the Design Engineer with respect to particle size, uniformity and chemical compatibility. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.

Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover shall be maintained between the equipment tires/tracks and the GCL at all times during the covering process. This thickness recommendation does not apply to frequently trafficked areas or roadways, for which a minimum thickness of 2 feet (600 mm) is required (see **TABLE 1**).

Soil cover shall be placed in a manner that prevents the soil from entering the GCL overlap zones. Cover soil shall be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used to facilitate the installation of any geosynthetic material placed over the GCL. The GCL supplier or CQA engineer shall be contacted with specific recommendations on the appropriate procedures in this situation.

When a textured geomembrane is installed over the GCL, a temporary smooth geosynthetic covering known as a slip sheet or rub sheet shall be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

4.0 DOCUMENTATION

The CQA Manager shall document that quality assurance requirements have been addressed and satisfied. The CQA Manager shall provide the Project Manager with signed descriptive remarks, data sheets, and logs to verify that all monitoring activities have been carried out. The CQA Manager shall also maintain at the job site a complete file of plans and specifications, a CQA plan, checklists, test procedures, daily logs, and other pertinent documents.

4.1 Daily Recordkeeping

Standard reporting procedures shall include preparation of a daily report, which at a minimum, will consist of: (a) field notes, including memoranda of meetings and/or discussions with the Contractor; (b) observation logs and testing data sheets; and (c) construction problems and solution data sheets. This information will be regularly submitted to and reviewed by the Project Manager.

4.1.1 Memorandum of Discussion with Earthwork Contractor or Subcontractors

A memorandum will be prepared each day, if required, summarizing discussions between the Soils CQA Monitor and Contractor. At a minimum, the memorandum will include the following information:

1. Date, project name, location, and other identification;
2. Name of parties to discussion;
3. Relevant subject matter or issues;
4. Activities planned;
5. Constraints or suggestions;
6. Schedule; and
7. Signature of the CQA Monitor and/or CQA Manager.

4.1.2 Observation Logs and Testing Data Sheets

Observation and testing data sheets shall be prepared daily with a Site Plan diagram prepared at the end of each week. At a minimum, these data sheets shall include the following information:

1. An identifying sheet number for cross referencing and document control;
2. Date, project name, location, and other identification;
3. Data on weather conditions;
4. A scaled Site Plan (weekly) showing all active and proposed work areas and test locations;

5. Descriptions and locations of ongoing construction;
6. Equipment and personnel in each work area, including subcontractors;
7. Descriptions and specific locations of areas of work being tested and/or observed and documented (identified by lift and location);
8. Locations where tests and samples were taken;
9. A summary of test results;
10. Calibration or recalibrations or test equipment, and actions taken as result of recalibration;
11. Off-site materials received, including quality verification documentation;
12. Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality; and
13. The CQA Monitor signature.

In any case, all logs must be completely filled out with no items left blank.

4.2 Construction Problems and Solution Data Sheets

Sheets describing special construction situations shall be cross-referenced with specific observation logs and testing data sheets, and must include the following information, where available:

1. An identifying sheet number for cross-referencing and document control;
2. A detailed description of the situation or deficiency;
3. The location and probable cause of the situation or deficiency;
4. How and when the situation or deficiency was found or located;
5. Documentation of the response to the situation or deficiency;
6. Final results of any responses;
7. Any measures taken to prevent a similar situation from occurring in the future; and
8. The signature of the CQA Monitor and signature indicating concurrence from the Project Manager.

The Project Manager shall be made aware of any significant recurring non-conformance with specifications. The Project Manager shall then determine the cause of the non-conformance and recommend appropriate changes in procedures or specifications. When this type of evaluation is made, the results must be documented, and the Owner and the Design Engineer shall approve any revision to procedures or specifications.

A summary of all supporting data sheets, along with final testing results and the CQA Manager's approval of the work, shall be required upon completion of construction.

4.3 Photographic Reporting Data Sheets

Photographic reporting data sheets, where used, shall be cross-referenced with observation and testing data sheet(s), and/or construction problems and solution data sheet(s). These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain digital color prints; the digital photos will also be stored on appropriate media. These records shall be presented to the Project Manager upon completion of the project and all CQA documentation will be stored in the POR.

4.4 Design and/or Specification Changes

Design and/or specification changes may be required during construction. In such cases, the CQA Manager shall notify the Project Manager and the Design Engineer. Design and/or specification changes shall be made only with written agreement from the Project Manager and the Design Engineer, and shall take the form of an addendum to the specifications.

4.5 Progress Reports

The CQA Manager shall prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report shall include the following information:

1. A unique identifying sheet number for cross-referencing and document control;
2. The date, project name, location, and other information;
3. A summary of work activities during progress reporting period;
4. A summary of construction situations, deficiencies, and/or defects occurring during progress reporting period;
5. A summary of test results, failures and retests; and
6. The signature of the CQA Manager.

4.6 Signatures and Final Report

At the completion of the work, the CQA Engineer shall submit to the Project Manager and/or Design Engineer a signed final Report. This report shall certify that the work has been performed in compliance with the plans and specifications except as properly authorized and implemented, and that the summary document provides the necessary supporting information.

At a minimum, this report shall include: (a) summaries of all construction activities; (b) observation logs and testing data sheets including sample location plans; (c) construction problems and solutions data sheets; (d) changes from design and material specifications; (e) Record Drawings; and (f) a summary statement sealed and signed by a registered Professional

Engineer. The Record Drawings shall include scaled drawings depicting the location of the construction details pertaining to the extent of construction (depths, plan dimensions, elevations, soil component thickness, etc.). This document shall be prepared by the CQA Consultant and included as part of the CQA documentation. CQA documentation will be submitted to the NMOCD and retained in the Facility POR.

SECTION 4
GEOSYNTHETICS CONSTRUCTION QUALITY ASSURANCE

1.0 GEOMEMBRANE MANUFACTURING, SHIPPING, & CONFORMANCE TESTING

1.1 Manufacturing

1.1.1 Raw Material

The raw material to be utilized in the manufacturing of the geomembrane shall be first quality polyethylene resin. The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material. The base polyethylene resin shall be mixed with carbon black and a proprietary additive package of heat stabilizers and anti-oxidants. The percent distribution of these components including recycled polymer shall be as per the project specifications.

The raw material shall be first quality polyethylene resin and shall be tested by the Manufacturer for the specifications in **TABLES 5A** and **5B**.

Raw materials (resin, carbon black, and additive package) may be mixed during the production stage using a “masterbatch” carrier resin containing the carbon black and other additives or during a compounding process prior to production.

Conformance testing shall be carried out by the Manufacturer to demonstrate that the product meets this specification. At the Owner's discretion, additional testing may be carried out for purposes of conformance by the Geosynthetics CQC Firm, and paid for by the Owner. If the results of the Manufacturer's and the Geosynthetics CQC Firm's testing differ, the testing shall be repeated by the Geosynthetics CQC Firm, and the Manufacturer shall be allowed to monitor this testing. The results of this latter series of tests will prevail, if the applicable test methods have been followed.

Prior to the installation of any geomembrane material, the Manufacturer shall provide the Project Manager and the Geosynthetics CQA Monitor with the following information:

1. The origin (Resin Supplier's name and resin production plant), identification (brand name, number) and production date of the resin;
2. A copy of the quality control certificates issued by the Resin Supplier to include specific gravity (ASTM D1505) and melt index (ASTM D1238 Condition , 190ºC/2.16 kg); and
3. A statement that no reclaimed polymer is added to the resin (however, the use of polymer recycled during the manufacturing process may be permitted if done with appropriate cleanliness and if recycled polymer does not exceed 2% by weight).

The CQA Monitor shall review these documents and shall report any discrepancies to the Project Manager.

1.1.2 Geomembrane Manufacturing

The Project Manager shall provide to the CQA Monitor the plans, specifications and drawings for the lining system prepared by the Design Engineer. **TABLES 5A** and **5B** provide the frequency of testing for the geomembrane. The CQA Monitor shall verify that the specifications include at least all properties listed in **TABLES 5A** and **5B**, measured with the same methods or equivalent.

If the specifications do not fulfill the above conditions, the Design Engineer shall complete the required alterations of the specifications. The Geomembrane Manufacturer shall provide the Project Manager and the CQA Monitor with the following:

1. A properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the specifications, or equivalent;
2. A list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane;
3. The sampling procedures and results of testing; and
4. A certification that property values given in the properties sheet are guaranteed by the Geomembrane Manufacturer.

The CQA Monitor shall verify that:

1. the property values certified by the Geomembrane Manufacturer meet all of the specifications; and
2. the measurements of properties by the Geomembrane Manufacturer are properly documented and that the test methods used are acceptable.

In addition, the Geosynthetics CQA Monitor may, at the request of the owner, undertake a manufacturing plant visit, preferably during the production of the particular geomembrane for this project, in order to evaluate the Manufacturer's quality control procedures.

1.1.3 Rolls

Prior to shipment, the Geomembrane Manufacturer shall provide the Project Manager and the CQA Consultant with a quality control certificate for every roll of geomembrane to be provided for the particular project. A responsible party employed by the Geomembrane Manufacturer, such as the production manager, shall sign the quality control certificate. The quality control certificate shall include:

1. Roll numbers and identification; and

2. Sampling procedures and results of quality control tests - as a minimum, results shall be given for thickness, tensile strength, and tear resistance, evaluated in accordance with the methods indicated in the specifications or equivalent methods approved by the Designer.

The CQA Monitor shall:

1. Verify that the quality control certificates have been provided at the specified frequency, and that each certificate identifies the rolls related to it; and
2. Review the quality control certificates and verify that the certified roll properties meet the specifications.

1.2 Roll Label Requirements

All rolls delivered to the site must be labeled containing the following information:

1. Roll Number;
2. Material Type;
3. Nominal Thickness; and
4. Batch Number.

The geomembrane rolls are to be packaged with a label placed on the outside of the roll and one within the roll core. If both of these labels are missing or ineligible, the roll will be rejected.

1.3 Shipping, Handling, and Storage Requirements

1.3.1 Shipping

Shipping of the geomembrane is the responsibility of the Geomembrane Manufacturer, Fabricator, Installer, or other party as agreed upon. All handling on site is the responsibility of the Installer.

Upon delivery at the site, the Installer and the Geosynthetics CQA Consultant shall conduct a surface observation of all rolls or factory panels for defects and for damage. This inspection shall be conducted without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected. The Geosynthetics CQA Consultant shall indicate to the Project Manager:

1. Rolls, factory panels, or portions thereof, which shall be rejected and removed from the site because they have severe flaws; and
2. Rolls or factory panels that include minor repairable flaws.

1.3.2 Handling

The geomembrane temporary tagging area on site shall be coordinated with the on-site CQA Manager and the Installer to insure ease of transportation and placement in an area were the geomembrane will not be damaged or in the way of daily operations of the landfill. Two high strength carrying straps must be placed around the outside of the roll to assist in transportation and handling of the material on the construction site.

1.3.3 Storage Requirements

The Installer shall be responsible for the storage of the geomembrane on site. The Project Manager shall provide storage space in a location (or several locations) such that on-site transportation and handling are optimized if possible. Storage space shall be protected from theft, vandalism, passage of vehicles, etc. If the geomembrane is to be exposed to the weather for an extended period of time, it shall be covered until installed. The designated storage area shall be a firm, smooth surface free of large and/or sharp stones or any other sharp objects that could damage the liner. If the area is sloped or the rolls are stacked, precautions shall be taken to insure that the rolls will not shift or move causing possible damage to the rolls are injuring workers.

1.4 Conformance Testing of Geomembrane

1.4.1 Tests and Procedures

Upon or prior to delivery of the rolls of geomembrane, the CQA Monitor shall insure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQC Firm for testing to insure conformance to both the design specifications and the list of guaranteed properties. The test procedures shall be as indicated in **TABLES 5A** and **5B** based on material type or as specified in the project plans. Additionally, the Geomembrane shall meet or exceed the following specifications:

1. Conformance testing (1 test set every lot or every 100,000 ft^2 whichever is greater). Material lots found not in conformance will be rejected.
   a. Density (ASTM D1505);
   b. Carbon Black Content (ASTM D1603);
   c. Carbon Black Dispersion (ASTM D5596);
   d. Thickness (ASTM D5994);
   e. Tensile Properties (ASTM D6693/Type IV); and
   f. Tear Resistance (ASTM D1004, Die C).
2. Seam Testing:
   a. Trial seams tested in field tensiometer or at testing laboratory at the beginning of everyday and every five working hours; and
   b. Air pressure and vacuum testing of all field seam lengths (ASTM D4437).

1.4.2 Sampling Procedures
Samples shall be taken across the entire width of the roll and shall not include the first three linear feet. Unless otherwise specified, samples shall be 3 feet long by the roll width. The CQA Monitor shall mark the machine direction on the samples with an arrow. The required minimum sampling frequencies are provided in **TABLES 5A** and **5B** .

1.4.3 Test Results
The CQA Monitor shall examine all results from laboratory conformance testing and shall report any non-conformance to the Project Manager.

2.0 INSTALLATION OF GEOMEMBRANE

2.1 Earthwork
2.1.1 Subgrade Preparation
The CQA Monitor shall verify that:

1. A qualified land surveyor has verified all lines and grades;
2. A qualified geotechnical engineer, normally the Soils CQA Consultant, has verified that the supporting soil meets the density specification;
3. The surface to be lined has been rolled and compacted to be free of irregularities, protrusions, loose soil, and abrupt changes in grade;
4. The surface of the supporting soil does not contain stones larger than ½” in diameter and non-angular which may be damaging to the geomembrane; and
5. There is no area excessively softened by high water content.

The Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. The certificate of acceptance shall be given by the Installer to the Project Manager prior to commencement of geomembrane installation in the area under consideration. The CQA Consultant shall be given a copy of this certificate by the Project Manager.

After the supporting soil has been accepted by the Installer, it shall be the Installer's responsibility to indicate to the Project Manager any change in the supporting soil condition that may require repair work. If the Geosynthetics CQA Monitor concurs with the Installer, then the Project Manager shall insure that the supporting soil is repaired.

At any time before and during the geomembrane installation, the Geosynthetics CQA Monitor shall indicate to the Project Manager locations that may not provide adequate support to the geomembrane.

2.1.2 Anchor Trench System

All anchor trench systems will be excavated in accordance with the lines and widths as shown on the contract drawings, before geosynthetics placements. The CQA Consultant shall verify that the anchor trench has been constructed according to design drawings.

If the anchor trench is excavated in a clay liner susceptible to desiccation, no more than the amount of trench required for the geomembrane to be anchored in one day shall be excavated (unless otherwise specified) to minimize desiccation potential of the anchor trench clay soils. The corners of the anchor trench where geosynthetic enters the trench shall be slightly rounded to avoid sharp bends in the geosynthetics. No loose soil shall be allowed to underlie the geomembrane in the anchor trench. No large rocks or clay lumps will be allowed to underlie the geomembrane in the anchor trench.

Backfilling of the anchor trench shall be conducted utilizing suitable backfill materials as deemed appropriate by the CQA Manager. All anchor trenches shall be backfilled in 12” compacted lifts. If a compaction standard is included in the Project Specifications, the anchor trenches shall be tested at a frequency of one test per 100 feet of trench (each lift).

2.2 Geosynthetic Placement

2.2.1 Installation Schedule

Field panels may be installed using any one of the following schedules:

1. All field panels are placed prior to field seaming (in order to protect the subgrade from erosion by rain);
2. Field panels are placed one at a time and each field panel is seamed immediately after its placement (in order to minimize the number of unseamed field panels exposed to wind), and
3. Any combination of the above.

If a decision is reached to place all field panels prior to field seaming, installation normally shall begin at the low point area and proceed toward the low point with "shingle” overlaps to facilitate drainage in the event of precipitation. It is also usually beneficial to proceed in the direction of prevailing winds. Accordingly, an early decision regarding installation scheduling shall be made if, and only if, weather conditions can be predicated with certainty. Otherwise, scheduling decisions must be made during installation, in accordance with varying conditions. In any event, the Installer is fully responsible for the decision made regarding placement procedures.

The CQA Monitor shall evaluate changes in the schedule proposed by the Installer and advise the Project Manager on the acceptability of that change. The CQA Monitor shall verify that the condition of the supporting soil has not changed detrimentally during installation. The CQA Monitor shall record the identification code, location, and date of installation of each field panel.

2.2.2 Field Panel Location and Identification

Field panels are to be located by the CQA Monitor in a manner consistent with the specifications and in a manner best suited to existing site conditions (i.e., a field panel is a roll or a portion of roll cut in the field).

A field panel is the unit area of geomembrane which is to be seamed in the field. Two cases can be considered:

1. If the geomembrane is fabricated into panels in a factory, a field panel is a factory panel or a portion of factory panel cut in the field.
2. If the geomembrane is not fabricated into factory panels, a field panel is a roll or a portion of roll cut in the field.

It shall be the responsibility of the CQA Monitor to insure that each field panel is given an "identification code" (number or letter-number) consistent with the layout plan. The Project Manager, Installer and CQA Monitor shall agree upon this identification code. This field panel identification code shall be as simple and logical as possible. (Note that roll numbers established in the manufacturing plant must be traceable to the field panel identification code.)

The CQA Consultant shall establish documentation showing correspondence between roll numbers, factory panels, and field panel identification codes. The Field panel identification code shall be used for all quality assurance records. The CQA Consultant shall verify that field panels are installed at the location indicated in the Designer's layout plan, as approved or modified.

2.2.3 Weather Conditions

Geomembrane placement shall not proceed at an ambient temperature below 5°C (40°F) unless otherwise authorized. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponding water, or in the presence of excessive winds.

The CQA Monitor shall verify that the above conditions are fulfilled. Additionally, the CQA Consultant shall verify that the supporting soil has not been damaged by weather conditions. The Geosynthetics CQA Monitor shall inform the Project Manager if the above conditions are not fulfilled.

2.2.4 Method of Placement

The Geosynthetics CQA Monitor shall verify the following:

1. Construction equipment used to deploy geomembranes shall not create excessive rutting in the subgrade;
2. If the substratum is a geosynthetic material, deployment may be by hand, by use of small jack lifts on pneumatic tires having low ground contact pressure, or by use of all-terrain vehicles (ATVs) having low ground contact pressure;
3. Any equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons or other means;
4. The prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;
5. Any geosynthetic elements immediately underlying the geomembrane are clean and free of debris;
6. All personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane;
7. The method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;
8. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);
9. Adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continuous loading, e.g., adjacent sand bags, is recommended along edges of panels to minimize risk of wind flow under the panels);
10. Direct contact with the geomembrane is minimized; i.e., the Geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected;
11. No bridging or stressed conditions in the material; and
12. Pipes or other objects that penetrate the liner are connected to the liner material in a way that prevents leakage and unnecessary stresses.

The Geosynthetics CQA Monitor shall inform the Project Manager if the above conditions are not fulfilled.

2.2.5 Damage
The Geosynthetics CQA Monitor shall inspect each panel, after placement and prior to seaming, for damage. The Geosynthetics CQA Manager shall advise the Project Manager which panels, or portions of panels, shall be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected shall be marked and their removal from the work area recorded by the Geosynthetics CQA Consultant. Repairs shall be made according to procedures described in Section 2.4.

2.3 Seaming and Joining
2.3.1 Seam Layout
The Installer shall provide the Project Manager and the Geosynthetics CQA Monitor with a seam layout drawing, i.e., a drawing of the facility to be lined showing all expected seams. The Geosynthetics CQA Monitor shall review the seam layout drawing and verify that it is consistent with accepted industry practice. No panels may be seamed in the field without the Project Manager's approval. In addition, no panels not specifically shown on the seam layout drawing may be used without the Project Manager's prior approval.

Seams will be made by overlapping sheets approximately three inches (3”) for extrusion welding and approximately four inches (4”) for hot wedge welding. In general, seams shall be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope, In corners and odd shaped geometric locations, the number of seams shall be minimized. No horizontal seam shall be less than 5 feet from the toe of the slope, or areas of potential stress concentrations, unless otherwise authorized.

A seam numbering system compatible with the panel numbering system shall be agreed upon at the Resolution and/or Pre-Construction Meeting.

2.3.2 Requirements of Personnel
All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests. At least one seamer shall have experience seaming a minimum of 5,000,000 ft^2 of polyethylene geomembrane using the same type of seaming apparatus to be used to fabricate the site-specific geomembrane. The most experienced seamer, the "master seamer", shall provide direct supervision over less experienced seamers.

The Installer shall provide the Project Manager and the Geosynthetics CQA Consultant with a list of proposed seaming personnel and their experience records. The Project Manager and the Geosynthetic CQA Monitor shall review this document.

2.3.3 Seaming Equipment and Products

The approved processes for field seaming are extrusion welding and hot wedge (fusion) welding. Proposed alternate processes will be documented and submitted to the owner or his representative for approval. The hot wedge welding system is generally the primary system for geomembrane installation and the extrusion welding system is utilized for repairs and detail work. Only apparatus, which have been specifically approved by make and model, shall be used. The Project Manager and the Geosynthetics CQA Monitor shall approve all seaming processes and apparatus.

The Installer will verify the following general conditions during the seaming of the liner:

1. Equipment used for seaming is not likely to damage the geomembrane;
2. The electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
3. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
4. The geomembrane is protected from damage in heavily trafficked areas.

2.3.3.1 Hot Wedge Welding/Fusion System

The hot wedge welding apparatus (typically called a fusion welder) is self-propelled and produces a double seam with an enclosed air channel for testing. The fusion welding consists of placing two heated wedge mounted self-propelled unit, between two overlapped sheets of polyethylene liner. The heated plate heats and fuses the two sheets together. The fusion welder must meet the following requirements:

1. A temperature readout device that continuously monitors the temperature of the wedge;
2. For cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to welding;
3. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
4. The geomembrane is protected from damage in heavily trafficked areas.

2.3.3.2 Extrusion (Fillet) Welding System

The extrusion-welding apparatus shall be equipped with gauges giving the extrudate temperature in the apparatus and at the nozzle. The Installer shall provide documentation regarding the extrudate to the Project Manager and the Geosynthetics CQA Monitor, and shall certify that the extrudate is compatible with the specifications, and in any event is comprised of the same resin as the geomembrane sheeting.

The Geosynthetics CQA Monitor and the Installer shall log apparatus temperatures, extrudate temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals. The Geosynthetics CQA Monitor shall verify that the extruder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel. The welder also must be equipped with gauges giving the temperature in the apparatus and the preheat temperature at the nozzle.

2.3.4 Seam Preparation

The Installer shall insure that:

1. Before seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
2. If seam overlap grinding is required, the process is completed according to the Geomembrane Manufacturer's instructions, within one hour of the seaming operation and in a way that does not damage the geomembrane; and
3. Seams are aligned with the fewest possible number of wrinkles and "fish mouths".

2.3.5 Seaming in Various Weather Conditions

The high temperature limit for welding is based on two factors:

1. The well-being of the crew. Black lining material will get very hot when exposed to sunlight. It is possible that the elevated sheet temperature in conjunction with immoderate ambient conditions could place the well-being of the crew at risk. (It is the responsibility of the Installer to determine if their crew can work in the weather conditions at the site).
2. Material capability.

The highest temperature at which the material can be welded is dependent upon ambient temperature, wind, subgrade conditions exposure to light, material type, and material thickness.

Thinner materials and low density products are the most difficult to seam at high liner temperatures. The problem typically is characterized by frequent burnouts (places in the liner weld where the rollers lose traction and the machine stops moving causing the wedge to burn through the liner). The number of burnouts can often be reduced by adjusting the speed or the temperature at which the welder is operating. If the Installer determines the sheet temperature has reached a temperature in which to large a number of burnouts occurs they can stop welding until favorable conditions return.

The lowest allowable temperature at which welding may be permitted is dependent on ambient temperature, wind, subgrade conditions exposure to light, material type, and material thickness.

Typically during cold weather it is necessary to reduce the welders speed and increase the temperature. Pre-heating the liner in advance of the welding apparatus may also be done by using a hot air blower.

At low temperatures, special attention must be made to the pre-weld destructive samples (trial welds). In cold conditions trial welds shall be performed under the same conditions that will be seen during actual seaming conditions. The lowest temperature at which welding may occur is at the temperature which consistent passing trial seams can be performed under actual seaming conditions. In order to obtain passing results, it may be necessary to preheat the sheet in advance and/or shield the sheets from the wind. This is allowable as long as it is done during the actual welding of the liner.

The normally required weather conditions for seaming are as follows:

1. Unless authorized in writing by the Project Manager, no seaming shall be attempted at an ambient temperature below 5°C (40°F) or above 40°C (104°F);
2. In all cases, the geomembrane shall be dry and protected from wind.

If the Installer wishes to use methods which may allow seaming at ambient temperature below 5 °C (40°F) or above 40°C (104°F), the Installer shall demonstrate and certify that such methods produce seams which are entirely equivalent to seams produced at ambient temperatures above 5°C (40°F), and that the overall quality of the geomembrane is not adversely affected. In addition, an addendum to the contract between the Owner and the Installer is required which specifically states that the seaming procedure does not cause any physical or chemical modification to the geomembrane that will generate any short or long term damage to the geomembrane. Then, the temperatures in the above quality assurance procedure shall be modified accordingly.

The Geosynthetics CQA Monitor shall verify that these weather conditions are fulfilled and will advise the Project Manager if they are not. The Project Manager shall then decide if the installation shall be stopped or postponed.

2.3.6 Trial Seams

Trial seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period, and at least once each five hours, for each seaming apparatus used that day. In addition, each seamer shall make at least one trial seam each day. Trial seams shall be made under the same conditions as actual seams.

An extrusion welded trial seam sample shall be at least 3 feet long by 1 foot wide (after seaming) with the seam centered lengthwise. Fusion welded trial seam samples shall be at least 15 feet long by 1 foot wide (after seaming) with the seam centered lengthwise.

Ten adjoining specimens, each 1 inch wide, shall be cut from the trial seam sample by the Installer. Three specimens shall be tested for shear strength and three shall be tested for peel using a gauged tensiometer. If a specimen fails to meet the seam requirement set forth in the Project Specifications, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial seams achieved.

The CQA Monitor shall observe all trial seam procedures. The remainder of the successful trial seam sample shall be assigned a number and marked accordingly by the CQA Monitor, who shall also log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. At the discretion of the CQA Consultant, samples of trial seams may be submitted to the Geosynthetics Laboratory for analysis.

After completion of the above described tests, the remaining portion of the trial seam sample can be discarded. Alternatively, if agreed upon between the parties involved and documented by the CQA Monitor in his daily report, the remaining portion of the trial seam sample can be subjected to destructive testing. If a trial seam sample fails a test conducted by the Geosynthetics Installer, then a destructive test seam sample shall be taken from each of the seams completed by the seamer during the shift related to the considered trial seam. These samples shall be forwarded to the Geosynthetics Laboratory and, if they fail the tests, the procedure indicated in Section 2.3.9.5 shall apply. The conditions of this paragraph shall be considered fulfilled for a given seam if a destructive seam test sample has previously been taken.

2.3.7 Seaming Procedures

Unless otherwise specified, the general seaming procedure used by the Installer shall be as follows:

1. For fusion welding, a movable protective layer of plastic may be required to be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded;
2. The rolls of the membrane will be overlapped wide enough to weld and test properly; this is usually 3” for extrusion welding and 4” for fusion welding;
3. Fish mouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fish mouths or wrinkles shall be seamed and any position where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches beyond the cut in all directions;
4. If seaming operations are carried out at night, adequate illumination shall be provided at the Contractor's expense; and

5. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

The CQA Monitor shall verify that the above seaming procedures are followed, and shall inform the Project Manager if they are not.

2.3.8 Non-Destructive Testing

The Installer shall non-destructively test all field seams over their full length using a vacuum test unit or air pressure test (for double fusion seams only), or other approved method. The purpose of nondestructive tests is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

The CQA Monitor shall:

1. Observe all continuity testing;
2. Record location, date, test unit number, name of tester, and outcome of all testing;
3. Inform the Installer and Project Manager of any required repairs;
4. Observe the repair and re-testing of the repair;
5. Mark on the geomembrane that the repair has been made; and
6. Document the results.

The seam number, date of observation, name of tester, and outcome of the test or observation shall be recorded by the CQA Monitor.

2.3.8.1 Vacuum Testing

The equipment shall be comprised of the following:

1. A vacuum pump that is fuel or electric powered and capable of sustaining the required vacuum for the test;
2. A vacuum gauge capable of registering to 10 psi (70 kPa) in increments of ¾ psi (5 kPa);
3. A foaming solution shall be pre-mixed with water at a ratio to form bubbles. It shall be dispensed by spray, brush, or other means. The solution shall be compatible with the geomembrane;
4. A vacuum chamber shall have an open bottom and a clear viewing panel on top. It shall be an appropriate size and shape, made of rigid materials, and equipped with a vacuum gauge, valve, and soft pliable gasket around the periphery of the open bottom.

The following procedures shall be followed:

1. The area to be tested shall be clean and free of soil or foreign objects to promote a good seal;
2. Energize the vacuum pump;
3. Wet the seam and surrounding area approximately twice the width and length of the vacuum chamber with a foamy solution;
4. Place the vacuum chamber over the test area such that the gasket is in complete contact with the geomembrane;
5. Apply a force to the top of the vacuum chamber to obtain a seal and open the vacuum valve;
6. Ensure a leak tight seal is created. A minimum vacuum of 4 to 8 psi (28 to 55 kPa) registered on the gauge shall be appropriate;
7. With the force applied, observe the geomembrane seam through the viewing port for bubbles through any defects in the seam. The vacuum shall hold for a duration not less than 10 seconds;
8. If bubbles appear on the geomembrane seam, open the valve to release the vacuum and remove the chamber from the seam. The defective area shall be marked for repair;
9. If no bubble appears after 10 seconds, open the valve to release the vacuum and remove the vacuum chamber from the seam.
10. Move the vacuum chamber to the adjoining portion of the seam or test area overlapping the previously tested area by no less than 10% of the chamber length or at least 2"(50mm), whichever is greater and repeat the procedure for the entire seam.
11. All areas where soap bubbles appear shall be marked and repaired in accordance with Section 2.4.

2.3.8.2 Air Pressure Testing (Fusion Welded Seams)
The following procedures are applicable to those processes that produce a double seam with an enclosed space. The equipment shall be comprised of the following:

1. An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure of 50 psi and mounted on a cushion to protect the geomembrane;
2. A rubber hose with fittings and connections;
3. A sharp hollow needle, or other approved pressure feed device;
4. A knife capable of cutting the liner material; and
5. A pressure gauge capable of indicating air pressure in 1 psi within the test range.

The following procedures shall be followed:

1. Seal both ends of the seam to be tested;
2. Insert needle or other approved pressure feed device into the tunnel created by the fusion weld;
3. insert a protective cushion between the air pump and the geomembrane;
4. Energize the air pump to a pressure of 35 psi plus or minus 1%, close valve, and sustain pressure for at least 5 minutes;
5. Cut opposite end of tested seam after completion of the 5-minute pressure hold period to verify complete testing of the seam. If the pressure gauge does not indicate a release of pressure, locate blockage of the air channel and retest until entire seam is tested; and
6. Remove needle or other approved pressure feed device and seal.

2.3.9 Destructive Testing
Destructive testing provides direct evaluation of seam strength and bonding efficiency which indicates seam strength and durability. Destructive seam tests shall be performed at selected locations. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

Destructive testing involves two techniques (1) shear testing and (2) peel testing. Shear testing applies a tensile stress from the top of the sheet through the weld and into the bottom sheet. Peel testing, on the other hand, peels the top sheet back against the overlapped edge of the bottom of the sheet in order to observe how separation occurs. The peel test indicates whether the sheets are continuously and homogeneously connected through the seam.

2.3.9.1 Location and Frequency

The Geosynthetics CQA Monitor shall select locations where seam samples will be cut out for laboratory testing. Those locations shall be established as follows:

- A minimum frequency of one test location per 500 feet of seam length as indicated in **TABLES 5A** and **5B**. This minimum frequency is to be determined as an average taken throughout the entire facility;
- A maximum frequency shall be agreed upon by the Installer, Project Manager and Geosynthetics CQA Monitor at the Resolution and/or Pre-Construction Meeting; and
- Test locations shall be determined during seaming at the Geosynthetics CQA Manager's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The Installer shall not be informed in advance of the locations where the seam samples will be taken.

Note: For either test, sample failure shall be a Film Tear Bond (FTB) as outlined in NSF 54, Appendix A.

2.3.9.2 Sampling Procedure

Samples shall be cut by the Installer as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The CQA Monitor shall:

1. Observe sample cutting;
2. Assign a number to each sample, and mark it accordingly;
3. Record sample location on layout drawing; and
4. Record reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described in Section 2.4. The continuity of the new seams in the repaired area shall be tested according to Section 2.3.8.1. At a given sampling location, two types of samples shall be taken by the Installer.

First, two samples for field testing shall be taken. Each of these samples shall be 1 inch wide by 12 inch long, with the seam centered parallel to the width. The distance between these two samples shall be 42 inches. If both samples pass the field test described in Section 2.3.9.3, a sample for laboratory testing shall be taken. The sample for laboratory testing shall be located between the two samples for field testing. The sample for laboratory testing shall be 12 inches wide by 42 inches long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

1. One portion to the Installer for laboratory testing, (12 in. x 12 in.);
2. One portion for Geosynthetics CQC Firm testing, (12 in. x 18 in.); and
3. One portion to the Owner for archive storage, (12 in. x 12 in.).

Final determination of the sample sizes shall be made at the Pre-Construction Meeting.

2.3.9.3 Field Testing
The ten, 1-inch wide strips mentioned in Section 2.3.9.2 shall be tested in the field, by gauged tensiometer, for peel and shear respectively and shall not fail in the seam in addition to meeting the requirements outlined in the specifications. If any field test sample fails to pass, then the procedures outlined in Section 2.3.9.5 shall be followed.

The CQA Monitor shall witness all field tests and mark all samples and portions with their number. The CQA Monitor shall also log the date and time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail description.

2.3.9.4 Laboratory Testing
Destructive test samples shall be packaged and shipped, if necessary, under the responsibility of the CQA Monitor in a manner which will not damage the test sample. The Project Manager will verify that packing and shipping conditions are acceptable. The Project Manager will be responsible for storing the archive samples. This procedure shall be fully outlined at the Resolution Meeting. Test samples shall be tested by the Geosynthetics CQC Firm. The Geosynthetics CQA Consultant shall select the Geosynthetics CQC Firm, with the concurrence of the Project Manager.

Testing shall include "Bonded Seam Strength and Peel Adhesion". At least 5 specimens shall be tested for each test method. Specimens shall be selected alternately be test from the samples (i.e., peel, shear, peel, shear...). A passing test shall meet the minimum required values in at least 4 out of 5 specimens.

The Geosynthetics CQC Firm shall provide test results no more than 24 hours after they receive the samples. The Geosynthetics CQA Manager shall review laboratory test results as soon as they become available, and make appropriate recommendations to the Project Manager.

The Installer's laboratory test results shall be presented to the Project Manager and the CQA Monitor for comments.

2.3.9.5 Procedures for Destructive Test Failure

The following procedure shall apply whenever a sample fails a destructive test, whether the Geosynthetics CQC Firm, the Installer's laboratory, or the gauged tensiometer conducted that test.

1. The Installer shall trace the welding path to an intermediate location at 10 feet minimum from the point of the failed test in each direction and take a small sample for an additional field test at each location. If these additional samples pass the test, then full laboratory samples are taken. If these laboratory samples pass the tests, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam shall be reconstructed.

All acceptable seams must be bonded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 feet of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing. Repairs shall be made in accordance with Section 2.4. The CQA Monitor shall document all actions taken in conjunction with destructive test failures.

2.4 Defects and Repairs

2.4.1 Identification

All seams and non-seam areas of the geomembrane shall be examined by the CQA Monitor for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination or foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be broomed or washed by the Installer if the amount of dust or mud inhibits examination.

2.4.2 Evaluation

Each suspect location both in seam and non-seam areas shall be non-destructively tested using the methods described in Section 2.3.8.1 as appropriate. Each location that fails the non-destructive testing shall be marked by the CQA Monitor and repaired by the Installer. Work shall not proceed with any materials which will cover locations which have been repaired until laboratory test results with passing values are available.

2.4.3 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the Project Manager, Installer, and CQA Monitor. The procedures available include:

1. Patching - used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
2. Buffing and re-welding - used to repair small sections of extruded seams;
3. Spot welding or seaming - used to repair small tears, pinholes, or other minor, localized flaws;
4. Capping, used to repair large lengths of failed seams;
5. Removing bad seam and replacing with a strip of new material welded into place (used with large lengths of fusion seams); and
6. Welding of the flap, used to make a new extrusion weld adjacent to an unsatisfactory fusion weld (this procedure may be used only if the flap created by the overlap of the top and bottom panels beyond the fusion weld has not been cut back to the outer edge of the fusion weld).

In addition, the following provisions shall be satisfied:

1. Surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair;
2. All surfaces must be clean and dry at the time of the repair;
3. All seaming equipment used in repairing procedures must be approved;
4. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Project Manager, Geosynthetics Construction Quality Assurance Manager, and Installer; and
5. Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.

2.4.4 Repairs - Non-destructive Testing

Each repair shall be non-destructively tested using the methods described in Section 2.3.8.1 as appropriate. Repairs, which pass the non-destructive test, shall be taken as an indication of an adequate repair. Failed test indicate that the repair must be redone and retested until a passing result is obtained.

2.5 Backfilling of Anchor Trench

The anchor trench, if any, shall be adequately drained, to prevent ponding or otherwise softening of the adjacent soils while the trench is open. The anchor trench shall be backfilled and compacted by the Earthwork Contractor of the Installer, as outlined in the specifications and/or bid documents. Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The Geosynthetics and/or Soils CQA Monitor shall observe the backfilling operation and advise the Project Manager of any problems.

Since backfilling the anchor trench can affect material bridging at the toe of the slope, consideration shall be given to backfilling the liner at its most contracted state, preferably during the cool of the morning or extended period of overcast skies.

2.6 Lining System Acceptance

The Installer and the Manufacturers shall retain all ownership and responsibility for the geosynthetics in the lining system until acceptance by the Owner. The geosynthetic lining system shall be accepted by the Owner when:

- The installation of all materials are deployed an welded;
- Verification of the adequacy of all seams and repairs, including associated testing, is complete;
- All documentation of installation is completed including the Geosynthetics CQA Consultant's final report; and
- The Project Manager has received certification, including “as built” drawing, sealed by a registered professional engineer.

The Geosynthetics CQA Monitor shall certify that installation has proceeded in accordance with the Geosynthetics CQA Plan for the project except as noted to the Project Manager.

2.7 Materials in Contact with the Geomembrane

The quality assurance procedures indicated in this section are only intended to assure that the installation of these materials does not damage the geomembrane. Additional quality assurance procedures would be necessary to assure that systems built with these materials would be constructed in such a way to enable proper performance.

2.7.1 Soils

The Project Manager shall give a copy of the specifications, prepared by the Designer for placement of soils, to the Geosynthetics CQA Consultant. The Geosynthetics CQA Consultant shall verify that these specifications are consistent with current industry practices.

2.7.2 Concrete

The Project Manager shall give a copy of the specifications, prepared by the Design Engineer for placement of concrete, to the Geosynthetics CQA Monitor. The Geosynthetics CQA Monitor shall verify that these specifications are consistent with the state of the art, including the use of geosynthetic layers between concrete and geomembrane. The Geosynthetics CQA Consultant shall verify the geosynthetic layers are placed between the concrete and the geomembrane according to design specifications. He will also verify that construction methods used are not likely to damage the geomembrane.

2.7.3 Sumps and Appurtenances

The Project Manager shall give a copy of the specifications, prepared by the Design Engineer for sumps and appurtenances, to the Geosynthetics CQA Monitor. The Geosynthetics CQA Monitor shall review these specifications and verify the use of geosynthetic layers between concrete and geomembranes.

The Geosynthetics CQA Monitor shall verify that:

1. Installation of the geomembrane in sump and appurtenance areas, and connection of geomembrane to sumps and appurtenances have been made according to specifications;
2. Care is taken while welding around appurtenances, since neither non-destructive nor destructive testing may be feasible in these areas;
3. The geomembrane has not been damaged while making connections to sumps and appurtenances; and
4. All sumps are tested for primary and secondary geomembrane integrity by filling them with water and making appropriate observations.

3.0 DOCUMENTATION

3.1 Daily Reports

Each of the Geosynthetics CQA Monitors shall complete a daily report and/or logs on prescribed forms, outlining all of his or her monitoring activities for that day. The areas, panel numbers, seams completed and approved, and measures taken to protect unfinished areas overnight shall be identified. Failed seams or other panel areas requiring remedial action shall be identified with regard to nature of action, required repair, and precise location. Repairs completed shall also be identified. Any problems or concerns with regard to operations on site shall be noted. This report must be completed at the end of each monitor's shift, and submitted to the Geosynthetics CQA Manager daily, if possible, but at least by the end of each week.

The Geosynthetics CQA Manager shall review the daily reports submitted by the Geosynthetics CQA Monitors and incorporate a summary of their reports into his own daily report. Any matters requiring action by the Project Manager shall be highlighted. This report shall be completed daily, summarizing the previous day's activities, and a copy submitted to the Project Manager daily, if possible, but at least within his weekly summary each week.

3.2 Destructive Test Reports

The Geosynthetics CQA Monitor shall collate the destructive test reports from all sources. This includes field tests, Installer's laboratory tests, and Geosynthetics CQC Firm tests. A summary list of test samples pass/fail results shall be prepared by the Geosynthetics CQA Manager on an ongoing basis, and submitted with the periodic progress reports.

3.3 Progress Reports

Progress Reports shall be prepared by the Geosynthetics CQA Manager and submitted to the Owner. This report shall include: an overview of progress to date; an outline of any changes made to the plans, drawing, or specifications; any problems or deficiencies in operations at the site, and an outline of any action taken to remedy the situation(s); a summary of weather conditions; and a brief description of activities anticipated for the next reporting period. All Destructive Test Reports for the period shall be appended to each Progress Report.

3.4 Construction Problem and Solution Data Sheets

Sheets describing special construction situations shall be cross-referenced with specific observation logs and testing data sheets, and must include the following information, where available:

1. An identifying sheet number for cross-referencing and document control;
2. A detailed description of the situation or deficiency;
3. The location and probable cause of the situation or deficiency;
4. How and when the situation or deficiency was found or located;
5. Documentation of the response to the situation or deficiency;
6. Final results of any responses;
7. Any measures taken to prevent a similar situation from occurring in the future; and
8. The signature of the CQA Manager/Monitor and signature indicating concurrence from the Project Manager.

The Project Manager shall be made aware of significant recurring non-conformance with specifications. The Project Manager shall then determine the cause and recommend appropriate changes in procedures or specifications. When this type of evaluation is made, the results shall be documented, and the Owner and Design Engineer shall approve any revision to procedures or specifications.

A Summary of all supporting data sheets, along with final testing results and the CQA Engineer's approval of the work, shall be required upon completion of construction.

3.5 Design and/or Specification Changes

Design and/or specifications changes may be required during construction. In such cases, the CQA Engineer shall notify the Project Manager and Design Engineer. Design and/or specifications changes shall be made only with written agreement of the Project Manager and the Design Engineer, and shall take the form of an addendum to the specifications.

3.6 Record Drawings

Record drawings shall be prepared by the Contractor and approved by the CQA Consultant. A third party independent surveyor shall perform the survey. Record drawings shall include, as a minimum, the following information for geomembranes:

1. The limits of the liner or final cover barrier construction;
2. The top and bottom liner or final cover barrier elevation at 50’ intervals referenced to the site grid coordination system;
3. If a granular drainage blanket is utilized in the design, top of blanket elevation shall be identified at 50’ intervals;
4. The location and elevation of slope breaks, leachate piping, leachate sumps and trenches, berms, and any other features which are material to the disposal area construction;
5. A key map showing the location of the construction in relation to the permitted design, along with an identification of areas previously constructed and areas yet to be constructed;
6. Dimensions of all geomembrane field panels;
7. Location, as closely as possible, of each panel relative to the surveyors plan (furnished by the Owner);
8. Identification of all seams and panels with appropriate number or "identification codes" (see Section 2.2.1);
9. Location of all patched and repairs; and
10. Location of all destructive testing samples.

The Record drawing shall address each layer of geomembrane, and if necessary, another drawing shall identify problems or unusual conditions of the geotextile or geonet layers. In addition, applicable cross-sections shall show layouts of geonets, geotextiles or Geogrids which are unusual or differ from the design drawings.

3.7 Photographic Reporting Data Sheets

Photographic reporting data sheets, where used, shall be cross-referenced with observation and testing data sheet(s) and/or construction problem and solution data sheets(s).

These photographs shall serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain digital color prints; the digital photos will also be stored on appropriate media. These records shall be presented to the Project Manager upon completion of the project and all CQA documentation will be stored in the POR.

3.8 Final Report

A Final Report shall be submitted upon completion of the work. This report shall include all reports prepared by the CQA Consultant personnel, summarize the activities of the project, and document all aspects of the quality assurance program performed. The Final Report shall include as a minimum the following information:

- Personnel involved with the project;
- Scope of work;
- Outline of project;
- Construction quality assurance methods;
- Test results (destructive and non-destructive, including laboratory tests);
- Sealed and signed by a registered professional engineer; and
- Record drawings, sealed and signed by a registered professional engineer.

3.9 Storage of Records

During construction, the Geosynthetics CQA Monitor shall be responsible for submitting the facility Record drawings. The owner/operator, in a manner that will allow for easy access, shall store the document originals. CQA documentation will be submitted to the NMOCD as required and a copy shall be retained in the Facility POR.

SECTION 5
OTHER

1.0 GEOTEXTILES

1.1 Manufacturing

The geotextile manufacturer shall provide the Project Manager with a list of guaranteed "minimum average roll value" (MARV) properties for the type of geotextile to be delivered. The geotextile manufacturer shall also provide the Project Manager with a written quality control certification signed by a responsible party employed by the manufacturer that the materials actually delivered have property "minimum average roll values" which meet or exceed all property values guaranteed for that type of geotextile. The quality control certificates shall include:

1. Roll identification numbers;
2. Sampling procedures; and
3. Results of quality control testing.

The geotextile manufacturer shall provide, as a minimum, test results for the following in accordance with **TABLE 6**:

1. Mass per unit area;
2. Grab strength;
3. Trapezoidal Tear strength;
4. Puncture strength;
5. Apparent opening size (AOS);
6. Thickness; and
7. Permittivity and apparent opening size.

The geotextile manufacturer shall provide a written certification that the nonwoven, needle-punched geotextiles are continuously inspected and found to be needle-free. Quality assurance tests shall be performed in accordance with the test methods specified in **TABLE 6** for every 100,000 ft^2 of geotextile produced for the project.

The CQA Consultant shall examine all manufacturer certifications to insure the following: property values listed on the certifications meet or exceed those specified for the particular type of geotextile; the measurements of properties by the Manufacturer are properly documented; test methods are acceptable; and the certificates have been provided at the specified frequency properly identifying the rolls related to testing. Any deviations shall be reported to the Project Manager.

1.2 Roll Label Requirements

The geotextile manufacturer shall identify all rolls of geotextile with the following:

1. Manufacturer's name
2. Product identification;
3. Lot number;
4. Roll number; and
5. Roll dimensions.

Additionally, if any special handling of the geotextile is required, it shall be so marked on the top surface of the geotextile, e.g., "This Side Up" or "This Side Against Geonet". The CQA Monitor shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

1.3 Shipping, Handling & Storage

During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. To that effect, geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings.

Geotextiles shall not be exposed to precipitation prior to being installed. Wrappings protecting geotextile rolls shall be removed less than one hour prior to unrolling the geotextile. After the wrapping has been removed, a geotextile shall not be exposed to sunlight for more than 15 days, unless otherwise specified and guaranteed by the geotextile manufacturer.

The CQA Consultant shall observe rolls upon delivery at the site and any deviation from the above requirements shall be reported to the Project Manager. Any damaged rolls shall be rejected and replaced at no cost to the Owner.

1.4 Conformance Testing

Upon delivery of the rolls of geotextiles, the CQA Monitor shall insure that samples are removed and forwarded to the Geosynthetics Laboratory for testing to ensure conformance to both the design specifications and the list of guaranteed properties. The material may also be sampled at the manufacturing facility by a third party and forwarded to the Geosynthetic Laboratory. As a minimum, the following tests shall be performed on geotextiles:

1. Mass per unit area;
2. Grab strength;
3. Grab elongation;

4. Puncture strength; and
5. Apparent opening size.

These conformance tests shall be performed in accordance with the test methods specified in the project specifications. Other conformance tests may be required by the specifications. Testing frequency for the geotextiles is presented in **TABLE 6**.

1.4.1 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first three linear feet. Unless otherwise specified, samples shall be 3 feet long by the roll width. The CQA Monitor shall mark the machine direction on the samples with an arrow. Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 100,000 ft^2, whichever is least, as indicated in **TABLE 6** for geotextiles.

1.4.2 Test Results

The CQA Consultant shall examine all results from laboratory conformance testing and shall report any non-conformance to the Project Manager.

1.5 Handling and Placement

The Installer shall handle all geotextiles and geocomposites in such a manner to ensure they are not damaged in any way. The following shall be complied with:

1. On slopes, the geotextile and geocomposites shall be securely anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the geotextile or the geocomposite sheet in tension;
2. In the presence of wind, all geotextiles and geocomposites shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with earth cover material;
3. Geotextiles/Geocomposites shall be cut using an approved geotextile cutter only. If in place, special care must be taken to protect other materials from damage which could be caused by the cutting of the geotextiles/geocomposites; and
4. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile or the geocomposite.

In addition, the following applies to geotextiles only:

1. During placement of geotextiles, care shall be taken not to entrap in the geotextile: stones, excessive dust, or moisture that could generate clogging of drains or filters, or hamper subsequent seaming; and

2. A visual examination of the geotextile shall be carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, such as needles, are present.

1.6 Seams and Overlaps

On slopes steeper than 10 horizontal/1 vertical, all geotextiles shall be continuously sewn (i.e., spot sewing is not allowed). Geotextiles shall be overlapped 0.15m (6 in.) prior to seaming. No horizontal seams shall be allowed on side slopes (i.e., seams shall be along, not across, the slope), except as part of a patch. The Design Engineer must approve other seaming options.

On bottom and slopes flatter than 10/1 (horizontal/vertical), geotextiles can be either seamed as indicated above, or thermally bonded. The Installer and CQA Monitor shall pay particular attention at seams to insure that no earth cover material could be inadvertently inserted beneath the geotextile. Any sewing shall be done using polymeric thread with chemical and ultraviolet resistance properties equal to or exceeding those of the geotextile.

1.7 Defects and Repairs

Any holes or tears in the geotextile shall be repaired as follows:

1. On slopes: A patch made from the same geotextile shall be double seamed into place [with each seam 5 mm to 20 mm (1/4 in. to 3/4 in.) apart and no closer than 25 mm (1 in.) from any edge]. Shall any tear exceed 10% of the width of the roll, that roll shall be removed from the slope and replaced.
2. Non-slopes: A patch made from the same geotextile shall be spot-seamed in place with a minimum of 0.60m (24 in.) overlap in all directions.

Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile. The CQA Consultant shall observe any repair, note any non-compliance with the above requirements and report them to the Project Manager.

1.8 Placement of Soil Materials

The Installer shall place all soil materials located on top of a geotextile or geocomposite, in such a manner as to insure:

1. No damage of the geotextile or geocomposite;
2. Minimal slippage of the geotextile or geocomposite on underlying layers; and
3. No excess tensile stresses in the geotextile.

Unless otherwise specified by the Designer, all lifts of soil material shall be in conformance with the guidelines in **TABLE 1**.

Any non-compliance shall be noted by the CQA Consultant and reported to the Project Manager. If portions of the geotextile or the geocomposite are exposed, the CQA Consultant shall periodically place two (or more, at his discretion) marks on the geotextile or the geocomposite 3 m (10 ft.) apart along the slope and measure the elongation of the geotextile or the geocomposite during the placement of soil. The Designer shall relate this elongation to the tensile stress in the geotextile or the geocomposite.

2.0 GEONETS AND GEOCOMPOSITES

2.1 Manufacturing

The geonet, unless otherwise specified, shall be made from the same type of resins used to manufacture HDPE geomembranes. The raw material will consist of polyethylene resin, heat stabilizers, and anti-oxidant additives.

The geonet and geocomposite manufacturer shall provide the Project Manager with a list of guaranteed "minimum average roll value" properties for the type of geonet and/or geocomposite to be delivered. The manufacturer shall also provide the Project Manager with a written quality control certification signed by a responsible party employed by the manufacturer that the materials actually delivered have property "minimum average roll values" which meet or exceed all property values guaranteed for that type of geonet. The quality control certificates shall include:

1. Roll identification numbers;
2. Resin batch numbers;
3. Nominal thickness;
4. Sampling procedures; and
5. Results of quality control testing:
   - Polymer specific gravity;
   - Mass per unit area; and
   - Thickness.

These conformance tests shall be performed in accordance with the test methods specified in the project specifications. Other conformance tests may be required by the project specifications.

The manufacturer shall provide the origin, identification, and production date of the resin and quality control certificates for the resin used in the manufacture of the geonets and/or geocomposite. Quality assurance tests shall be performed in accordance with the test methods specified in **TABLE 6** for every 100,000 ft^2 of geonet and/or geocomposite produced for the project.

The CQA Consultant shall examine all manufacturer's certifications to insure the following: property values listed on the certifications meet or exceed those specified; the measurements of properties by the manufacturer are properly documented; test methods are acceptable; and the certificates have been provided at the specified frequency properly identifying the rolls related to testing. Any deviations shall be reported to the Project Manager.

2.2 Roll Label Requirements

The manufacturer shall identify all rolls of geonets and/or geocomposite with the following:

1. Manufacturer's name;
2. Product identification;
3. Lot number;
4. Roll number; and
5. Roll dimensions.

The CQA Monitor shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Project Manager.

2.3 Shipping, Handling, and Storage

Protecting the geonet and/or geocomposite for cleanliness is important to ensure proper drainage characteristics are maintained. The CQA Consultant shall verify that geocomposite and/or geonet rolls are wrapped in polyethylene sheets or otherwise protected against dust and dirt during shipping and storage. The wrapping shall be removed just prior to the deployment of the rolls. The CQA Consultant shall verify that geonets and/or geocomposite are free of dirt and dust just before installation. The CQA Consultant shall report the outcome of this verification to the Project Manager. If the geonets and/or geocomposite are judged dirty, they shall be cleaned by the Installer prior to installation.

2.4 Conformance Testing

2.4.1 Testing Requirements

Upon delivery of the rolls of geonets, the CQA Consultant shall take conformance samples of the geonet and/or geocomposite, to ensure conformance to both the design specifications and the list of guaranteed properties. The material may also be sampled at the manufacturing facility by a third party and forwarded to the Geosynthetic Laboratory. The tests presented in **TABLE 6** shall be performed on the geonet and/or geocomposite.

2.4.2 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first three linear feet. Unless otherwise specified, samples shall be 3 ft wide by the roll width.

2.4.3 Test Results

The CQA Monitor shall examine all results from laboratory conformance testing and shall report any non-conformance to the Project Manager. Any lots not meeting conformance testing specifications will result in the rejection of the lot.

2.5 Installation of the Geonet

2.5.1 Handling and Placement

The Installer shall take steps necessary to insure that any underlying layers are not damaged during the placement of the geonet and/or geocomposite. These steps shall include but are not limited to the following conditions:

1. During placement of geonets and/or geocomposite, care shall be taken not to entrap in the geonet, dirt or excessive dust that could cause clogging of the drainage system. If dirt or excessive dust is entrapped in the geonet, it shall be hosed clean prior the placement of the next material on top of it. In this regard, care shall be taken with the handling of sandbags, to prevent rupture or damage of the sandbag;
2. Geonets and/or geocomposite shall only be cut using scissors or curved blade (hook blade) utility knife that will not damage underlying geosynthetics;
3. On slopes, the geonets and/or geocomposite shall be secured in the anchor trench and then rolled down the slope in such a manner as to continually keep the geonet sheet in tension. If necessary, the geonet and/or geocomposite shall be positioned by hand after being unrolled to minimize wrinkles. Geonets and geocomposites can be placed in the horizontal direction (i.e., across the slope) in some special locations (e.g., at the toe of a slope, if an extra layer is required, this extra layer can be placed in the horizontal direction). The Designer shall identify such locations in the design drawings. Designers shall note that placement of layers at 90 degree angles to each other will result in a partial loss of effective thickness and transmissivity; and
4. In the presence of wind, all geonets and/or geocomposite shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with cover material.

The CQA Monitor will note any deficiencies or non-compliance and report it to the Project Manager.

2.5.2 Stacking Geonets/Geocomposites

When several layers of geonets and/or geocomposite are stacked, care shall be taken to prevent strands from one layer from penetrating the channels of the next layer, thereby significantly reducing the transmissivity. This cannot happen if stacked in the same direction. A stacked geonet shall never be laid in perpendicular directions to the underlying geonet (unless otherwise specified by the Designer). In the corners of side slopes of rectangular landfills, adjacent overlapping geonets are usually perpendicular and special precautions shall be taken as discussed below. The CQA Monitor shall note any non-compliance and report it to the Project Manager.

2.5.3 Joining and Splicing

Adjacent geonets and/or geocomposite shall be joined according to construction drawings and specifications. As a minimum, the following requirements shall be met:

1. Geonets may be butt-joined or lapped if specified;
2. Nylon/plastic cable ties will be applied to the net edge at five feet intervals along the edge; and
3. End splices will be made as follows:
   - On slopes, the ends will overlap two feet with the uphill panel on top with two rows of cable ties applied; and
   - In flat areas, the end will be overlapped a minimum of two inches and one row of cable ties applied.

The CQA Monitor shall note any non-compliance and report it to the Project Manager.

2.5.4 Defects and Repairs

If the geonet and/or geocomposite are damaged, it can be repaired by the following methods at the discretion of the CQA Monitor. Holes and tears in the geonet shall be repaired by placing a patch extending 2 feet beyond edges of the hole or tear. The patch shall be secured to the original geonet by spot welding or tying every 6 inches. Tying devices shall be as indicated in Section 2.5.3. If the hole or tear width across the roll is more the 50% the width of the roll, the damaged area shall be cut out and the two portions of the geonet shall be joined as indicated in Section 2.5.3.

The CQA Monitor shall observe any repair, note any non-compliance with the above requirements and report them to the Project Manager.

3.0 OTHER PROJECT CONSTRUCTION

The CQA Consultant shall be responsible for reviewing, verifying and testing all aspects of the Construction Project. The Scope of the CQA Consultant's responsibilities shall include the review and quality control testing of all road installations, concrete structure installations, and other construction addressed in the Contractor's Project Specifications, but not discussed in this CQA Plan. Performance Criteria, and Quality Control Testing frequencies for construction not associated with the landfill footprint is addressed in applicable sections of the Project Specifications.

Quality Assurance for incidental Items – Quality assurance procedures for other materials deployed in the construction, such as geotextiles, geonets, granular drainage blankets, etc., shall also be included in the QA plans. There above requirements are only intended to act as minimum values and will not relieve the facility of the burden to prepare a project specific quality assurance plan.

TABLES

Table 1
Minimum Protective Soil Thickness

Equipment Ground Pressure (psi)	Minimum Lift Thickness (in.)
<= 5	12
5 - 8	18
8 - 16	24
>16	36

Table 1 is based off of EPA technical guidance document from "Quality Assurance and Quality Control for Waste Containment Facilities", EPA/600/R-93/182, dated September 1993, page 167, Table 3.7. Although this Facility is also incorporating a geocomposite to protect the geomembrane, this guidance should be followed during construction and operation.

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TABLE 2
Pre-construction & Construction Intermediate and Final Cover Materials

Pre-Construction Testing			
Test	**Method(1)**	**Testing Frequency**	**Min. Requirements**
Cover Material			
Standard Proctor	ASTM D698	1 test per source	Not Applicable
Atterberg Limits	ASTM D4318	1 test per source	P.I. >10
Moisture	ASTM D2216	1 test per source	0 to 10% above optimum moisture
Permeability	ASTM D5084	1 test per 6,500 CY of material to be placed	Not Applicable
Construction Testing			
Cover Material			
In-Place Field Density/Moisture	ASTM D6938	3 test per acre per cover placed	95% and 0% to 10% of OMC(2)
Standard Proctor	ASTM D698	1 test per 5,000 yd^3 or change of material or borrow area.	Not Applicable
Moisture	ASTM D2216	1 test per 1,000 yd^3 or change of material or borrow area.	0 to 10% above optimum moisture
Atterberg Limits	ASTM D4318	1 test per 1,000 yd^3 or change of material or borrow area.	P.I. >10
Permeability	ASTM D5084	1 test per lift per acre	To maintain average permeability determined duing preconstruction testing.

1. Test to be performed according to the latest test method as approved by the certifying engineer.

2. Optimum Moisture Content as determined by ASTM D 698 in Pre-Construction testing

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TABLE 3
Pre-constrution and Construction Testing of Subgrade, Protective Cover Material, & Gravel

Test	Method(1)	Testing Frequency	Min. Requirements
Pre-Construction Testing			
Subgrade Material			
USCS Classification	ASTM D 2487	Once Per Source	Report
Atterberg Limits	ASTM D 4318	Once per 20,000 yd^3 or Source Change	Report
Gradation (3" thru # 200 sieve)	ASTM D 422	Same as above	Report
Standard Proctor	ASTM D 698	Same as above	Not Applicable
Protective Cover Material			
Gradation	ASTM D 422	Once per Source	Report
Permeability (3)	ASTM D 2434	Once Per Source	1.0×10^{-2} cm/sec or greater
USCS Classification	ASTM D 2487	Once Per Source	GW, GP, SW, SP, SM
Calcium Carbonate	ASTM D 4373	Once Per Source	15% (max)
Collection System Gravel			
Gradation	ASTM D 422	Once per Source	Minimum 90% larger than pipe perforations (typically 3/4 inch sieve)
Calcium Carbonate	ASTM D 4373	Once Per Source	15% (max)
USCS Classification	ASTM D 2487	Once Per Source	GW or GP
Permeability (3)	ASTM D 2434	Once Per Source	1.0×10^{-2} cm/sec or greater
Construction Testing			
Subgrade and Clay Berm Material			
Recompacted (5)	ASTM D 6938/3017	12 tests per acre per lift	90% compaction (2)
Protective Cover Material			
Gradation (4)	ASTM D 422	1 test per 3,000 yd^3	Report
Permeability (3)	ASTM D 2434	Once Per Source	1.0×10^{-2} cm/sec or greater
USCS Classification	ASTM D 2487	1 test per 3,000 yd^3	GW, GP, SW, SP, SM
Collection System Gravel			
Gradation	ASTM D 422	1 test per 1,500 yd^3	Minimum 90% larger than pipe perforations (typically 3/4 inch sieve)
Calcium Carbonate	ASTM D 4373	Once Per Source	15% (max)
USCS Classification	ASTM D 2487	1 test per 1,500 yd^3	GW, GP
Permeability (3)	ASTM D 2434	Once Per Source	1.0×10^{-2} cm/sec or greater

1. Test to be performed according to the latest test method as approved by the certifying engineer.
2. Optimum Moisture Content as determined by ASTM D 698 in Pre-Construction testing
3. Permeability testing not required on final cover protective soil.
4. Minimum 90% larger than the pipe perforations (Normally 3/4 inch).
5. No subgrade testing required unless material is over-excavated.

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TABLE 4
Geosynthetic Clay Liner Specifications

Test	Method(1)	Testing Frequency	Units	Min. Requirements
Manufacturer's Quality Control				
Reinforced				
Bentonite Swell Index[2]	ASTM D 5890	1 per 100,000 lbs	mL/g	≥ 24 / 2 (min)
Bentonite Fluid Loss[2]	ASTM D 5891	1 per 100,000 lbs	mL	≤ 18 (max)
Bentonite Mass per Area[3]	ASTM D 5993	40,000 ft^2	lb/ft^2	≥ 0.75 (min)
GCL Grab Strength[4]	ASTM D 4632 ASTM D 6768	200,000 ft^2	lbs/in	≥ 30 MARV
GCL Peel Strength[4]	ASTM D 6496	40,000 ft^2	lbs/in	≥ 3.5 MARV
GCL Index Flux[5]	ASTM D 5887	30,000 $yd.^2$	$m^3/m^2/s$	≤ 1×10^{-8} (max)
GCL Permeability[5]	ASTM D 5887	30,000 yd.2	cm/sec	≤ 5×10^{-9} (max)
GCL Hydrated Internal Shear Strength[6]	ASTM D 5321 ASTM D 6243	Periodic (6)	psf	≥ 500 typical @ 200 psf (min)
Conformance Testing by CQA Engineer				
Bentonite Mass per Area[3]	ASTM D 5993	100,000 ft^2	lb/ft^2	0.75 (min)
GCL Grab Strength[4]	ASTM D 4632 ASTM D 6768	100,000 ft^2	lbs/in	≥ 30 MARV
GCL Peel Strength[4]	ASTM D 4632/6496	100,000 ft^2	lbs/in	≥ 3.5/NA MARV
GCL Permeability[5]	ASTM D 5887	100,000 ft^2	cm/sec	5×10^{-9} (max)

1. Test to be performed according to the latest test method as approved by the certifying engineer. Test methods that have been superceded by updated or different methods that are then accepted as industry standard will be replaced by the updated standards.

2. These parameters are for the bentonite incorporated into the GCL and do not necessarily reflect the properties of the bentonite in the finished product.

3. Bentonite mass per area is exclusive of the average weight of the geotextiles and is normalized to 0 percent moisture content per ASTM D 5993.

4. All tensile testing is performed in the machine direction, with results as minimum average roll values unless otherwise indicated.

5. Index flux and permeability testing with deaired distilled/deionized water at 80 psi cell pressure, 77 psi headwater pressure and 75 psi tail water pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5 x 10-9 cm/sec for typical GCL thickness. This flux value should not be used for equivalency calculations unless gradient used represent field conditions. A flux test using gradients that represent field conditions must be performed to determine equivalency. The last 20 weekly values prior to end of the production date of the supplied GCL may be provided.

6. ASTM D5321-08 (geosynthetics) or D 6243 (GCLs) internal direct shear performed on GCL sample hydrated under 200 psf normal load and then sheared at 0.2 in./min. max for Procedure A and 0.04 in/min for Procedure B. Use wet conditions as per ASTM D5321. The testing is required prior to construction of the first E&PW Cell.

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TABLE 5A
60 mil HDPE Textured MQC Specifications

Resin Manufacturer (1)			
Test	**Method(2)**	**Testing Frequency**	**Min. Requirements (5)**
Density	ASTM D 1505 ASTM 792, Meth B	200,000 lb and per batch	$\geq$ 0.932 g/cm^3
Melt Flow Index	ASTM D 1238 (190°C/2.16 kg)	200,000 lb and per batch	≤ 1.0 g / 10 min.
Manufacturer's Quality Control			
Thickness, nominal	ASTM D 5994	Each Roll	60 mil
Thickness, Min. ave	ASTM D 5994	Each Roll	57 mil
Thickness, lowest indiv. For 8 of 10 spec.	ASTM D 5994	Each Roll	54 mil
Thickness, lowest indiv. For 1 of 10 spec.	ASTM D 5994	Each Roll	51 mil
Asperity Height (Min. ave.) [3]	GRI GM13 ASTM D 7466	Each Roll	16 mil
Density	ASTM D 1505	Per 200,000 lb.	0.94 g/cm^3
Carbon Black Dispersion [4]	ASTM D 5596	Per 45,000 lb	Category 1 or 2
Carbon Black Content [6]	ASTM D 1603 ASTM D 4218	Per 20,000 lb	2 to 3 %
Tensile Properties:			
Break Strength Elongation Yield Strength Elongation	ASTM D 6693 Type IV Dumbbell, 2 ipm G.L. = 2.0 inches	Per 20,000 lb	 90 lb/in 100% 126 lb/in 12%
Tear Resistance	ASTM D 1004	Per 45,000 lb	42 lb
Puncture Resistance	ASTM D 4833	Per 45,000 lb	90 lb
Oxidation Induction Time (OIT)			
Standard OIT	ASTM D 3895	200,000 lb and per batch	100 min
High Pressure OIT	ASTM D 5885		400 min
Oven Aging @ 85^{0}C			
Standard OIT	ASTM D 3895	Per each formulation	55%
High Pressure OIT	ASTM D 5885		80%
UV Resistance			
High Pressure OIT	ASTM D 5885	Per each formulation	50%

1. The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material. No post consumer resin (PCR) of any type shall be added to the formulation.

2. Test to be performed according to the latest test method as approved by the certifying engineer. Test methods that have been superceded by updated or different methods that are then accepted as industry standard will be replaced by the updated standards.

3. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane.

4. Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.

5. If 60-mil HDPE smooth is used, it must meet GRI-GM13 standards. Use of smooth geomembrane instead of textured geomembrane must be approved by the certifying engineer.

6. Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

TABLE 5B
60 mil HDPE Textured Conformance & Field Testing Specifications

Test	Method(1)	Testing Frequency	Min. Requirements
Conformance Testing by CQA Engineer			
Thickness, nominal	ASTM D 5994	1 per 100,000 sf	60 mil
Thickness, Min. ave	ASTM D 5994		57 mil
Thickness, lowest indiv. For 8 of 10 spec.	ASTM D 5994		54 mil
Thickness, lowest indiv. For 1 of 10 spec.	ASTM D 5994		51 mil
Asperity Height (Min. ave.)	GRI GM13 ASTM D 7466	1 per 100,000 sf	16 mil
Density	ASTM D 1505	1 per 100,000 sf	0.94 g/cm^3
Carbon Black Dispersion [2]	ASTM D 5596	1 per 100,000 sf	A-1, A-2 or B-1 rating
Carbon Black Content [3]	ASTM D 1603	1 per 100,000 sf	2 to 3 %
Tensile Properties:			
Break Strength Elongation Yield Strength Elongation	ASTM D 6693 Type IV Dumbbell, 2 ipm G.L. = 2.0 inches	1 per 100,000 sf	 90 lb/in 100% 126 lb/in 12%
Tear Resistance	ASTM D 1004	1 per 100,000 sf	42 lb
Trial Seams			
Shear	ASTM D 6392 GRI GM 19	Every 5 (five) hours of seaming.	Shear 120 ppi
Peel Fusion[4]			Peel 91 ppi
Peel Extrusion[4]			Peel 78 ppi
Destructive Seam Testing			
Shear	ASTM D 6392 GRI GM 19	1 per 500 linear feet (LF) of seam	Shear 120 ppi
Peel Fusion[4]			Peel 91 ppi
Peel Extrusion[4]			Peel 78 ppi
Shear Elongation at break	GRI GM19	1 per 500 linear feet (LF) of seam	
Fusion [4]			50%
Extrusion [4]			50%
Peel Separation	GRI GM19	1 per 500 linear feet (LF) of seam	
Fusion			25%
Extrusion			25%
Non-destructive Seam Field Testing			
Air Pressure	GRI GM6	Dual track fusion weld seams	Min 30 psi, held for 5 minutes; losing < 4 psi; puncture opposite end after test to check for continuity
Vacuum	ASTM D 4437	Extrusion Seams	4 to 8 psi held for ≥ 10 sec.

1. Test to be performed according to the latest test method as approved by the certifying engineer. Test methods that have been superceded by updated or different methods that are then accepted as industry standard will be replaced by the updated standards.

2. Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.

3. Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

4. Four (4) out of five (5) specimens must meet the requirements. The 5th specimen can be as low as 80% of the listed values. For peel adhesion, seam separation shall not extend more than 25 percent in the same interface. Testing shall be discontinued when the sample has visually yielded a sample. Elongation measurements should be omitted for field testing.

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TABLE 6
Geonet, Geotextile, & Geocomposite MQC & Conformance Testing Specifications

Manufacturer's Quality Control			
Geonet			
Test	**Method (1)**	**Testing Frequency**	**Min. Requirements**
Thickness	ASTM D5199	1/50,000 sf	200±20 mil
Density	ASTM D1505	1/50,000 sf	0.94 g/cm^3
Tensile Strength (2)	ASTM D5035	1/50,000 sf	45 lb/in
Transmissivity (3)	ASTM D4716	1/540,000 sf	2.0 x 10^{-3} m^2/s
Carbon Black Content	ASTM D1603[3]/4218	1/50,000 sf	2%
Geotextile			
Mass per Unit Area	ASTM D 5261	1/90,000 sf	≥8 oz/sq. yd.
Grab Tensile	ASTM D 4632	1/90,000 sf	220 lbs.
Grab Elongation	ASTM D 4632	1/90,000 sf	50%
Trapezoid Tear Strength	ASTM D 4533	1/90,000 sf	90 lbs.
Puncture Strength	ASTM D 4833/6241	1/90,000 sf	120/575 lbs.
Permittivity, T	ASTM D 4491	1/540,000 sf	1.26 Sec^{-1}
AOS (largest opening size)	ASTM D 4751	1/540,000 sf	80 Sieve Size
Geocomposite			
Ply Adhesion	ASTM D 7005	1/50,000 sf	1.0 lb./in (MARV)
Transmissivity (3)	ASTM D 4716	1/540,000 sf	1.0 x 10^{-4} m^2/s
Conformance Testing by CQA Engineer			
Geonet			
Test	**Method**	**Testing Frequency**	**Min. Requirements**
Thickness	ASTM D5199	1/100,000 sf	200±20 mil
Density	ASTM D1505	1/100,000 sf	0.94 g/cm^3
Tensile Strength (1)	ASTM D5035	1/100,000 sf	45 lb/in
Transmissivity (4)	ASTM D4716	1/100,000 sf	2.0 x 10^{-3} m^2/s
Carbon Black Content	ASTM D1603/4218	1/100,000 sf	2%
Geotextile			
Mass per Unit Area	ASTM D 5261	1/100,000 sf	≥8 oz/sq. yd.
Grab Tensile	ASTM D 4632	1/100,000 sf	220 lbs.
Grab Elongation	ASTM D 4632	1/100,000 sf	50%
Puncture Strength	ASTM D 4833/6241	1/100,000 sf	120/575 lbs.
AOS (largest opening size)	ASTM D 4751	1/100,000 sf	80 Sieve Size
Geocomposite			
Ply Adhesion	ASTM D 7005	1/100,000 sf	1.0 lb./in (MARV)
Transmissivity (4)	ASTM D 4716	1/100,000 sf	1.0 x 10^{-4} m^2/s

1. Test to be performed according to the latest test method as approved by the certifying engineer. Test methods that have been superceded by updated or different methods that are then accepted as industry standard will be replaced by the updated standards.

2. Machine Direction

3. Measured using water @ 20^o C with a gradient of one, between two steel plates, after 15 minutes. Confining pressure 10,000 psf.

4. Transmissivity conformance testing only required on the geonet when the geonet and geotextile are installed separately. If a geocomposite is used, then the transmissivity testing will be performed on the geocomposite material.

EXHIBIT A
DEFINITIONS

SOIL RELATED TERMS

Aggregate - any combination of sand, gravel and crushed stone in their natural or processed state.

Atterberg limits - The liquid limit, plastic limit, and shrinkage limit for soil. The water content where the soil behavior changes from liquid to the plastic state is the liquid limit; from plastic to semisolid state is plastic limit; and from the semisolid to the solid state is the shrinkage limit.

Backfill - Soil material placed back into an area that has been excavated, such as against structures, in anchor trenches and in pipe trenches

Borrow - Soil material obtained from an off-site source for the clay liner, leachate collection layer, daily cover, or other construction projects.

Clays - Very small soil particles having a crystalline (layer structure, created as the result of the chemical alteration of primary rock minerals. Since the clay particles are very small, the air voids are very small and the flow of water through the soil material is very slow.

Coarse Aggregate - is generally considered to be a crushed stone or gravel almost all of which is retained on a No. 4 sieve.

Compaction - The process of increasing the density or unit weight of a soil by rolling, tamping, vibrating, or other mechanical means.

Density - The mass per unit volume.

Fine Aggregate - is considered to be any aggregate material that will pass a 3/8 in. sieve and essentially all of which will pass a No. 4 sieve and is predominately retained on a No. 4 sieve.

Liquid Limit - The water content where the soil behavior changes from liquid to the plastic state.

Hydraulic Conductivity - the property that reflects the ability of a material to conduct a fluid or vapor through a porous media such as soil or geotextiles.

In situ - Refers to soil when it is at its natural location in the earth and in its natural condition

Permeability - A generic term for the property that reflects the ability of a material to conduct a fluid or vapor through a porous media such as soil or geotextiles. Properly called *hydraulic conductivity*.

Plastic Limit - The water content where the soil behavior changes from plastic to semisolid state.

Plasticity - Term applied to fine-grained soils (particularly clays) to indicate the soils' (plus included waster's) ability to flow or be remolded without raveling or breaking apart.

Sand - The category of coarse-grained soil whose particles size range between about 0.07 mm and 5 mm in diameter.

Silt - The category of fine-grained soil particles whose mineralogical composition remains similar to the rock they were derived from.

Shrinkage Limit - The water content where the soil behavior changes from the semisolid to the solid state.

Sump - Small excavation or pit provided in the floor of a structure, or in the earth, to serve as a collection basin for surface water and leachate.

Water content - The ratio of the quantity of water in a soil (by weight) to the weight of the soil solid (dry soil), typically expressed as a percentage.

GEOTEXTILE AND GEOTEXTILE-RELATED* TERMS

Actinic degradation - The strength of fibers and fabrics due to exposure to sunlight or an accelerated weathering light source.

Arching - The formation of soil particles upstream of a geotextile where the particles arch (or bridge) over the fabrics' voids.

Basis weight* - A deprecated term for *mass per unit area*.

Blinding - The condition in which soil particles block the voids at the surface of a geotextile, thereby reducing the hydraulic conductivity of the geotextile.

Blocking - A synonym for *blinding.*

Bonding - The process of combining fibers, filaments, or films into sheets, webs, or bats by means of mechanical, thermal, or chemical binding.

Clogging - The movement by mechanical action or hydraulic flow of soil particles into the voids of a fabric and retention therein, thereby reducing the hydraulic conductivity of a geotextile.

Composite - *See* Fabric, composite.

Cross-plane - The direction of a geosynthetic which is perpendicular to the plane of its manufactured direction. Referred to in hydraulic situations.

Deformation - The change in length of a geosynthetic under load from its original manufactured dimensions.

Denier - The weight in grams of 9000 m of yarn.

Density* - The mass per unit volume.

Direction, cross-machine - The direction perpendicular to the long, machine, or manufactured direction (synonyms: *woven geotextiles, weft direction*).

Direction, machine - In textiles, the direction in a machine-made fabric parallel to the direction of movement the fabric followed in the manufacturing process (synonym: *lengthwise,* or *long direction*, and for woven geotextiles, *wrap direction*).

Downstream - The direction of the opposite side of a geotextile from which liquid is moving.

Elongation - The increase in length produced in the gage length of the test specimen by a tensile load.

Elongation at break - The elongation corresponding to the maximum load.

Elongation, percent - For geosynthetics, the increase in length of a specimen expressed as a percentage of the original gage length (i.e., engineering strain).

Fabric - Term used interchangeably with geotextile, particularly after placement in the manner described in this book.

Fabric, composite - A textile structure produced by combining nonwoven, woven, or knit manufacturing methods.

Fabric, knit - A textile structure produced by interlooping one or more ends of yarn or comparable material.

Fabric, nonwoven - For geotextiles, a planar and essentially random textile structure produced by bonding, interlocking of fibers or both, accomplished by mechanical, chemical, thermal, or solvent means and combinations thereof.

Fabric, woven - A planar textile structure produced by interlacing two or more sets of elements, such as yarns, fibers, rovings, or filaments, where the elements pass each other, usually at right angles, and one set of elements are parallel to the fabric axis.

Filament yarn - The yarn made from continuous filament fibers.

Fill - A deprecated term for *filling*.

Filing - The yarn running from selvedge to selvedge at right angles to the wrap in a woven fabric.

Filling Direction - *See* Direction, cross-machine. *Note*: For use with woven fabrics only.

Filter cake - The soil structure developed upstream of a geotextile by separating the suspended soil from liquid as the mixture attempts to pass through a soil fabric system.

Filter cloth - A deprecated term for *geotextile*.

Geocell - A three-dimensional structure filled with soil, thereby forming a mattress for increased stability when used with loose or compressible subsoils.

Geocomposite - A manufactured material using geotextiles, geogrids, geonets, and/or geomembranes in laminated or composite form.

Geogrid - A deformed or nondeformed gridlike polymeric material formed by intersecting ribs joined at the junctions used for reinforcement with foundations, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project structure or system.

Geomembrane - An essentially impermeable membrane used a s liquid or vapor barrier with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project, structure, or system.

Geonet - A netlike polymeric material formed form intersecting ribs integrally joined at the junctions used for drainage with foundation, soil, rock, earth, or any other geotechnical-related material as an integral part of a human-made project, structure, or system.

Geopipe - Any plastic pipe used with foundation, soil, rock, earth, or any other subsurface related material as an integral part of a human-made project, structure, or system.

Geosynthetic clay liner (GCL) - Factory-manufactured hydraulic barriers consisting of a layer of bentonite clay or other very low permeability material supported by geotextiles and/or geomembranes, and mechanically held together by needling, stitching, or chemical adhesives.

Geosynthetics - The generic term for all synthetic materials used in geotechnical engineering applications; it includes geotextiles, geogrids, geonets, geomembranes, and geocomposites.

Geotechnical engineering* - The engineering application of geotechnics.

Geotechnics* The application of scientific methods and engineering principles to the acquisition, interpretation, and use of knowledge of materials of the earth's crust to the solution of engineering problems, it embraces the filed of soil mechanics, rock mechanics, and many of the engineering aspects of geology, geophysics, hydrology, and related sciences.

Geotextile* - Any permeable textile used with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project, structure, or system.

Gradient - The degree of slope or a rate of change of a parameter measured over distance.
Heat bonded Thermally bonded by melting the fibers to form weld points.

Hydrophilic - A material's attraction to water.

Hydrophobic - A material's repulsion of water.

In-plane - The direction of a geosynthetic that is parallel to its long, manufactured, or machine direction. Referred to in hydraulic situations.

Knit - *See* Fabric, knit.

Mass per unit area - The proper term to represent and compare to the amount of material per unit area (units are oz./yd^2 or g/m^2). Often incorrectly called "weight" or "basis weight."

Melt bounded - *See* Heat bonded.

Modulus of elasticity - The initial linear portion of the stress-versus-strain test of a geosynthetic during its evaluation in a tensile strength test (units are lb./in.^{2}, kPa, lb./in., or kN/m).

Needle-punched - Mechanically bonded by needling with barbed needles.

Nonwoven - *See* Fabric, nonwoven.

Normal direction* - For geotextiles, the direction perpendicular to the plane of a geotextile.

Permeability - A generic term for the property that reflects the ability of a material to conduct a fluid or vapor through a porous media such as soil or geotextiles. Properly called *hydraulic conductivity*.

Permittivity - For a geotextile, the volumetric flow rate of water per unit cross-section area, per unit head, under laminar flow conditions, in the normal direction through the fabric.

pH - A measure of the acidity or alkalinity of a material, liquid, or solid. pH is represented on a scale of 0 to 14; 7 represents a neutral state; 0 represents the most acid, and 14 the most alkaline.

Resin bonded - The joining of fibers at their intersection points by resin in the formation of a nonwoven geotextile or geocomposites.

Siphoning - The transferring of a liquid to a lower level over an intermediate higher elevation than both of the endpoints, which can be achieved by saturated geotextiles in planar flow.

Staple - Short fibers in the range 0.5 to 3.0 in. (1 cm to 8 cm) long.

Staple yarn - Yarn made from staple fibers.

Tenacity - The fiber strength on a grams per denier basis.

Tex - Denier multiplied by 9 and is the weight in grams of 1000 m of yarn.

Transmissivity - For a geotextile, the volumetric flow rate per unit thickness under laminar flow conditions, within the in-plane direction of the fabric.

Transverse direction - A deprecated term for *cross-machine direction*.

Ultraviolet degradation - The breakdown of polymeric structure when exposed to natural light.

Upstream - The direction from which flowing liquid approaches a filter or drain.

Voids - The open spaces in a geosynthetic material through which flow can occur.

Wrap - The yarn running the length of the fabric in the machine direction when manufacturing woven fabrics.

Wrap direction - *See* Direction, machine. *Note*: For use with woven fabrics only.

Water table - (1) The upper limit of the part of the soil or underlying rock material that is wholly saturated with water. (2) The upper surface of the zone of saturation in ground water in which the hydrostatic pressure is equal to atmospheric pressure.

Weft - The cross-machine direction when manufacturing woven geotextiles.

Width - For a geotextile, the cross-direction edge-to-edge measurement of a fabric in a relaxed condition on a flat surface.

Woof - A deprecated term for *cross-machine direction*.

Woven - *See* Fabric, woven.

Woven, monofilament - The woven fabric produced with monofilament yarns.

Woven, multifilament - The woven fabric produced with multifilament yarns.

Woven, slit-film - The woven fabric produced with yarns produced from slit film.

Yarn* - A generic term for continuous strands of textile fibers or filaments in a form suitable for knitting, weaving, or otherwise intertwining to form a textile fabric. *Yarn* may refer to (1) a number of fibers twisted together, (2) a number of filaments laid together without twist (a zero-twist yarn), (3) a number of filaments laid together with more or less twist, or (4) a single filament with or without twist (a monofilament).

** Those items marked by an asterisk (*) are from ASTM's Committee D35 on Geotextiles Tentative Terminology Standard.*

GEOMEMBRANE AND GEOMEMBRANE-RELATED* TERMS

Adhesion - The state in which two surfaces are held together by interfacial forces which may consist of molecular forces or interlocking action or both. Measured in shear and peel modes.

Air lance - A device used to test, in the field, the integrity of field seams in plastic sheeting, It consists of a wand or tube through which compressed air is blown.

Alloys, polymeric - A blend of two or more polymers (e.g., a rubber and plastic) to improve a given property (e.g., impact strength).

Antioxidants - Primary types include phenols and amines that scavenge extraneous free radicals. Secondary types decompose peroxides as a source of free radicals.

Berm - The upper edge of an excavation on which the ends of a geomembrane are buried to hold it in place or to anchor the material.

Blocking - Unintentional adhesion usually occurring during storage or shopping between plastic films or between a film and another surface.

Bodied solvent adhesive - An adhesive consisting of a solution of the geomembrane compound used in the seaming of geomembranes.

Boot - A bellows-type covering to exclude dust, dirt, moisture, etc., from a geomembrane protrusion.

Breaking factor - Tensile strength at break in force per unit of width. Expressed in Newtons per meter or pounds per inch.

Calender - A machine equipped with three or more heavy internally heated or cooled rolls, revolving in opposite directions. Used for preparation of continuous sheeting or plying up of polymer compounds and frictioning or coating of fabric with rubber or plastic compounds.

Catalysts - Used in the polymerization process to make plastics. Generally they do not become part of the polymers. Typical examples are metal oxides (to make polyolefins) and the Ziegler-Natta systems containing aluminum allklys and transition metal salts.

Chlorosulfonated polyethylene (CSPE) - Family of polymers that is produced y polyethylene reacting with chlorine and sulfur dioxide. Present CSPEs contain 25 to 43% chlorine and 1.0 to 1.4% sulfur. They are used in both vulcanized and nonvulcanized forms. Most membranes based on CSPE are nonvulcanized. (ASTM designation for this polymer is CSM.)

Coated fabric - Fabric that has been impregnated and/or coated with a rubbery or plastic material in the form of a solution, dispersion, hot melt, or powder. The term also applies to materials resulting from the application of a performed film to a fabric by means of calendering.

Creep - The slow change in length or thickness of a material under prolonged stress.

Cross-linking - A general term referring to the formation of chemical bonds between polymeric chains to yield an insoluble, three-dimensional polymeric structure. Cross-linking of rubbers is vulcanization. *See also* Vulcanization.

Curing - *See* Vulcanization.

Denier - A unit used in the textile industry to indicate the fineness of continuous filaments. Fineness in deniers equals the mass in grams of 9000-m length of the filament.

Dielectric seaming - *See* Heat seaming.

Elasticity - The property of matter by virtue of which it tends to return to its original size and shape after removal of the stress that caused the deformation.

Elastomer - *See* Rubber.

EPDM - A synthetic elastomer based on ethylene, propylene, and a small amount of a nonconjugated diene to provide sites for vulcanization.

EVA - A family of copolymers of ethylene and vinyl acetate used for adhesives and thermoplastic modifiers. They posses a wide range of melt indexes.

Extruder - A machine with a driver screw for continuous forming of polymeric compounds by forcing through a die; regularly used to manufacture geomembranes.

Fabric reinforcement - A fabric, scrim, and so on, used to add structural strength to a two-ply (or more) polymeric sheet. Such sheeting is referred to as *supported*.

Fill - As used in textile technology refers to the threads or yarns in a fabric running at right angles to the wrap. Also called *filler threads*.

Film - Sheeting having norminal thickness not greater than 10 mils.

Heat seaming - The process of joining two or more thermoplastic geomembranes by heating areas in contact with each other to the temperature at which fusion occurs. The process is usually aided by a controlled pressure (synonym: *heat fusion*).

Hot wedge - Common method of heat seaming of thermoplastic geomembranes by a fusing process wherein heat is delivered by a hot wedge passing between the opposing surfaces to be bonded.

Lapped seam - A seam made by placing one surface to be joined partly over another surface and bonding the overlapping portions.

Leachate - Liquid that has percolated through or drained from solid waste or other human-emplaced materials and contains soluble, partially soluble, or miscible components removed from such waste.

Leno fabric - An open fabric in which two warp yarns wrap around each fill yarn to prevent the warp or fill yarns from sliding over each other.

Liner - A layer of emplaced materials beneath a surface impoundment or landfill which serves to restrict the escape of waste or its constituents from the impoundment or landfill [*Fed. Regist.*].

Membrane - A continuous sheet of material, whether prefabricated as a flexible polymeric sheeting or sprayed or coated in the field, such as a sprayed-on asphalt (synonym: *geomembrane*).

Modulus - The stress on deforming a material to a given strain value (e.g., E_{50} and E_{100}).

Modulus of elasticity - The ratio of stress to strain within the elastic range, also known as Young's modulus [ASTM].

Nylon - Generic name for a family of polyamide polymers characterized by the presence of the amide group, $CONH_2$. Used as a scrim in fabric-reinforced geomembranes.

Plastic - A material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and at some stage in its manufacture or processing into finished articles can be shaped by flow.

Plasticizer - A plasticizer is a material, frequently solvent-like, incorporated in a plastic or a rubber to increase its ease of workability, its flexibility, or distensibility. Adding the plasticizer may lower the melt viscosity, the temperature of the second-order transition, or the elastic modules of the polymer. Plasticizer may be monomer liquids (phthalate esters), low-molecular-weight liquid polymers (polyesters), or rubbery high polymers (EVA). The most important use of plasticizers is with PVC geomembranes, where the choice of plasticizer will dictate under what conditions the liner may be used.

Polyester fiber - Generic name for a manufactured fiber in which the fiber-forming substance is any long-chain synthetic polymer composed of an ester of a dihydric alcohol and terephthalic acid. Scrims made of polyester fibers are used for fabric reinforcement.

Polyethylene - A polyolefins formed by bulk polymerization (for low density) or solution polymerization (for high density) where the ethylene monomer is placed in a reactor under high pressure and temperature. The oxygen produces free radicals which initiate the chain polymerization. For solution polymerization the monomer is first dissolved in an inert solvent. Catalysts are sometime required to initiate the reaction.

Polymer - A macromolecular material formed by the chemical combination of monomers having either the same or different chemical composition. Plastics, rubbers, and textile fibers are all high-molecular-weight polymers.

Polymeric liner - Plastic or rubber sheeting used to line disposal sites, pits, pounds, lagoons, canals, and so on.

Polyolefin - A family of polymeric materials that includes polypropylene and polyethylene, the former being very common in geotextiles, the latter in geomembranes. Many variations of each exist.

Polyvinyl chloride (PVC) - A synthetic thermoplastic polymer prepared from vinylchloride, PVC can be compounded into flexible and rigid forms through the use of plasticizers, stabilizers, fillers, and other modifiers; rigid forms used in pipes and well screens; flexible forms used in manufacture of geomembranes.

Puncture resistance - Extent to which a material is able to withstand the action of a sharp object without perforation.

Quality assurance (QA) - A planned system of activities whose purpose it to provide a continuing evaluation of the quality control program, initiating corrective action were necessary. It is applicable to both the manufactured product and its field installation.

Quality control (QC) - Actions that provide a means of controlling and measuring the characteristics of (both) the manufactured and the field installed product.

Roll goods - A general term applied[lied to rubber and plastic sheeting, whether fabric reinforced or not. It is usually furnished in rolls.

Rubber - A polymeric material which, at room temperature, is capable of recovering substantially in shape and size after removal of a deforming force. Refers to both synthetic and natural rubber. Also called an *elastomer*.

Scrim - A woven, open-mesh reinforcing fabric made from continuous-filament yarn, that is, a high-percent--open-area geotextile. Used in the reinforcement of some geomembranes.

Seam strength - Strength of a seam of geomembrane material measured either in shear or peel modes. Strength of the seam is reported either in absolute units (e.g., pounds per inch of width) or as percent of the strength of the sheet.

Sheeting - A form of plastic or rubber in which the thickness is very small in proportion to length and width and in which the polymer compound is present as a continuous phase throughout, with or without fabric (synonym: *geomembrane*).

Slope - Deviation of a surface from the horizontal expressed as a percentage, by a ration, or in degrees, In engineering, usually expressed as a percentage of vertical to horizontal change [EPA].

Spread coating - A manufacturing process whereby a polymeric material is spread in a continuous fashion on a fabric substrate thereby forming a reinforced geomembrane composite.

Strikethrough - A term used in the manufacture of fabric-reinforced polymeric sheeting to indicate that two layers of polymer have made bonding contact through the scrim.

Support sheeting - *See* Fabric reinforcement.

Surface cure - Curing or vulcanization that occurs in a thin layer on the surface of a manufactured polymeric sheet or other items.

Tear strength - The maximum force required to tear a specified specimen, the force acting substantially parallel to the major axis of the test specimen. Measured in both initiated and uninitiated modes. Obtained value is dependent on specimen geometry, rate of extension, and type of fabric reinforcement. Values are reported in force (e.g., pounds) of force per unit of thickness (e.g., pounds per inch).

Tensile strength - The maximum force required to cause tension failure in a given test specimen. The obtained value is dependent on specimen geometry, rate of extrusion and property of material.. Values are reported in maximum stress (e.g., pounds per square inch) or force per unit thickness (e.g., pound per inch width).

Thermoplastic elastomers - New materials that are being developed and that are probably related to elasticized polyolefins. Polymers of this type behave similarly to cross-linked rubber. They have a limited upper-temperature service range which, however, is substantially above the temperature encountered in waste disposal sites (200°F may be too high for some TPEs).

Thread count - The number of threads per inch in each direction with the warp mentioned first and the fill second. A thread count of 20 X 10 means 20 threads per inch in the warp and 10 threads per inch in the fill direction.

Ultimate elongation - The elongation of a stretched specimen at the time of break. Usually reported as percent of the original length. Also called *elongation at break* (synonym: *engineering strain at failure*).

Unsupported sheeting - A polymeric sheeting consisting of one or more plies without a reinforcing-fabric layer or scrim.

Vacuum box - A device used to asses the integrity of field seams in geomembrane installations.

Vulcanize - Used to denote the product of the vulcanization of a rubber compound without reference to shape or form.

Vulcanization - An irreversible process during which a rubber compound, through a change in its chemical structure (cross-linking), becomes less plastic and more resistant to swelling by organic liquids, and during which elastic properties are conferred, improved, or extended over a greater range of temperature.

Warp - In textiles, the lengthwise yarns in a woven fabric.

Water vapor transmission (WVT) - Water vapor flow normal to two parallel surfaces of a material, through a unit area, under the conditions of a specified test such as ASTM E96.

** Many of these terms are from Lining of Waste Impoundment and Disposal Facilities, by Matrecon, Inc., for U.S. EPA Municipal Environmental Research Laboratory, Cincinnati, OH, R. Landreth, Project Officer, 1984, EPA/SW870, March 1983, G.P.O. No. 055-000-00231-2.*

Appendix K

Permit Design Drawings

K-1 North Ranch Surface Waste Management Facility Design Drawings

Appendix K-1

North Ranch Surface Waste Management Facility Design Drawings

PERMIT APPLICATION DRAWINGS FOR

NGL WASTE SERVICES, LLC
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

SEPTEMBER 2019
PROJECT NO. 35187378

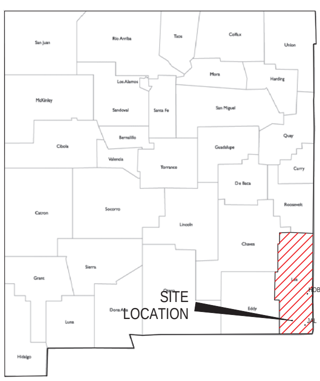
PROFESSIONAL ENGINEER'S CERTIFICATION

"I CERTIFY TO THE BEST OF MY PROFESSIONAL JUDGMENT THAT THIS DRAWING SET PROPERLY ADHERE TO ESTABLISHED, SOUND ENGINEERING PRACTICES. THIS CERTIFICATION IS CONTINGENT ON THE FACT THAT ALL INFORMATION SUPPLIED TO THE SIGNATORY AUTHORITY, UP TO THE DATE OF THIS CERTIFICATION, IS UNQUESTIONABLY ACCURATE AND WAS PROVIDED IN GOOD FAITH."

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

PREPARED FOR:

NGL WASTE SERVICES, LLC
3773 CHERRY CREEK DR # 1000
DENVER, COLORADO 80209
(303) 815-1010



VICINITY MAP
N.T.S.

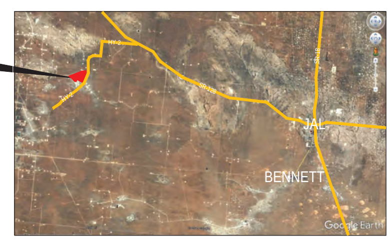
Know what's below. Call before you dig.

PREPARED BY:

Terracon
Consulting Engineers and Scientists

25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

SITE
LOCATION



SITE LOCATION MAP
SCALE: N.T.S.

INDEX OF DRAWINGS

DRAWING NO.	TITLE
--	COVER SHEET
--	INDEX SHEET
1.	EXISTING CONDITIONS
2.	SITE DEVELOPMENT
3.	EXISTING DRAINAGE
4.	FINAL DRAINAGE
5.	SITE EXCAVATION (CUT) PLAN
6.	CELL E-1 & E-2 PLAN VIEW
7.	CELL E-1 & E-2 SECTION VIEW
8.	CELL E-3 & E-4 PLAN VIEW
9.	CELL E-3 & E-4 SECTION VIEW
10.	CELL E-5 & E-6 PLAN VIEW
11.	CELL E-5 & E-6 SECTION VIEW
12.	CELL W-1 & W-2 PLAN VIEW
13.	CELL W-1 & W-2 SECTION VIEW
14.	CELL W-3 & W-4 PLAN VIEW
15.	CELL W-3 & W-4 SECTION VIEW
16.	CELL W-5 CELL PLAN VIEW
17.	CELL W-5 SECTION VIEW
18.	PIGGY BACK PLAN VIEW
19.	PIGGY BACK SECTION VIEW
20.	TOP OF PROTECTIVE COVER
21.	INTERMEDIATE TOP OF WASTE
22.	FINAL TOP OF WASTE
23.	FINAL COVER SYSTEM GRADE
24.	FINAL COVER SYSTEM GRADE SECTION VIEW
25.	LINER AND FINAL COVER DETAILS
26.	ANCHOR TRENCH DETAILS
27.	FINAL COVER STORMWATER STRUCTURE DETAILS
28.	BASE LINER TIE IN AND TECHNICAL DETAILS
29.	LEACHATE COLLECTION AND SUMP DETAILS
30.	MISCELLANEOUS LINER DETAILS
31.	MISCELLANEOUS INFRASTRUCTURE DETAILS
32.	MISCELLANEOUS INFRASTRUCTURE DETAILS
33.	DRYING PAD PLAN VIEW
34.	DRYING PAD DETAIL AND CROSS-SECTION
35.	TRUCK WASH PLAN VIEW
36.	TRUCK WASH CROSS-SECTION (1 OF 2)
37.	TRUCK WASH CROSS-SECTION (2 OF 2)
38.	LEACHATE POND CROSS-SECTIONS
39.	LEACHATE POND DETAILS

TYPICAL ABBREVIATIONS

DIA	DIAMETER
ELEV	ELEVATION
FT	FEET
HDPE	HIGH DENSITY POLYETHYLENE
HORZ	HORIZONTAL
ID	INSIDE DIAMETER
IN	INCHES
INV	INVERT
MAX	MAXIMUM
MIN	MINIMUM
MSL	MEAN SEA LEVEL
NTS	NOT TO SCALE
OD	OUTSIDE DIAMETER
PL	PROPERTY LINE
SDR	STANDARD DIMENSION RATIO
TYP	TYPICAL
VERT	VERTICAL

CONTACT INFORMATION

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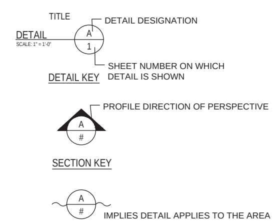
SANTA FE, NM 87505
PHONE: (505) 476-3440
FAX: (505) 476-3462

GENERAL NOTES

1. EXISTING FACILITIES AND FEATURES ARE SHOWN LIGHT-LINED AND/OR SCREENED. NEW FACILITIES AND FEATURES ARE SHOWN SOLID AND HEAVY-LINED.
2. SLOPES AND GRADES ARE IN UNITS OF FT(H):FT(V), UNLESS OTHERWISE NOTED.
3. THESE DRAWINGS WERE PREPARED IN ACCORDANCE WITH APPLICABLE STATE NEW MEXICO OIL CONVERSATION DIVISION REGULATIONS AND NEW MEXICO ADMINISTRATIVE CODE, TITLE 19, CHAPTER 15, PART 36.
4. THESE DRAWINGS ARE ONLY PART OF AND SUPPLEMENTAL TO THE PERMIT MODIFICATION APPLICATION.

SECTION/DETAIL KEY



MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

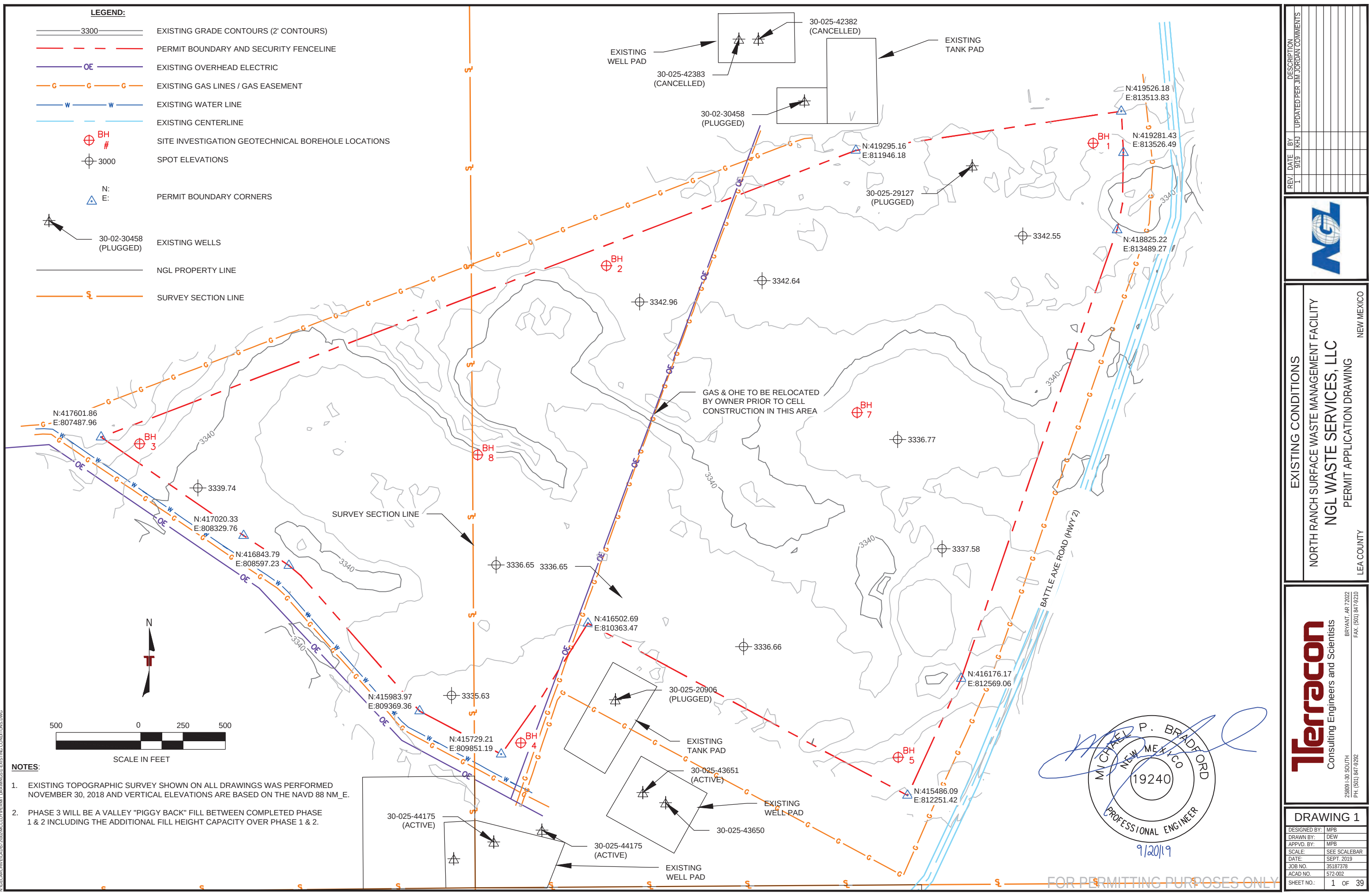
REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

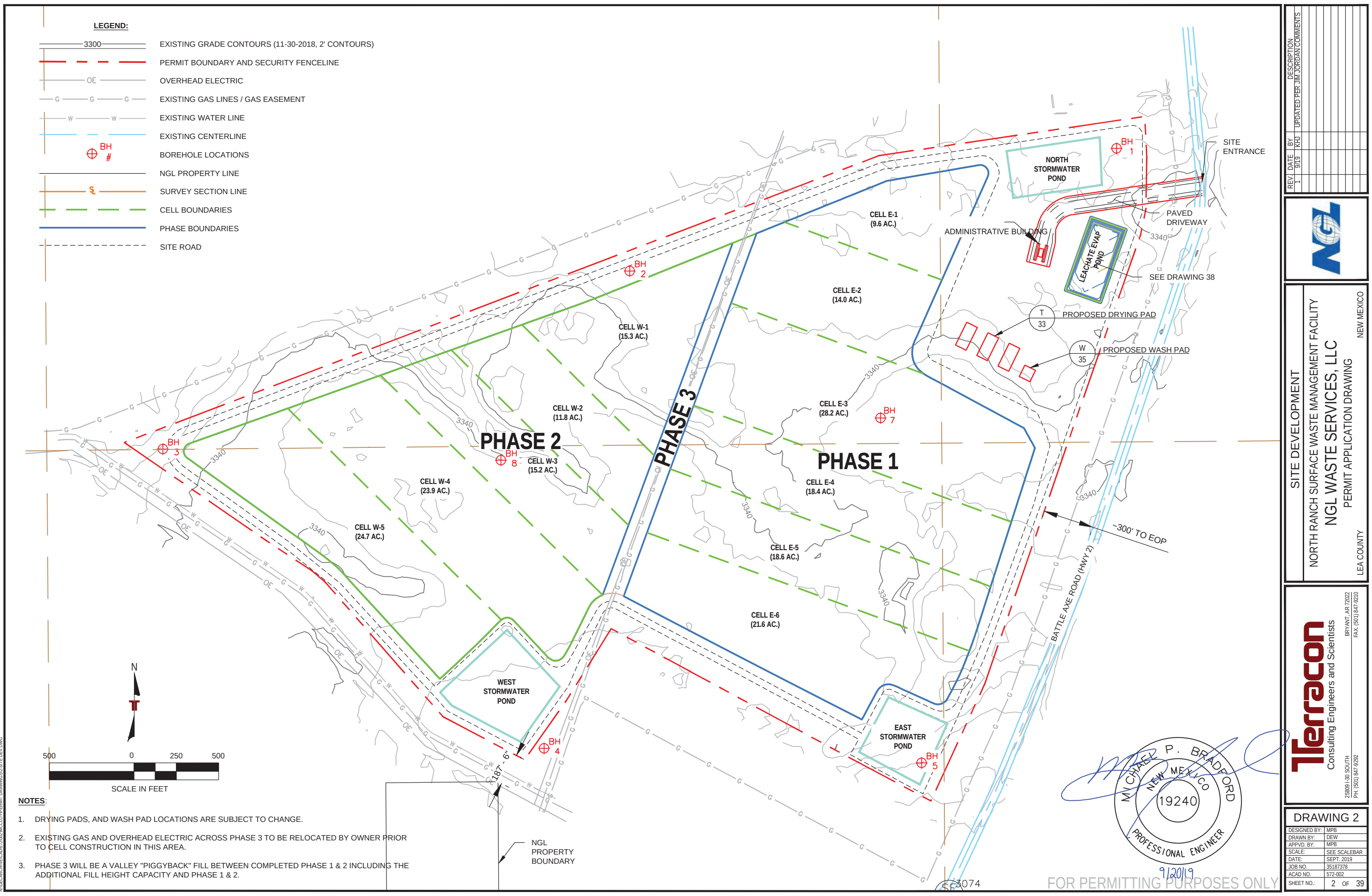
INDEX
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

-

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF


LEGEND:
3300
EXISTING GRADE CONTOURS (2' CONTOURS)
PERMIT BOUNDARY AND SECURITY FENCELINE
EXISTING OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
EXISTING CENTERLINE
SITE INVESTIGATION GEOTECHNICAL BOREHOLE LOCATIONS
SPOT ELEVATIONS
PERMIT BOUNDARY CORNERS
30-02-30458 (PLUGGED)
EXISTING WELLS
NGL PROPERTY LINE
SURVEY SECTION LINE
NOTES:
1. EXISTING TOPOGRAPHIC SURVEY SHOWN ON ALL DRAWINGS WAS PERFORMED NOVEMBER 30, 2018 AND VERTICAL ELEVATIONS ARE BASED ON THE NAVD 88 NM_E.
2. PHASE 3 WILL BE A VALLEY "PIGGY BACK" FILL BETWEEN COMPLETED PHASE 1 & 2 INCLUDING THE ADDITIONAL FILL HEIGHT CAPACITY OVER PHASE 1 & 2.
SCALE IN FEET
500 0 250 500
N
EXISTING WELL PAD
30-025-42382 (CANCELLED)
30-025-42383 (CANCELLED)
EXISTING TANK PAD
30-02-30458 (PLUGGED)
N:419526.18 E:813513.83
N:419281.43 E:813526.49
N:419295.16 E:811946.18
30-025-29127 (PLUGGED)
N:418825.22 E:813489.27
3342.55
3342.64
3342.96
BH 1
BH 2
BH 3
BH 4
BH 5
BH 7
BH 8
GAS & OHE TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA
N:417601.86 E:807487.96
3339.74
3336.77
N:417020.33 E:808329.76
N:416843.79 E:808597.23
SURVEY SECTION LINE
3336.65
3336.65
3337.58
N:416502.69 E:810363.47
3336.66
N:416176.17 E:812569.06
BATTLE AXE ROAD (HWY 2)
N:415983.97 E:809369.36
3335.63
30-025-20906 (PLUGGED)
EXISTING TANK PAD
N:415729.21 E:809851.19
30-025-43651 (ACTIVE)
EXISTING WELL PAD
30-025-43650
N:415486.09 E:812251.42
30-025-44175 (ACTIVE)
30-025-44175 (ACTIVE)
EXISTING WELL PAD
MICHAEL P. BRADFORD NEW MEXICO 19240 PROFESSIONAL ENGINEER
9/20/19
FOR PERMITTING PURPOSES ONLY
REV. DATE BY DESCRIPTION
1 9/19 KHJ UPDATED PER JIM JORDAN COMMENTS
EXISTING CONDITIONS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO
Terracon
Consulting Engineers and Scientists
DRAWING 1
DESIGNED BY: MPB
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
SHEET NO.: 1 OF 39


LEGEND:
3300 EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
PERMIT BOUNDARY AND SECURITY FENCELINE
OE OVERHEAD ELECTRIC
G EXISTING GAS LINES / GAS EASEMENT
W EXISTING WATER LINE
EXISTING CENTERLINE
BH # BOREHOLE LOCATIONS
NGL PROPERTY LINE
SURVEY SECTION LINE
CELL BOUNDARIES
PHASE BOUNDARIES
SITE ROAD
PHASE 1
PHASE 2
PHASE 3
CELL E-1 (9.6 AC.)
CELL E-2 (14.0 AC.)
CELL E-3 (28.2 AC.)
CELL E-4 (18.4 AC.)
CELL E-5 (18.6 AC.)
CELL E-6 (21.6 AC.)
CELL W-1 (15.3 AC.)
CELL W-2 (11.8 AC.)
CELL W-3 (15.2 AC.)
CELL W-4 (23.9 AC.)
CELL W-5 (24.7 AC.)
NORTH STORMWATER POND
WEST STORMWATER POND
EAST STORMWATER POND
LEACHATE EVAP POND
ADMINISTRATIVE BUILDING
SITE ENTRANCE
PAVED DRIVEWAY
SEE DRAWING 38
T 33 PROPOSED DRYING PAD
W 35 PROPOSED WASH PAD
~300' TO EOP
BATTLE AXE ROAD (HWY 2)
187.6'
NGL PROPERTY BOUNDARY
3340
3074
N
500 0 250 500
SCALE IN FEET
NOTES:
1. DRYING PADS, AND WASH PAD LOCATIONS ARE SUBJECT TO CHANGE.
2. EXISTING GAS AND OVERHEAD ELECTRIC ACROSS PHASE 3 TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA.
3. PHASE 3 WILL BE A VALLEY "PIGGYBACK" FILL BETWEEN COMPLETED PHASE 1 & 2 INCLUDING THE ADDITIONAL FILL HEIGHT CAPACITY AND PHASE 1 & 2.
MICHAEL P. BRADFORD
NEW MEXICO
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PROFESSIONAL ENGINEER
9/20/19
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REV. DATE BY DESCRIPTION
1 9/19 KHJ UPDATED PER JIM JORDAN COMMENTS
SITE DEVELOPMENT
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO
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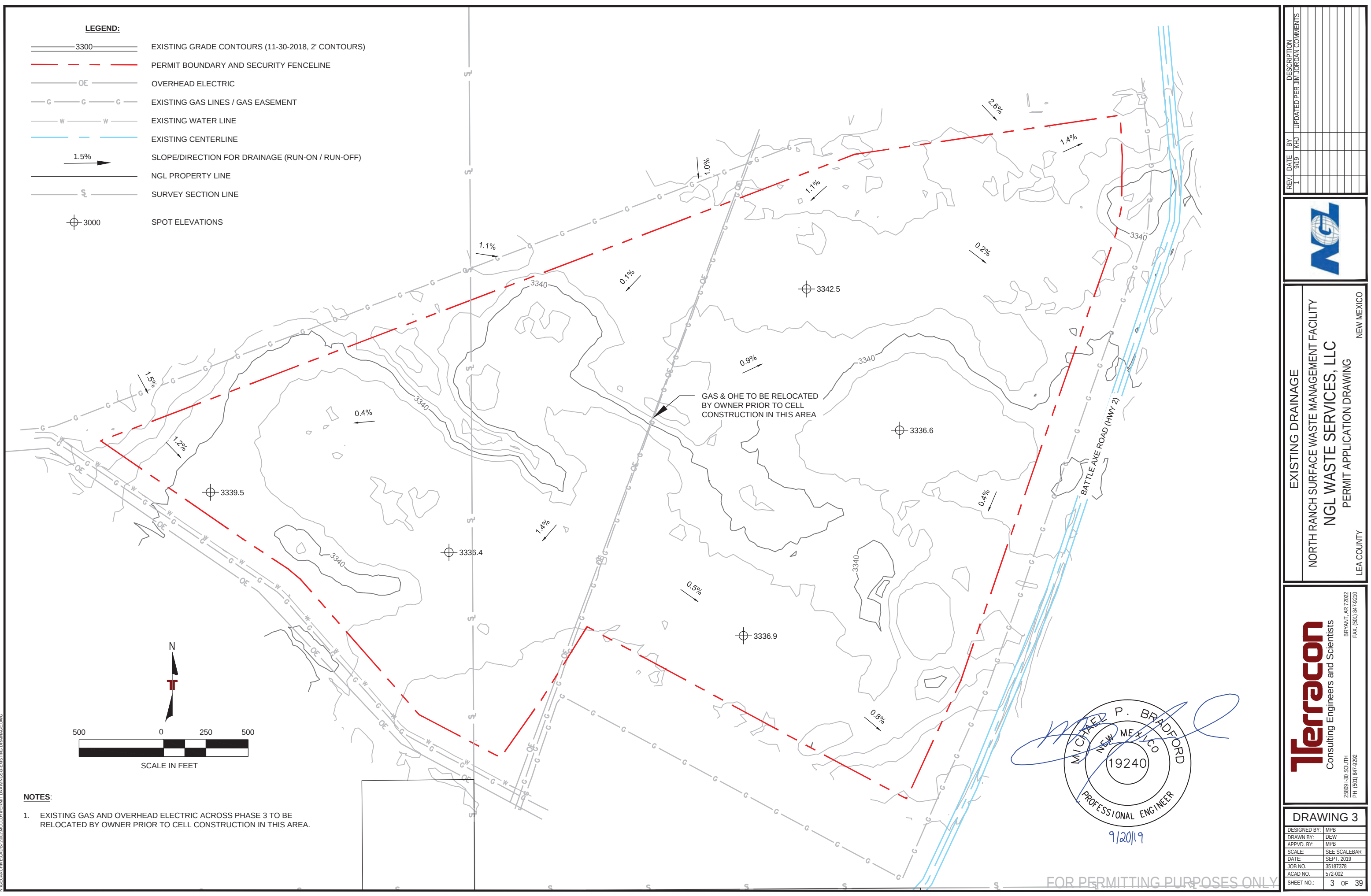
DRAWING 2
DESIGNED BY: MPB
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
ACAD NO. 572-002
SHEET NO.: 2 OF 39


LEGEND:
3300 EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
PERMIT BOUNDARY AND SECURITY FENCELINE
OE OVERHEAD ELECTRIC
G G G EXISTING GAS LINES / GAS EASEMENT
W W EXISTING WATER LINE
EXISTING CENTERLINE
1.5% SLOPE/DIRECTION FOR DRAINAGE (RUN-ON / RUN-OFF)
NGL PROPERTY LINE
SL SURVEY SECTION LINE
3000 SPOT ELEVATIONS
GAS & OHE TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA
BATTLE AXE ROAD (HWY 2)
3342.5
3336.6
3339.5
3336.4
3336.9
3340
N
500 0 250 500
SCALE IN FEET
NOTES:
1. EXISTING GAS AND OVERHEAD ELECTRIC ACROSS PHASE 3 TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA.
MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19
FOR PERMITTING PURPOSES ONLY
REV DATE BY DESCRIPTION
1 9/19 KHJ UPDATED PER JIM JORDAN COMMENTS
EXISTING DRAINAGE
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO
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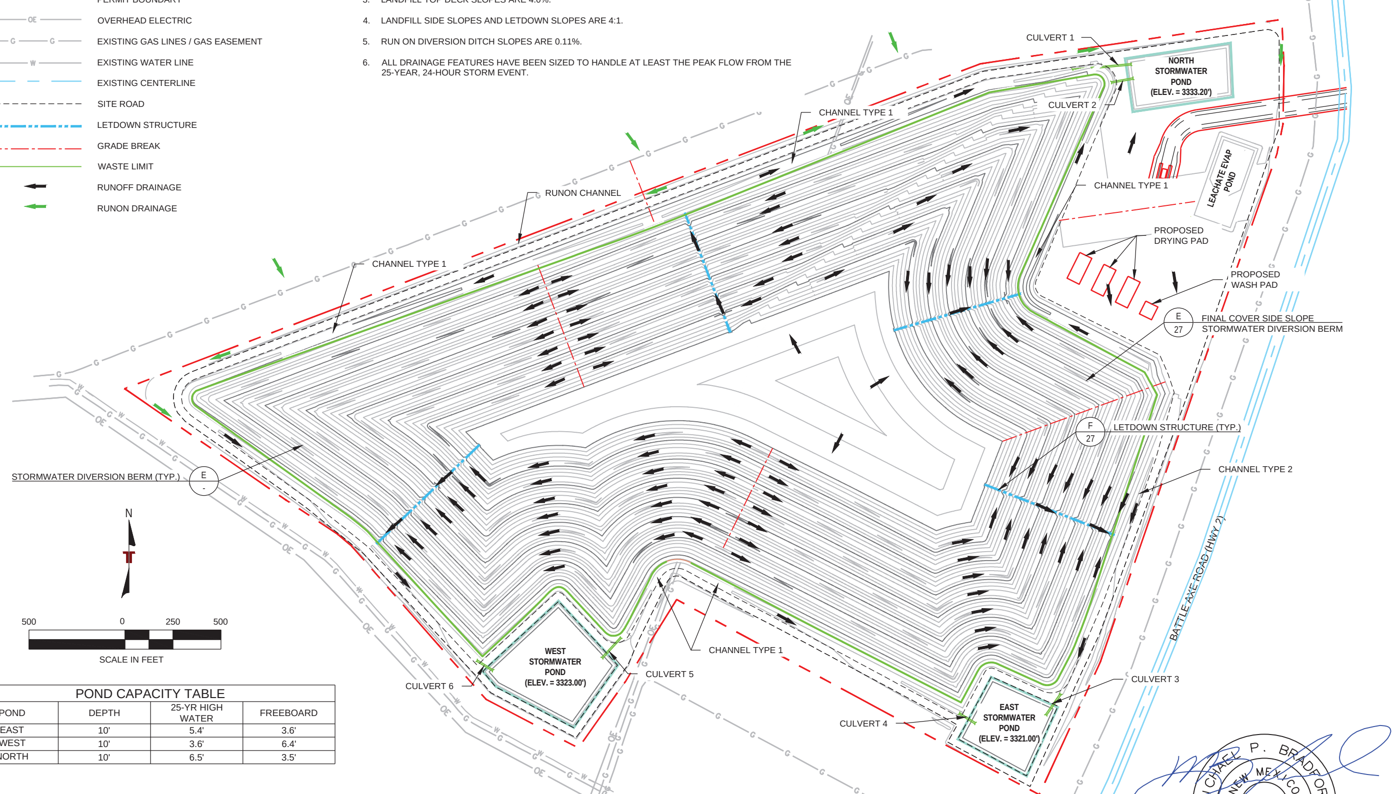
DRAWING 3
DESIGNED BY: MPB
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
ACAD NO. 572-002
SHEET NO.: 3 OF 39

LEGEND:

3300	FINAL COVER CONTOURS (5' INTERVALS)
3300	PERIMETER INFRASTRUCTURE CONTOURS (5' INTERVALS)
	PERMIT BOUNDARY
OE	OVERHEAD ELECTRIC
G G	EXISTING GAS LINES / GAS EASEMENT
W	EXISTING WATER LINE
	EXISTING CENTERLINE
	SITE ROAD
	LETDOWN STRUCTURE
	GRADE BREAK
	WASTE LIMIT
	RUNOFF DRAINAGE
	RUNON DRAINAGE

NOTES:

1. ALL PERIMETER CHANNEL FLOWLINE SLOPES ARE 0.5%.
2. ALL SIDE SLOPE CHANNEL FLOWLINE SLOPES ARE 1.0%.
3. LANDFILL TOP DECK SLOPES ARE 4.0%.
4. LANDFILL SIDE SLOPES AND LETDOWN SLOPES ARE 4:1.
5. RUN ON DIVERSION DITCH SLOPES ARE 0.11%.
6. ALL DRAINAGE FEATURES HAVE BEEN SIZED TO HANDLE AT LEAST THE PEAK FLOW FROM THE 25-YEAR, 24-HOUR STORM EVENT.



POND CAPACITY TABLE			
POND	DEPTH	25-YR HIGH WATER	FREEBOARD
EAST	10'	5.4'	3.6'
WEST	10'	3.6'	6.4'
NORTH	10'	6.5'	3.5'

CULVERT SIZE AND CAPACITY TABLE				
CULVERT #	DIAMETER (IN)	# BARRELS	CAPACITY (CFS)	PEAK FLOW 25-YR (CFS)
1	36	3	222	164
2	36	3	222	195
3	48	2	375	297
4	36	2	204	34
5	24	2	55	13
6	48	2	350	304

CHANNEL GEOMETRY TABLE				
CHANNEL TYPE	SHAPE	DEPTH (FT)	BOTTOM WIDTH (FT)	SIDE SLOPE (H:V)
1	TRAPEZOIDAL	3	10	4:1
2	TRAPEZOIDAL	3	6	4:1
SIDE SLOPE BERM	V-DITCH	1.5	-	4:1
ALL LET DOWN CHANNEL	TRAPEZOIDAL	2	10	3:1
RUN-ON CHANNEL	TRAPEZOIDAL	4	7	4:1

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N:\GEARCHIVE\CAD\572\002\MCCLOY\PERMIT DRAWINGS\4-FINAL DRAINAGE.DWG

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

FINAL DRAINAGE
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

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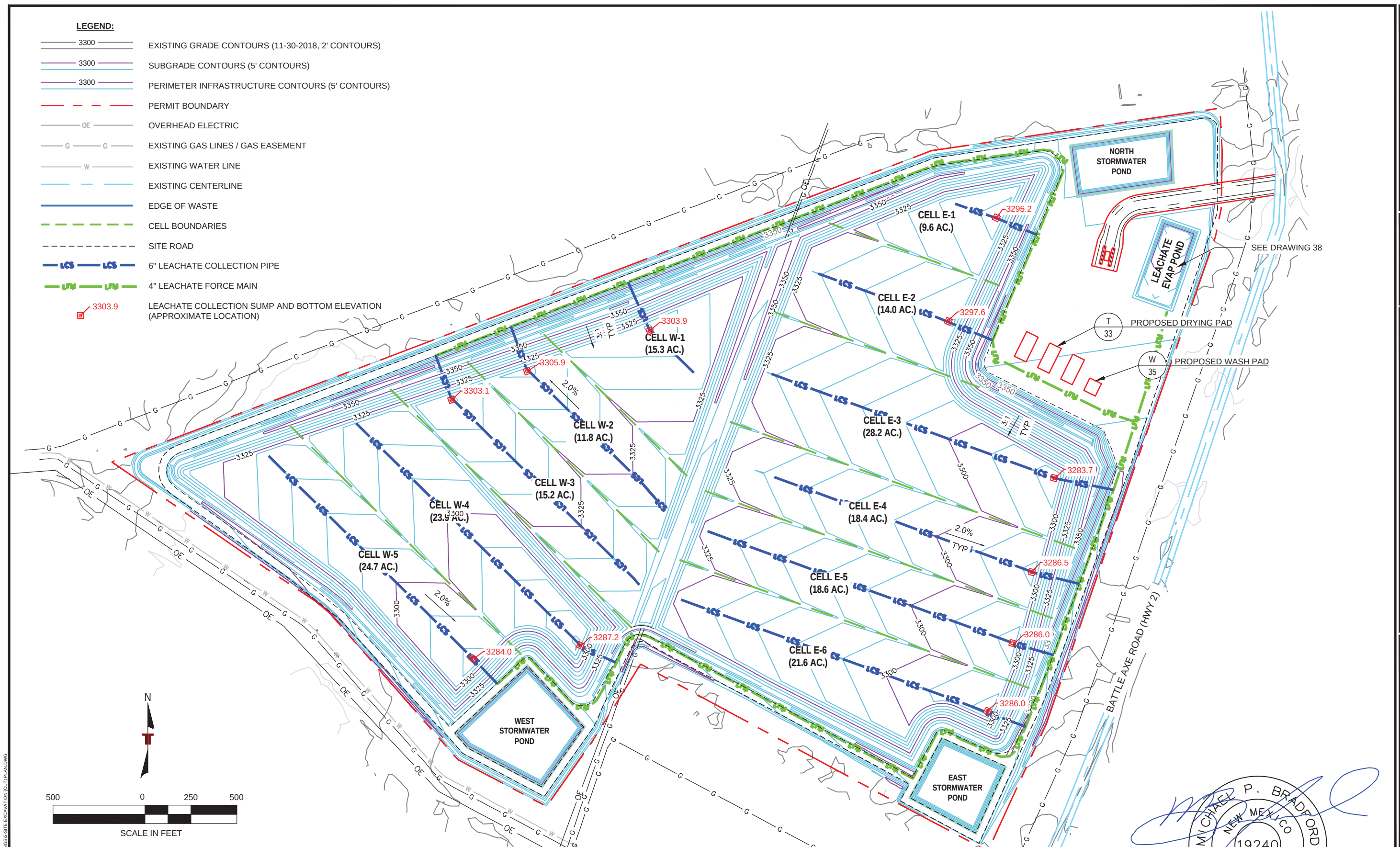
DRAWING 4

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	4 OF 39



NOTES:

1. DRYING PADS, AND WASH PAD LOCATIONS ARE SUBJECT TO CHANGE.
2. EXISTING GAS AND OVERHEAD ELECTRIC IN PHASE 3 AREA TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA AS SHOWN ON DRAWING 2 "SITE DEVELOPMENT".
3. PHASE 3 WILL BE A VALLEY "PIGGYBACK" FILL BETWEEN COMPLETED PHASE 1 & 2 INCLUDING THE ADDITIONAL FILL HEIGHT CAPACITY AND PHASE 1 & 2.

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

SITE EXCAVATION (CUT) PLAN
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

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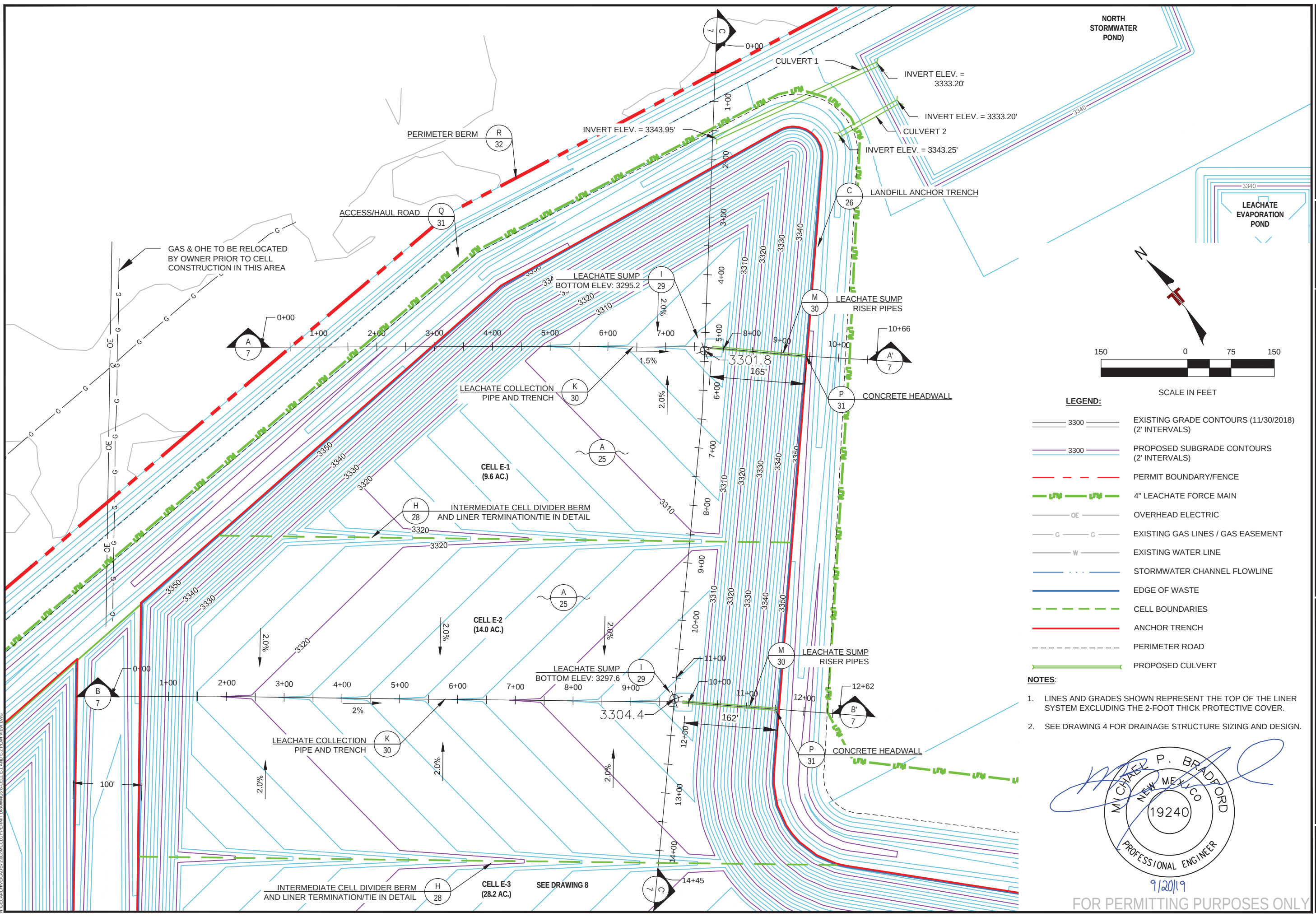
DRAWING 5

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	5 OF 39



LEGEND:

3300	EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
3300	PROPOSED SUBGRADE CONTOURS (2' INTERVALS)
	PERMIT BOUNDARY/FENCE
	4" LEACHATE FORCE MAIN
OE	OVERHEAD ELECTRIC
G	EXISTING GAS LINES / GAS EASEMENT
W	EXISTING WATER LINE
	STORMWATER CHANNEL FLOWLINE
	EDGE OF WASTE
	CELL BOUNDARIES
	ANCHOR TRENCH
	PERIMETER ROAD
	PROPOSED CULVERT

NOTES:

1. LINES AND GRADES SHOWN REPRESENT THE TOP OF THE LINER SYSTEM EXCLUDING THE 2-FOOT THICK PROTECTIVE COVER.
2. SEE DRAWING 4 FOR DRAINAGE STRUCTURE SIZING AND DESIGN.

MICHAEL P. BRADFORD
NEW MEXICO
19240
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9/20/19

FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

CELL E1 & E2 PLAN VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

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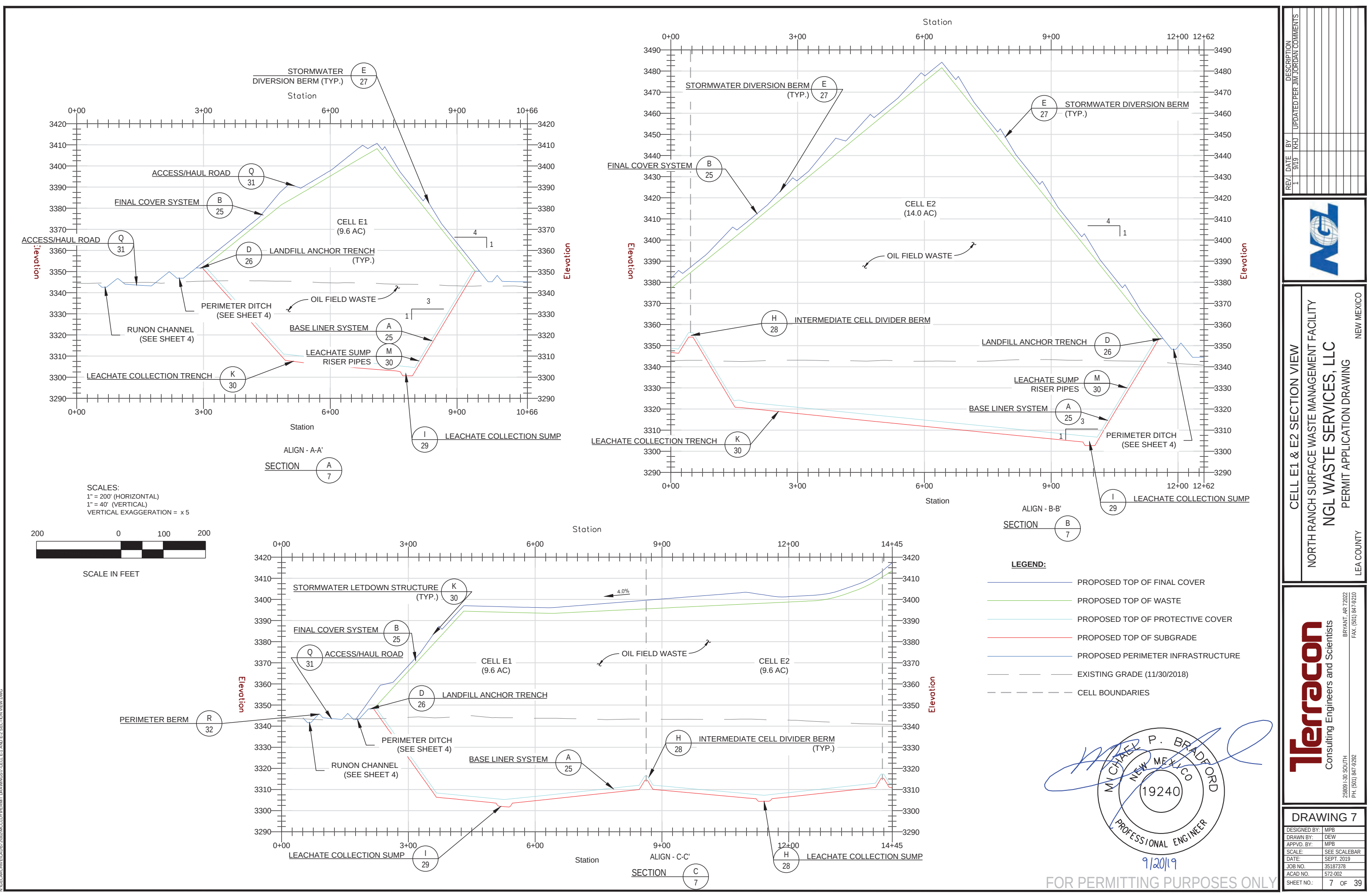
DRAWING 6

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	6 OF 39


SECTION A 7
ALIGN - A-A'
CELL E1
(9.6 AC)
STORMWATER DIVERSION BERM (TYP.) E 27
ACCESS/HAUL ROAD Q 31
FINAL COVER SYSTEM B 25
LANDFILL ANCHOR TRENCH (TYP.) D 26
PERIMETER DITCH (SEE SHEET 4)
RUNON CHANNEL (SEE SHEET 4)
OIL FIELD WASTE
BASE LINER SYSTEM A 25
LEACHATE SUMP RISER PIPES M 30
LEACHATE COLLECTION TRENCH K 30
LEACHATE COLLECTION SUMP I 29
SCALES:
1" = 200' (HORIZONTAL)
1" = 40' (VERTICAL)
VERTICAL EXAGGERATION = x 5
SCALE IN FEET
SECTION B 7
ALIGN - B-B'
CELL E2
(14.0 AC)
INTERMEDIATE CELL DIVIDER BERM H 28
SECTION C 7
ALIGN - C-C'
CELL E1 (9.6 AC)
CELL E2 (9.6 AC)
STORMWATER LETDOWN STRUCTURE (TYP.) K 30
PERIMETER BERM R 32
LEGEND:
PROPOSED TOP OF FINAL COVER
PROPOSED TOP OF WASTE
PROPOSED TOP OF PROTECTIVE COVER
PROPOSED TOP OF SUBGRADE
PROPOSED PERIMETER INFRASTRUCTURE
EXISTING GRADE (11/30/2018)
CELL BOUNDARIES
MICHAEL P. BRADFORD
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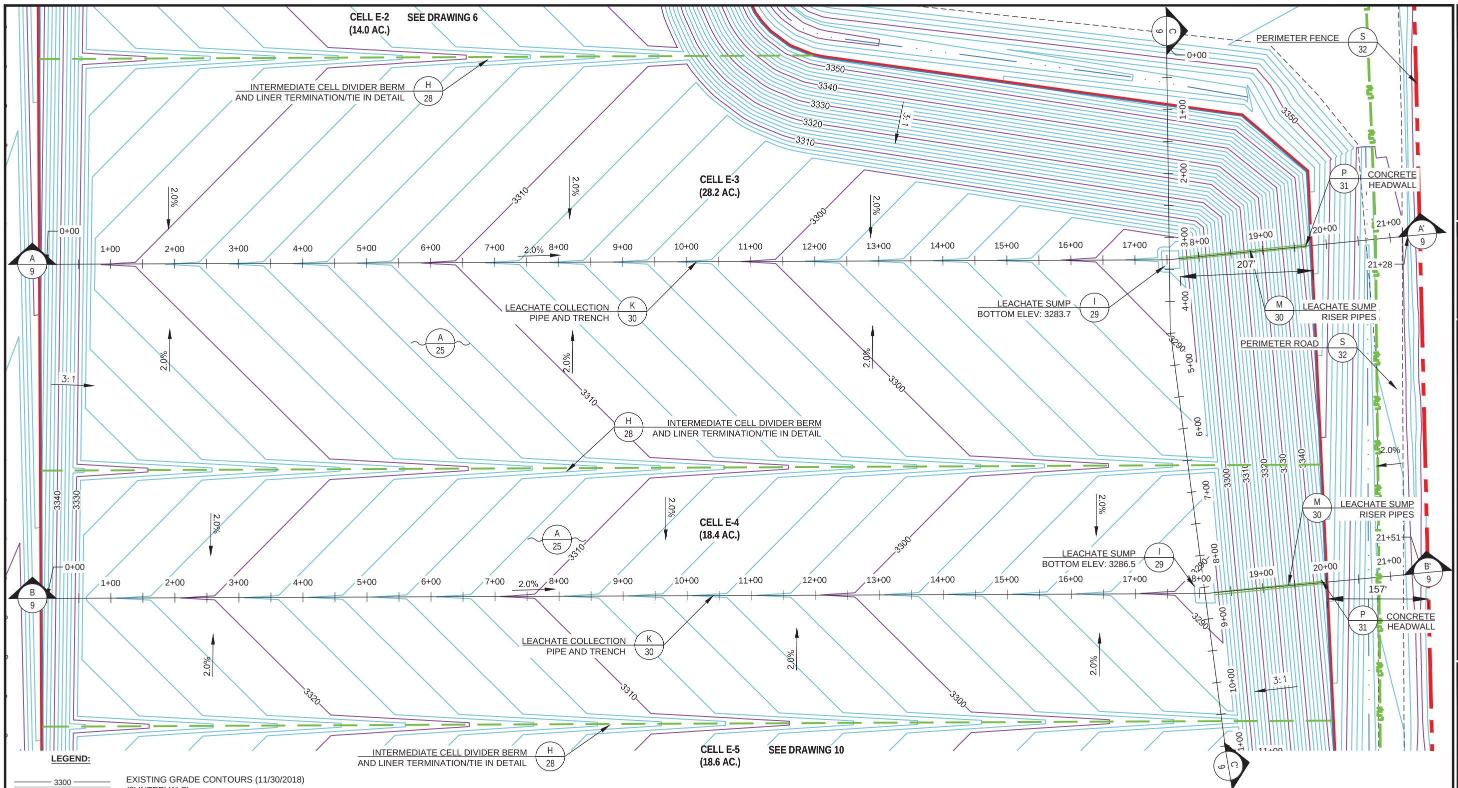
PROFESSIONAL ENGINEER
9/20/19
FOR PERMITTING PURPOSES ONLY
CELL E1 & E2 SECTION VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
DRAWING 7
SHEET NO.: 7 OF 39



LEGEND:

3300	EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
3300	PROPOSED SUBGRADE CONTOURS (2' INTERVALS)
	PERMIT BOUNDARY/FENCE
	4" LEACHATE FORCE MAIN
	STORMWATER CHANNEL FLOWLINE
	EDGE OF WASTE
	CELL BOUNDARIES
	ANCHOR TRENCH
	PERIMETER ROAD
	PROPOSED CULVERT

150 0 75 150

SCALE IN FEET

NOTES:

1. LINES AND GRADES SHOWN REPRESENT THE TOP OF THE LINER SYSTEM EXCLUDING THE 2-FOOT THICK PROTECTIVE COVER.
2. SEE DRAWING 4 FOR DRAINAGE STRUCTURE SIZING AND DESIGN.

MICHAEL P. BRADFORD
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9/20/19

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REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER 3M JORDAN COMMENTS

CELL E3 & E4 PLAN VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

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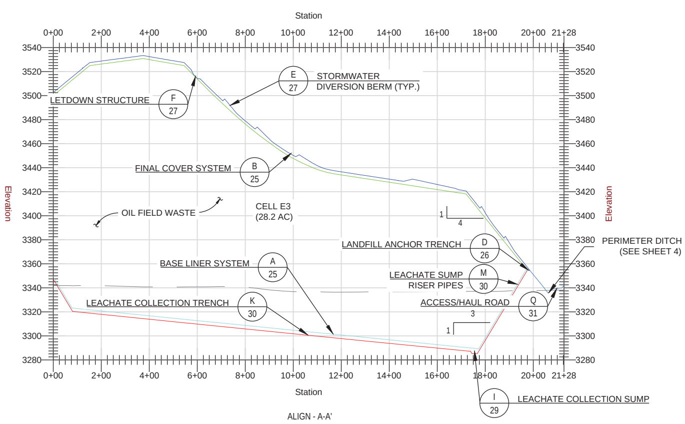
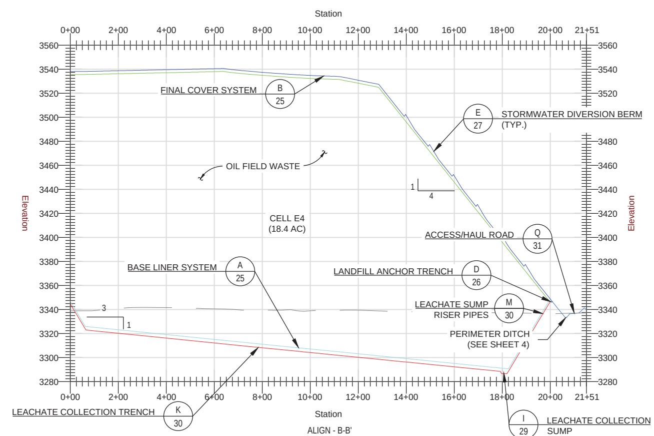
DRAWING 8

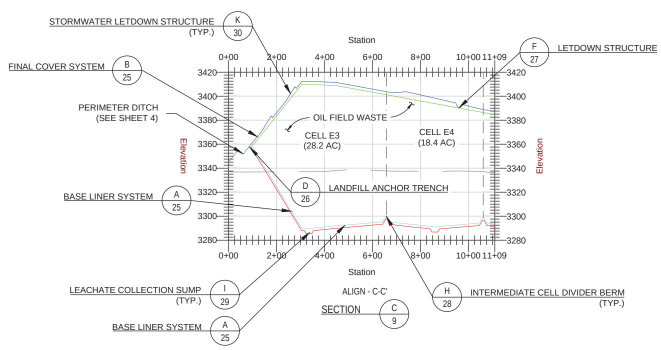
DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	8 OF 39



SECTION A / 9



SECTION B / 9



SECTION C / 9

LEGEND:

- PROPOSED TOP OF FINAL COVER
- PROPOSED TOP OF WASTE
- PROPOSED TOP OF PROTECTIVE COVER
- PROPOSED TOP OF SUBGRADE
- PROPOSED PERIMETER INFRASTRUCTURE
- EXISTING GRADE (11/30/2018)
- CELL BOUNDARIES

SCALES:
1" = 400' (HORIZONTAL)
1" = 80' (VERTICAL)
VERTICAL EXAGGERATION = x 5

400 0 200 400
SCALE IN FEET

MICHAEL P. BRADFORD
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9/20/19

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CELL E3 & E4 SECTION VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY   NEW MEXICO

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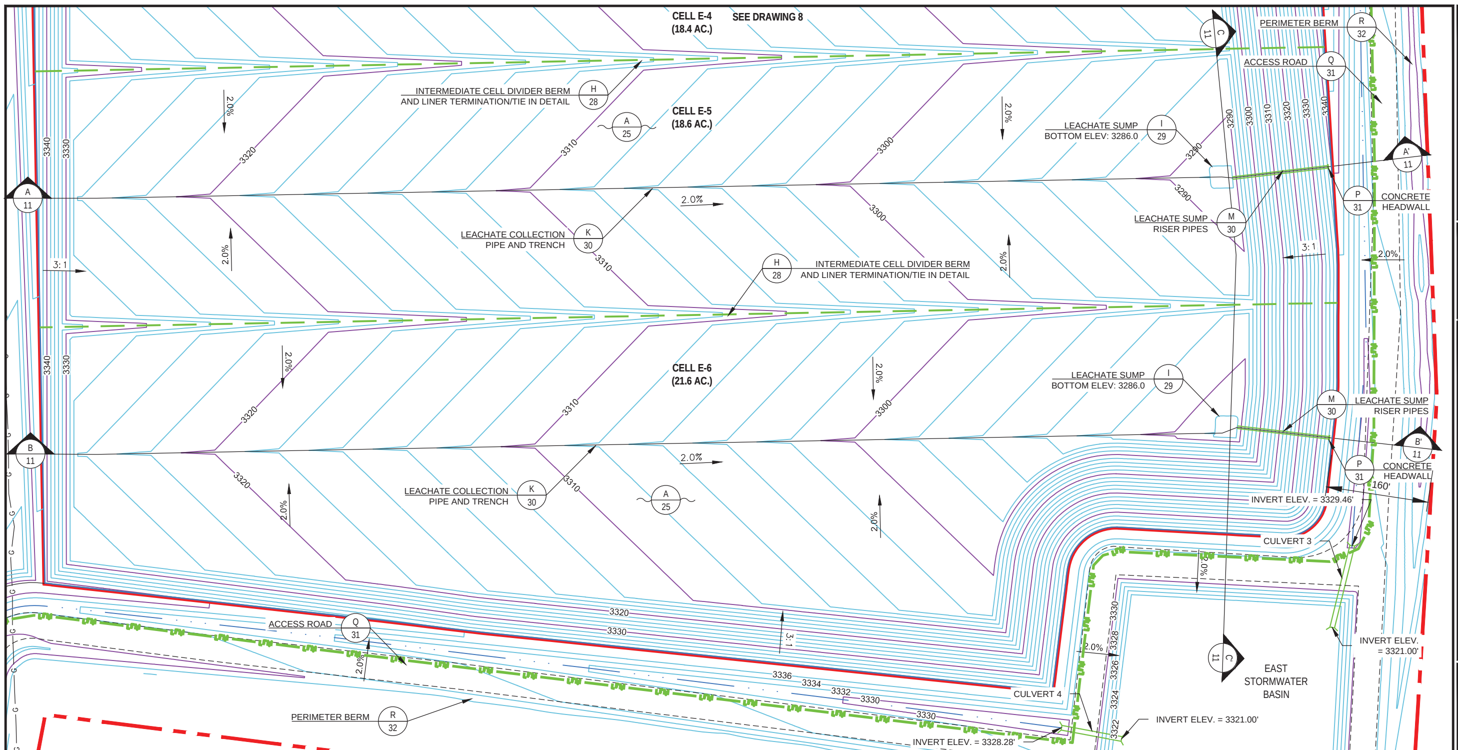
DRAWING 9

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	9 OF 39



LEGEND:

- EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
- PROPOSED SUBGRADE CONTOURS (2' INTERVALS)
- PERMIT BOUNDARY/FENCE
- 4" LEACHATE FORCE MAIN
- STORMWATER CHANNEL FLOWLINE
- EDGE OF WASTE
- CELL BOUNDARIES
- ANCHOR TRENCH
- PERIMETER ROAD
- PROPOSED CULVERT

150 0 75 150
SCALE IN FEET

NOTES:

1. LINES AND GRADES SHOWN REPRESENT THE TOP OF THE LINER SYSTEM EXCLUDING THE 2-FOOT THICK PROTECTIVE COVER.
2. SEE DRAWING 4 FOR DRAINAGE STRUCTURE SIZING AND DESIGN.

MICHAEL P. BRADFORD
NEW MEXICO
19240
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9/20/19

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CELL E5 & E6 PLAN VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

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DRAWING 10

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
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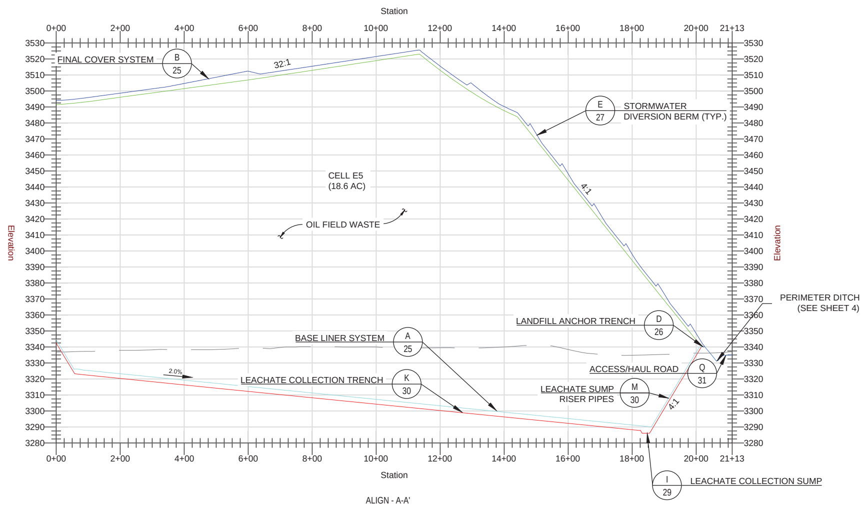
SHEET NO.:	10 OF 39



ALIGN - A-A'

SECTION A 11

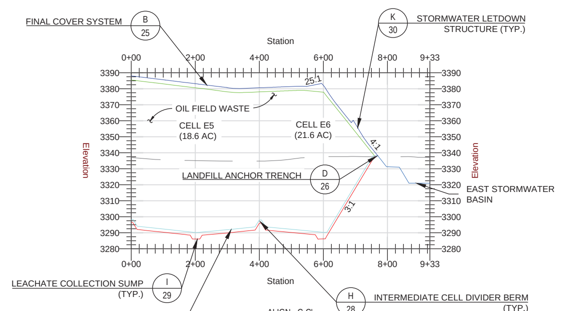
LEGEND:

- PROPOSED TOP OF FINAL COVER
- PROPOSED TOP OF WASTE
- PROPOSED TOP OF PROTECTIVE COVER
- PROPOSED TOP OF SUBGRADE
- PROPOSED PERIMETER INFRASTRUCTURE
- EXISTING GRADE (11/30/2018)
- CELL BOUNDARIES

SCALES:
1" = 300' (HORIZONTAL)
1" = 60' (VERTICAL)
VERTICAL EXAGGERATION = x 5

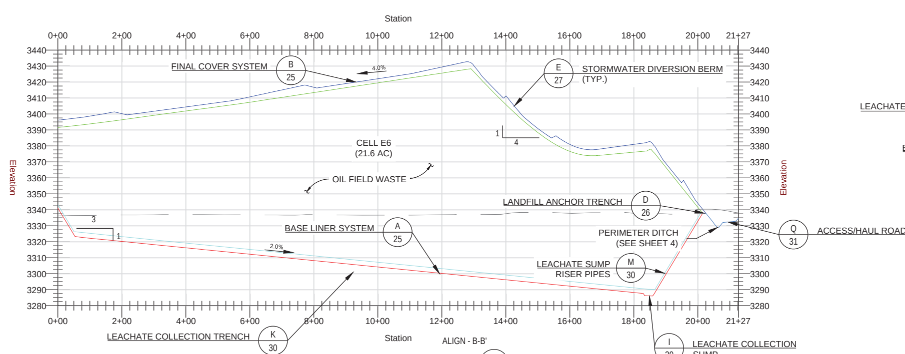
300 0 150 300

SCALE IN FEET



ALIGN - C-C'

SECTION C 11



ALIGN - B-B'

SECTION B 11

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

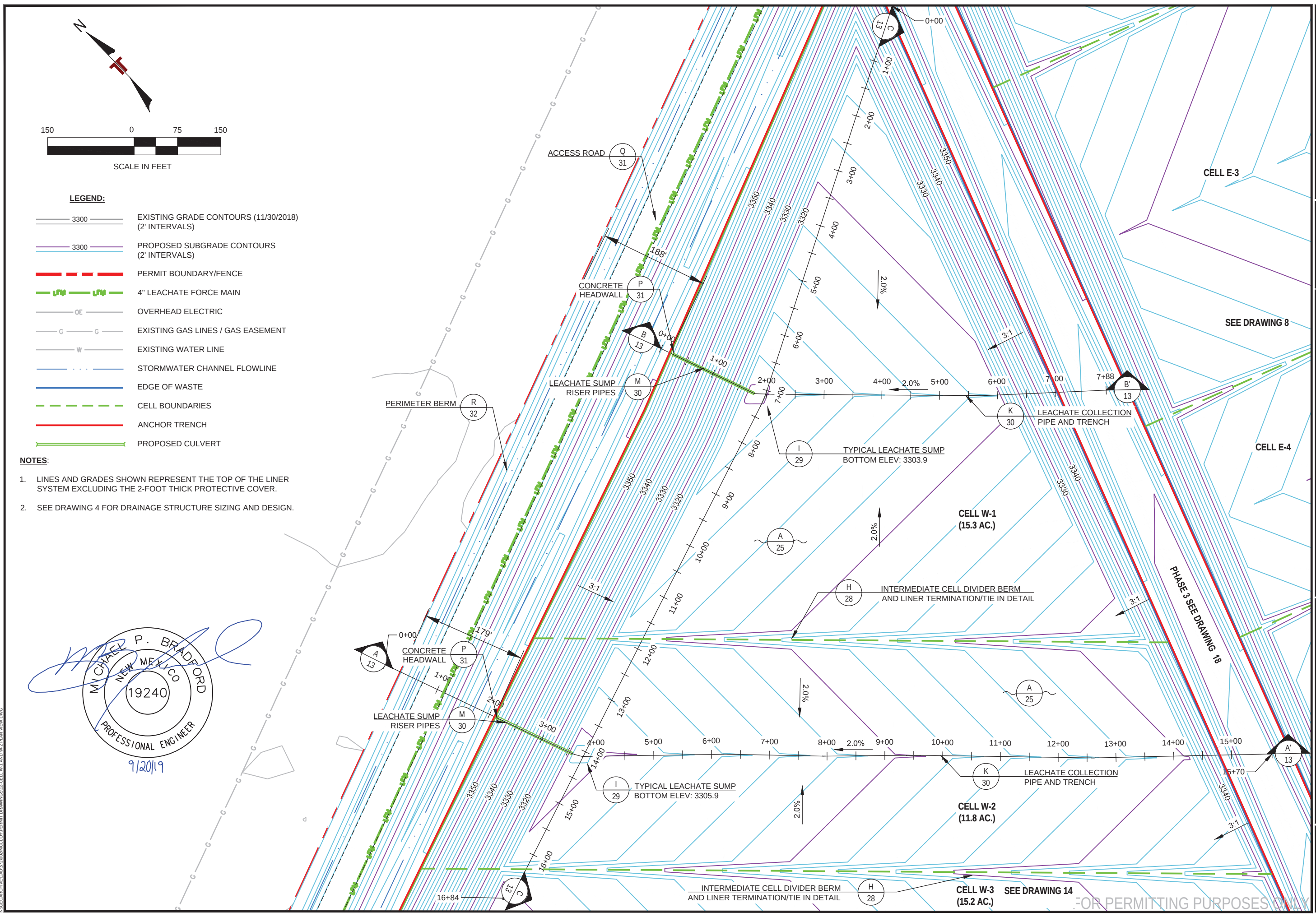
REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

CELL E5 & E6 SECTION VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 11

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	11 OF 39



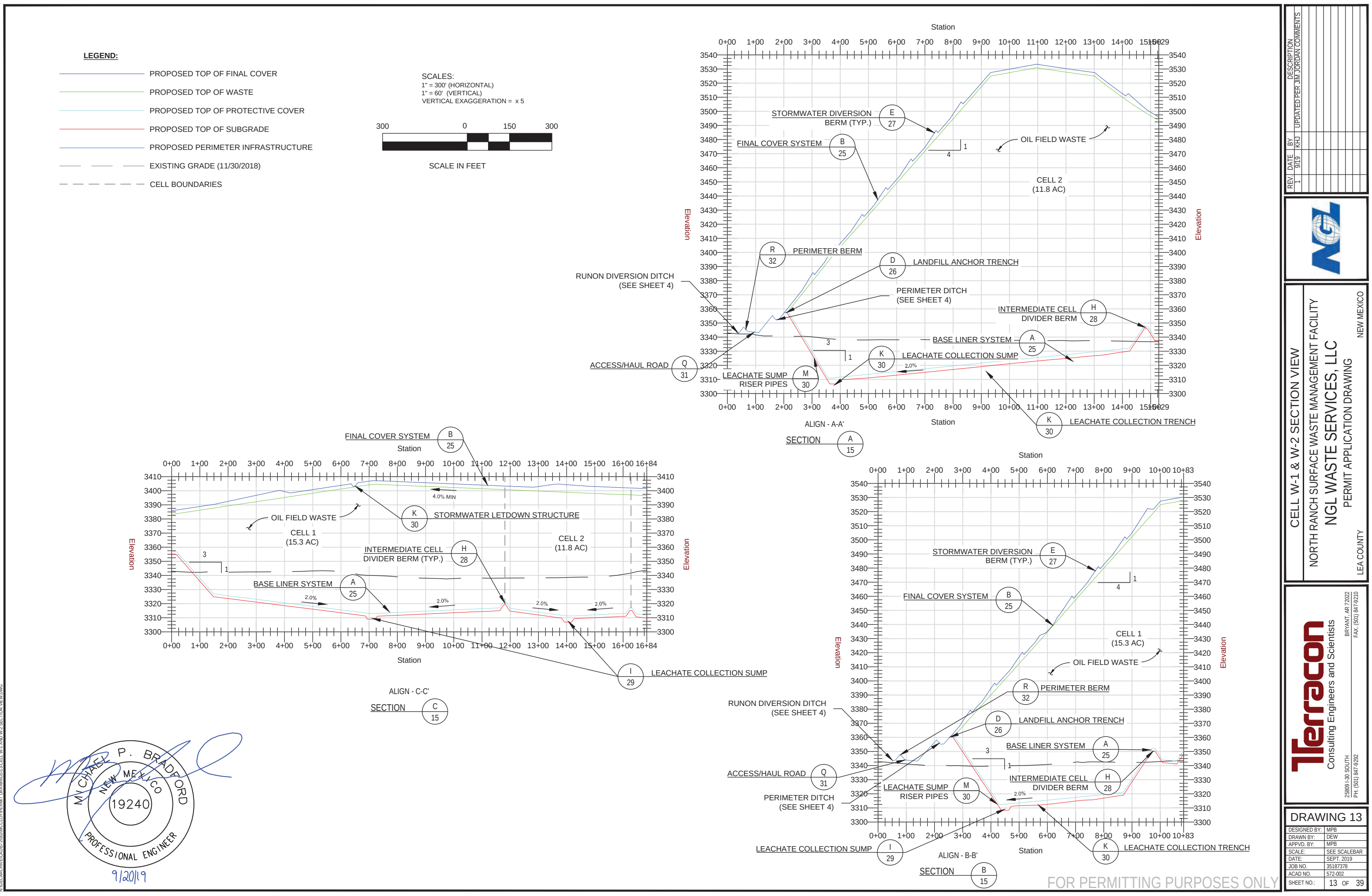
REV. | DATE | BY | DESCRIPTION
1 | 9/19 | KHJ | UPDATED PER JIM JORDAN COMMENTS

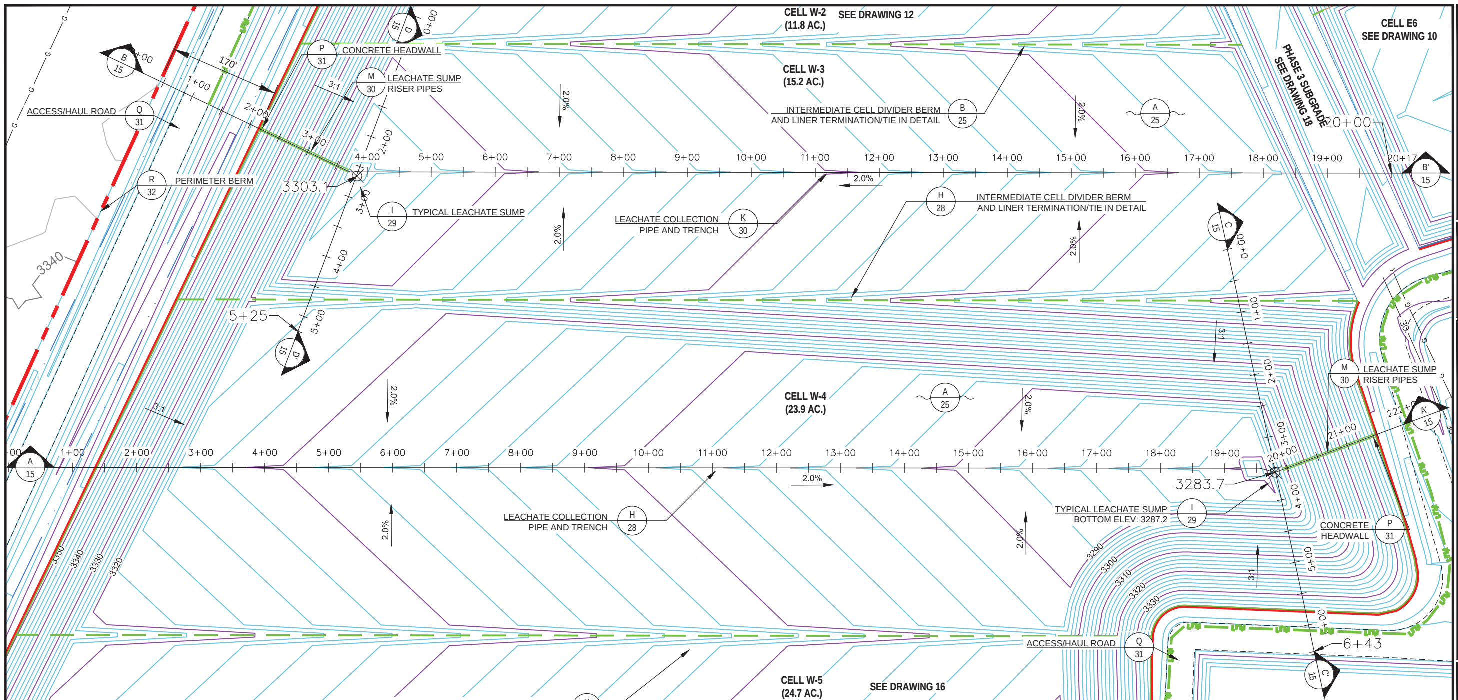
CELL W-1 & W-2 PLAN VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 12

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	12 OF 39


LEGEND:
PROPOSED TOP OF FINAL COVER
PROPOSED TOP OF WASTE
PROPOSED TOP OF PROTECTIVE COVER
PROPOSED TOP OF SUBGRADE
PROPOSED PERIMETER INFRASTRUCTURE
EXISTING GRADE (11/30/2018)
CELL BOUNDARIES
SCALES:
1" = 300' (HORIZONTAL)
1" = 60' (VERTICAL)
VERTICAL EXAGGERATION = x 5
300 0 150 300
SCALE IN FEET
Station
Elevation
STORMWATER DIVERSION BERM (TYP.) E 27
FINAL COVER SYSTEM B 25
OIL FIELD WASTE
CELL 2 (11.8 AC)
PERIMETER BERM R 32
LANDFILL ANCHOR TRENCH D 26
RUNON DIVERSION DITCH (SEE SHEET 4)
PERIMETER DITCH (SEE SHEET 4)
INTERMEDIATE CELL DIVIDER BERM H 28
BASE LINER SYSTEM A 25
LEACHATE COLLECTION SUMP K 30
ACCESS/HAUL ROAD Q 31
LEACHATE SUMP RISER PIPES M 30
LEACHATE COLLECTION TRENCH K 30
2.0%
ALIGN - A-A'
SECTION A 15
FINAL COVER SYSTEM B 25
4.0% MIN
OIL FIELD WASTE
STORMWATER LETDOWN STRUCTURE K 30
CELL 1 (15.3 AC)
CELL 2 (11.8 AC)
INTERMEDIATE CELL DIVIDER BERM (TYP.) H 28
BASE LINER SYSTEM A 25
LEACHATE COLLECTION SUMP I 29
ALIGN - C-C'
SECTION C 15
STORMWATER DIVERSION BERM (TYP.) E 27
FINAL COVER SYSTEM B 25
CELL 1 (15.3 AC)
OIL FIELD WASTE
PERIMETER BERM R 32
RUNON DIVERSION DITCH (SEE SHEET 4)
LANDFILL ANCHOR TRENCH D 26
BASE LINER SYSTEM A 25
ACCESS/HAUL ROAD Q 31
INTERMEDIATE CELL DIVIDER BERM H 28
LEACHATE SUMP RISER PIPES M 30
PERIMETER DITCH (SEE SHEET 4)
LEACHATE COLLECTION SUMP I 29
LEACHATE COLLECTION TRENCH K 30
ALIGN - B-B'
SECTION B 15
FOR PERMITTING PURPOSES ONLY
MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19
REV DATE BY DESCRIPTION
1 9/19 KHJ UPDATED PER JIM JORDAN COMMENTS
CELL W-1 & W-2 SECTION VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH
BRYANT, AR 72022
PH. (501) 847-9292
FAX. (501) 847-9210
DRAWING 13
DESIGNED BY: MPB
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
ACAD NO. 572-002
SHEET NO.: 13 OF 39



LEGEND:

3300	EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
3300	PROPOSED SUBGRADE CONTOURS (2' INTERVALS)
	PERMIT BOUNDARY/FENCE
	4" LEACHATE FORCE MAIN
OE	OVERHEAD ELECTRIC
G	EXISTING GAS LINES / GAS EASEMENT
W	EXISTING WATER LINE
	STORMWATER CHANNEL FLOWLINE
	EDGE OF WASTE
	CELL BOUNDARIES
	ANCHOR TRENCH
	PROPOSED CULVERT

150 0 75 150

SCALE IN FEET

NOTES:

1. LINES AND GRADES SHOWN REPRESENT THE TOP OF THE LINER SYSTEM EXCLUDING THE 2-FOOT THICK PROTECTIVE COVER.
2. SEE DRAWING 4 FOR DRAINAGE STRUCTURE SIZING AND DESIGN.

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

CELL W-3 & W-4 PLAN VIEW

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

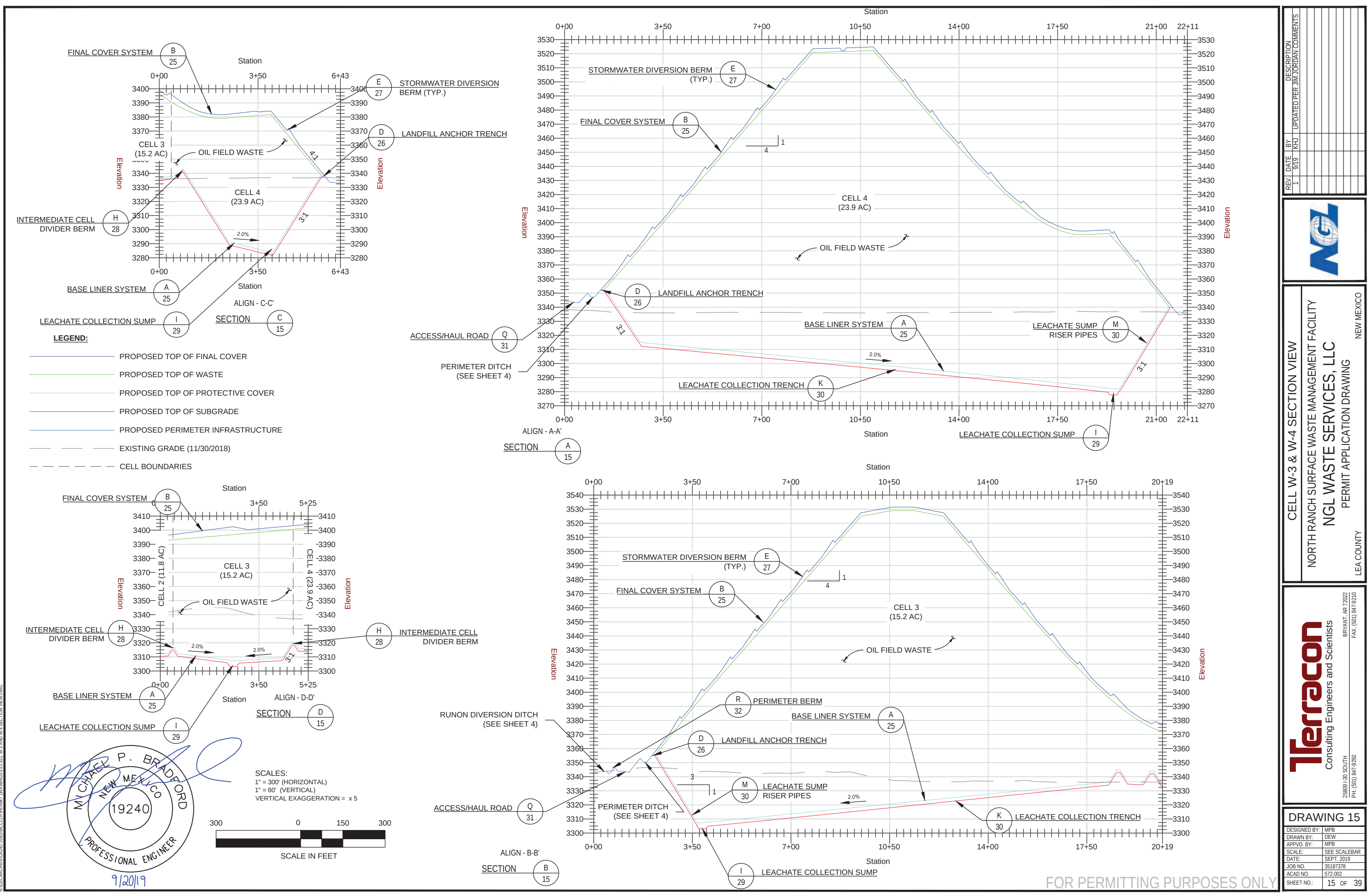
PERMIT APPLICATION DRAWING

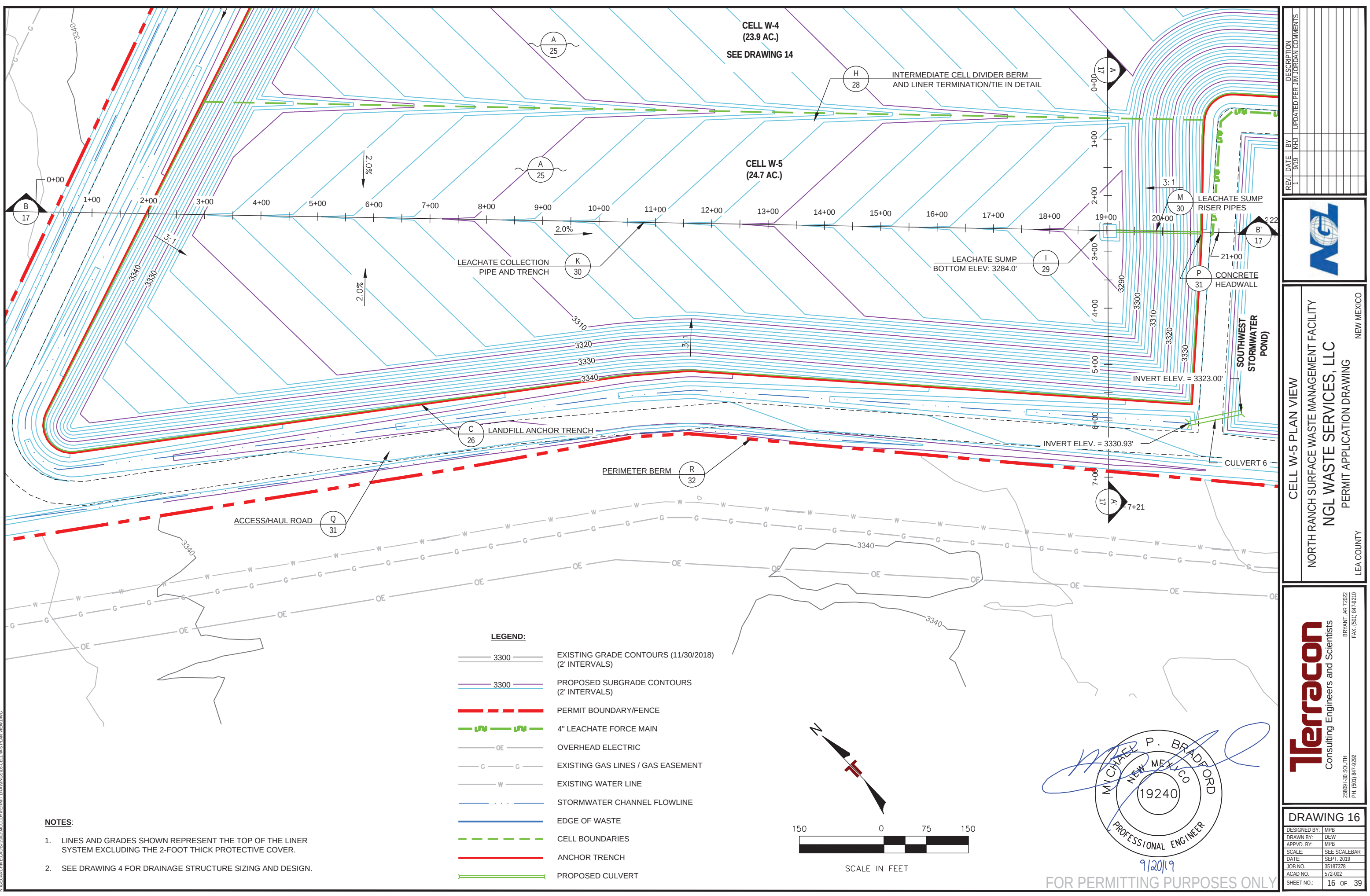
LEA COUNTY NEW MEXICO

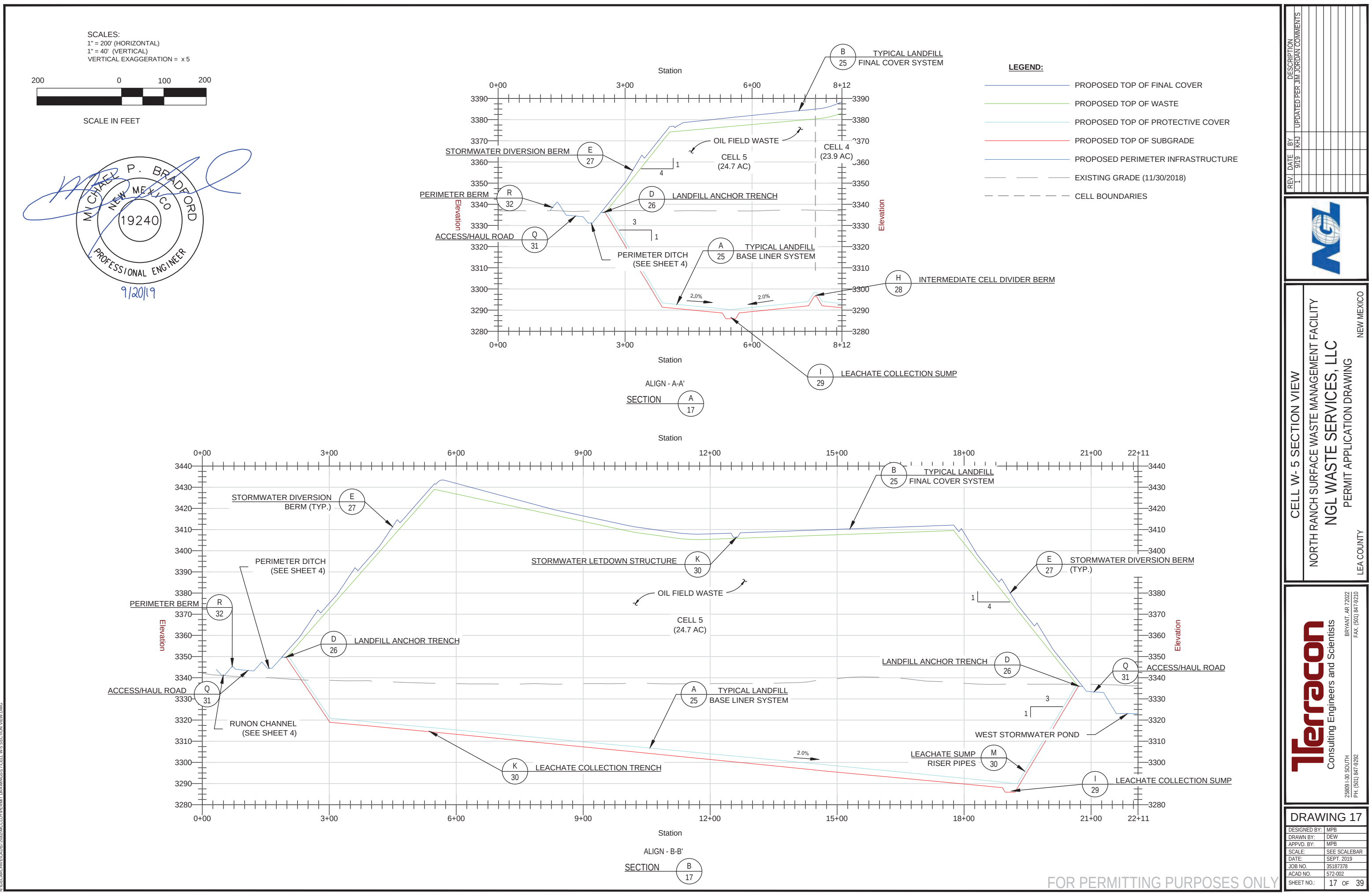
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

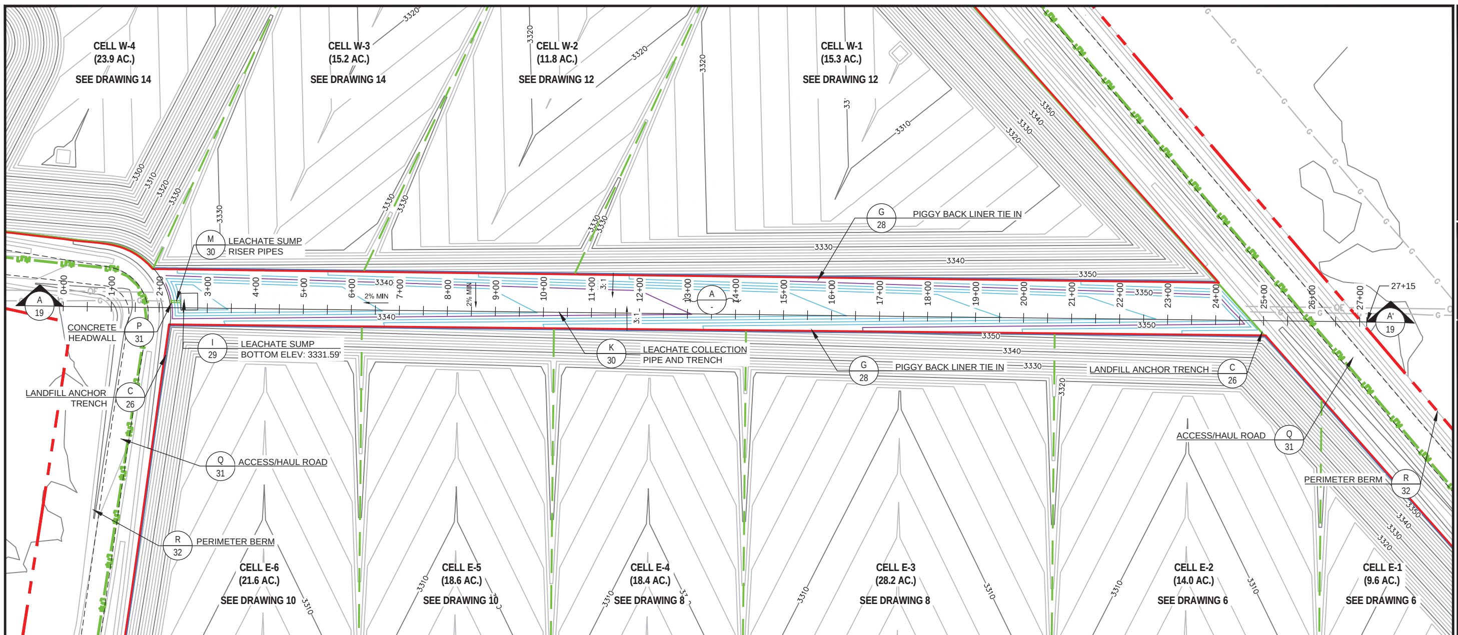
DRAWING 14

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	14 OF 39


SECTION C 15
ALIGN - C-C'
SECTION A 15
ALIGN - A-A'
SECTION D 15
ALIGN - D-D'
SECTION B 15
ALIGN - B-B'
Station
Elevation
CELL 4
(23.9 AC)
CELL 3
(15.2 AC)
CELL 2 (11.8 AC)
CELL 4 (23.9 AC)
OIL FIELD WASTE
FINAL COVER SYSTEM
STORMWATER DIVERSION BERM (TYP.)
LANDFILL ANCHOR TRENCH
INTERMEDIATE CELL DIVIDER BERM
BASE LINER SYSTEM
LEACHATE COLLECTION SUMP
LEACHATE COLLECTION TRENCH
LEACHATE SUMP RISER PIPES
ACCESS/HAUL ROAD
PERIMETER DITCH (SEE SHEET 4)
RUNON DIVERSION DITCH (SEE SHEET 4)
PERIMETER BERM
LEGEND:
PROPOSED TOP OF FINAL COVER
PROPOSED TOP OF WASTE
PROPOSED TOP OF PROTECTIVE COVER
PROPOSED TOP OF SUBGRADE
PROPOSED PERIMETER INFRASTRUCTURE
EXISTING GRADE (11/30/2018)
CELL BOUNDARIES
SCALES:
1" = 300' (HORIZONTAL)
1" = 60' (VERTICAL)
VERTICAL EXAGGERATION = x 5
SCALE IN FEET
MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19
FOR PERMITTING PURPOSES ONLY
CELL W-3 & W-4 SECTION VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO
UPDATED PER 3M JORDAN COMMENTS
Terracon
Consulting Engineers and Scientists
DRAWING 15
SHEET NO.: 15 OF 39


CELL W-4
(23.9 AC.)
SEE DRAWING 14
CELL W-5
(24.7 AC.)
INTERMEDIATE CELL DIVIDER BERM AND LINER TERMINATION/TIE IN DETAIL
LEACHATE COLLECTION PIPE AND TRENCH
LEACHATE SUMP BOTTOM ELEV: 3284.0'
LEACHATE SUMP RISER PIPES
CONCRETE HEADWALL
SOUTHWEST STORMWATER POND)
INVERT ELEV. = 3323.00'
INVERT ELEV. = 3330.93'
CULVERT 6
LANDFILL ANCHOR TRENCH
PERIMETER BERM
ACCESS/HAUL ROAD
LEGEND:
EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
PROPOSED SUBGRADE CONTOURS (2' INTERVALS)
PERMIT BOUNDARY/FENCE
4" LEACHATE FORCE MAIN
OVERHEAD ELECTRIC
EXISTING GAS LINES / GAS EASEMENT
EXISTING WATER LINE
STORMWATER CHANNEL FLOWLINE
EDGE OF WASTE
CELL BOUNDARIES
ANCHOR TRENCH
PROPOSED CULVERT
NOTES:
1. LINES AND GRADES SHOWN REPRESENT THE TOP OF THE LINER SYSTEM EXCLUDING THE 2-FOOT THICK PROTECTIVE COVER.
2. SEE DRAWING 4 FOR DRAINAGE STRUCTURE SIZING AND DESIGN.
SCALE IN FEET
MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19
FOR PERMITTING PURPOSES ONLY
REV. DATE BY DESCRIPTION
1 9/19 KHJ UPDATED PER JIM JORDAN COMMENTS
CELL W-5 PLAN VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210
DRAWING 16
DESIGNED BY: MPB
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
ACAD NO. 572-002
SHEET NO.: 16 OF 39


SCALES:
1" = 200' (HORIZONTAL)
1" = 40' (VERTICAL)
VERTICAL EXAGGERATION = x 5
SCALE IN FEET
MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19
LEGEND:
PROPOSED TOP OF FINAL COVER
PROPOSED TOP OF WASTE
PROPOSED TOP OF PROTECTIVE COVER
PROPOSED TOP OF SUBGRADE
PROPOSED PERIMETER INFRASTRUCTURE
EXISTING GRADE (11/30/2018)
CELL BOUNDARIES
TYPICAL LANDFILL FINAL COVER SYSTEM
STORMWATER DIVERSION BERM
OIL FIELD WASTE
CELL 5 (24.7 AC)
CELL 4 (23.9 AC)
PERIMETER BERM
LANDFILL ANCHOR TRENCH
ACCESS/HAUL ROAD
PERIMETER DITCH (SEE SHEET 4)
TYPICAL LANDFILL BASE LINER SYSTEM
INTERMEDIATE CELL DIVIDER BERM
LEACHATE COLLECTION SUMP
ALIGN - A-A'
SECTION A 17
STORMWATER DIVERSION BERM (TYP.)
STORMWATER LETDOWN STRUCTURE
RUNON CHANNEL (SEE SHEET 4)
LEACHATE COLLECTION TRENCH
WEST STORMWATER POND
LEACHATE SUMP RISER PIPES
ALIGN - B-B'
SECTION B 17
Station
Elevation
FOR PERMITTING PURPOSES ONLY
REV. 1 DATE 9/19 BY KHJ DESCRIPTION UPDATED PER JIM GRIFFIN (NMOCD) COMMENTS
CELL W- 5 SECTION VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO
Terracon
Consulting Engineers and Scientists
DRAWING 17
DESIGNED BY: MPB
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
SHEET NO.: 17 OF 39



LEGEND:

- 3300 — EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
- 3300 — PROPOSED SUBGRADE CONTOURS (5' INTERVALS)
- PERMIT BOUNDARY/FENCE
- 4" LEACHATE FORCE MAIN
- OE — OVERHEAD ELECTRIC
- G — EXISTING GAS LINES / GAS EASEMENT
- W — EXISTING WATER LINE
- STORMWATER CHANNEL FLOWLINE
- EDGE OF WASTE
- CELL BOUNDARIES
- ANCHOR TRENCH

N

200 0 100 200

SCALE IN FEET

NOTES:

1. LINES AND GRADES SHOWN REPRESENT THE TOP OF THE LINER SYSTEM EXCLUDING THE 2-FOOT THICK PROTECTIVE COVER.
2. SEE DRAWING 4 FOR DRAINAGE STRUCTURE SIZING AND DESIGN.

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

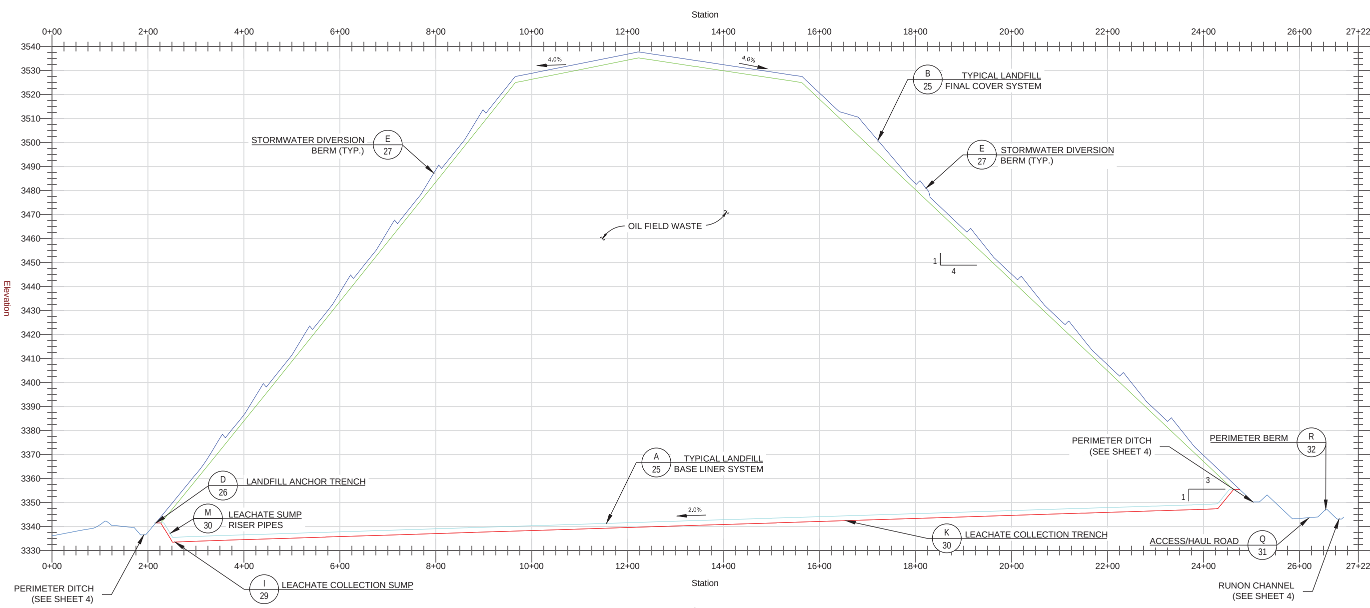
PIGGY BACK PLAN VIEW

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 18

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	18 OF 39



ALIGN - A-A'

SECTION A 19

SCALES:
1" = 200' (HORIZONTAL)
1" = 40' (VERTICAL)
VERTICAL EXAGGERATION = x 5

200 0 100 200
SCALE IN FEET

LEGEND:
- PROPOSED TOP OF FINAL COVER
- PROPOSED TOP OF WASTE
- PROPOSED TOP OF PROTECTIVE COVER
- PROPOSED TOP OF SUBGRADE
- PROPOSED PERIMETER INFRASTRUCTURE
- EXISTING GRADE (11/30/2018)
- CELL BOUNDARIES

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

PIGGY BACK SECTION VIEW
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

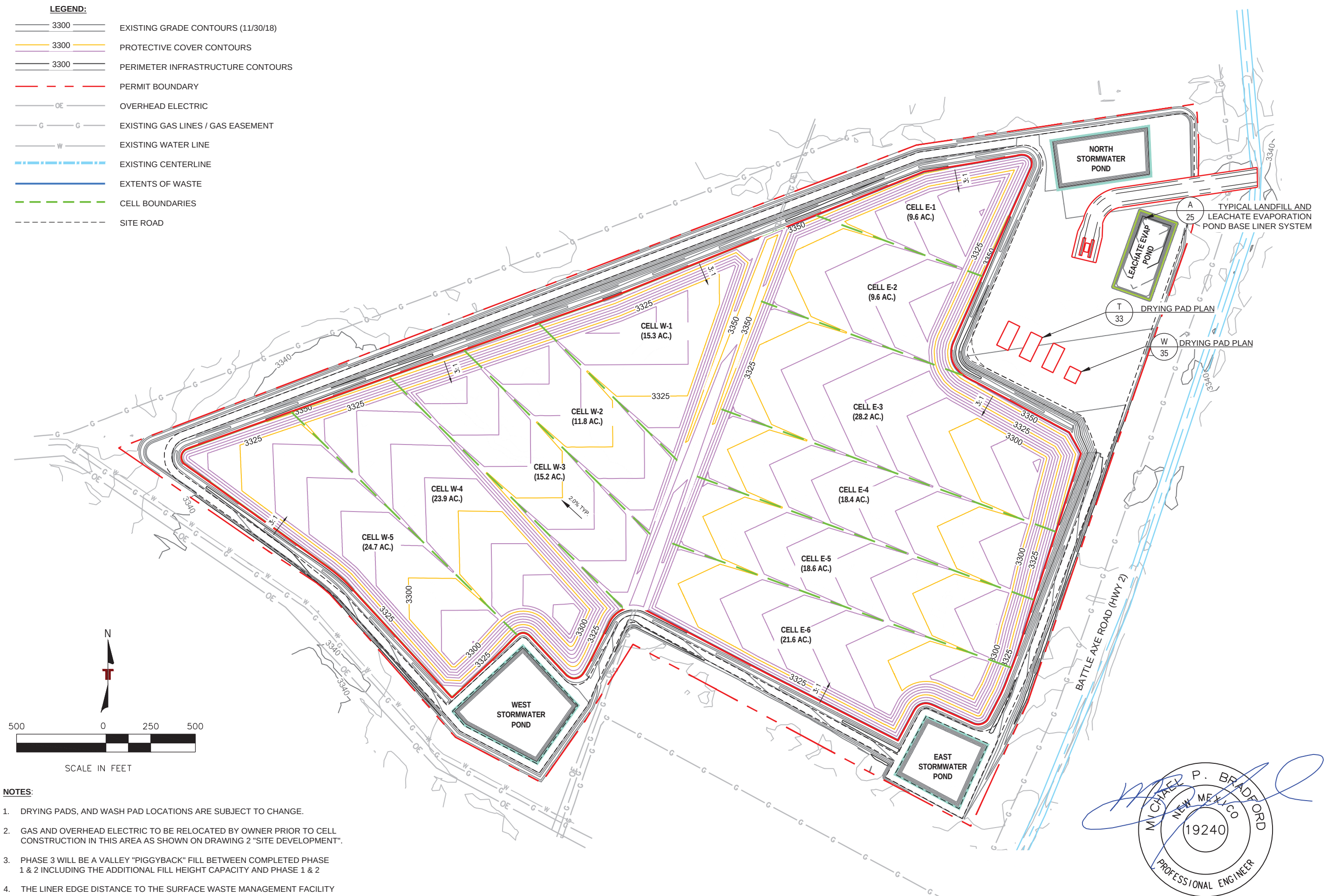
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 19

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	19 OF 39

LEGEND:

3300	EXISTING GRADE CONTOURS (11/30/18)
3300	PROTECTIVE COVER CONTOURS
3300	PERIMETER INFRASTRUCTURE CONTOURS
	PERMIT BOUNDARY
OE	OVERHEAD ELECTRIC
G	EXISTING GAS LINES / GAS EASEMENT
W	EXISTING WATER LINE
	EXISTING CENTERLINE
	EXTENTS OF WASTE
	CELL BOUNDARIES
	SITE ROAD



NOTES:

1. DRYING PADS, AND WASH PAD LOCATIONS ARE SUBJECT TO CHANGE.
2. GAS AND OVERHEAD ELECTRIC TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA AS SHOWN ON DRAWING 2 "SITE DEVELOPMENT".
3. PHASE 3 WILL BE A VALLEY "PIGGYBACK" FILL BETWEEN COMPLETED PHASE 1 & 2 INCLUDING THE ADDITIONAL FILL HEIGHT CAPACITY AND PHASE 1 & 2
4. THE LINER EDGE DISTANCE TO THE SURFACE WASTE MANAGEMENT FACILITY BOUNDARY VARIES, BUT IS A MINIMUM OF 125-FEET ALONG SOUTHWEST SIDE OF PHASE 2.

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

TOP OF PROTECTIVE COVER

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 20

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	20 OF 39

LEGEND:

3300	EXISTING GRADE CONTOURS (11/30/18)
3300	PROTECTIVE COVER CONTOURS
3300	PERIMETER INFRASTRUCTURE CONTOURS
— — —	PERMIT BOUNDARY
OE	OVERHEAD ELECTRIC
G — G	EXISTING GAS LINES / GAS EASEMENT
W	EXISTING WATER LINE
— - —	EXISTING CENTERLINE
- - - -	SITE ROAD

NOTES:

1. DRYING PADS, AND WASH PAD LOCATIONS ARE SUBJECT TO CHANGE.
2. EXISTING GAS AND OVERHEAD ELECTRIC OVER PHASE 3 AREA TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA AS SHOWN ON DRAWING 2 "SITE DEVELOPMENT".
3. PHASE 3 WILL BE A VALLEY "PIGGYBACK" FILL BETWEEN COMPLETED PHASE 1 & 2 INCLUDING THE ADDITIONAL FILL HEIGHT CAPACITY AND PHASE 1 & 2.

FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

NGL

INTERMEDIATE TOP OF WASTE

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon

Consulting Engineers and Scientists

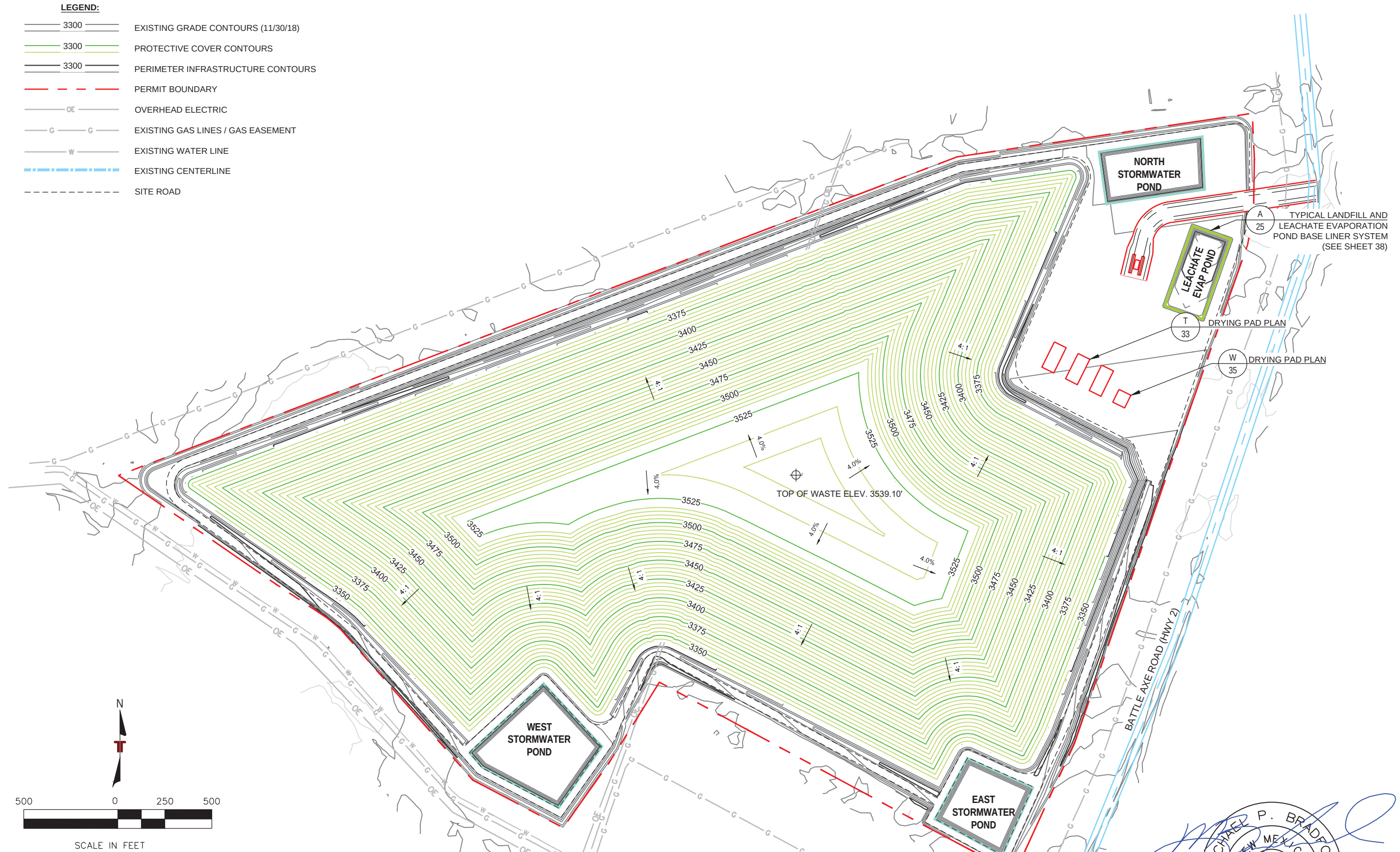
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 21

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	21 OF 39

LEGEND:

3300	EXISTING GRADE CONTOURS (11/30/18)
3300	PROTECTIVE COVER CONTOURS
3300	PERIMETER INFRASTRUCTURE CONTOURS
	PERMIT BOUNDARY
OE	OVERHEAD ELECTRIC
G G	EXISTING GAS LINES / GAS EASEMENT
W	EXISTING WATER LINE
	EXISTING CENTERLINE
	SITE ROAD



NOTES:

1. DRYING PADS, AND WASH PAD LOCATIONS ARE SUBJECT TO CHANGE.
2. EXISTING GAS AND OVERHEAD ELECTRIC OVER PHASE 3 AREA TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA AS SHOWN ON DRAWING 2 "SITE DEVELOPMENT".
3. PHASE 3 WILL BE A VALLEY "PIGGYBACK" FILL BETWEEN COMPLETED PHASE 1 & 2 INCLUDING THE ADDITIONAL FILL HEIGHT CAPACITY AND PHASE 1 & 2.

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

FINAL TOP OF WASTE

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

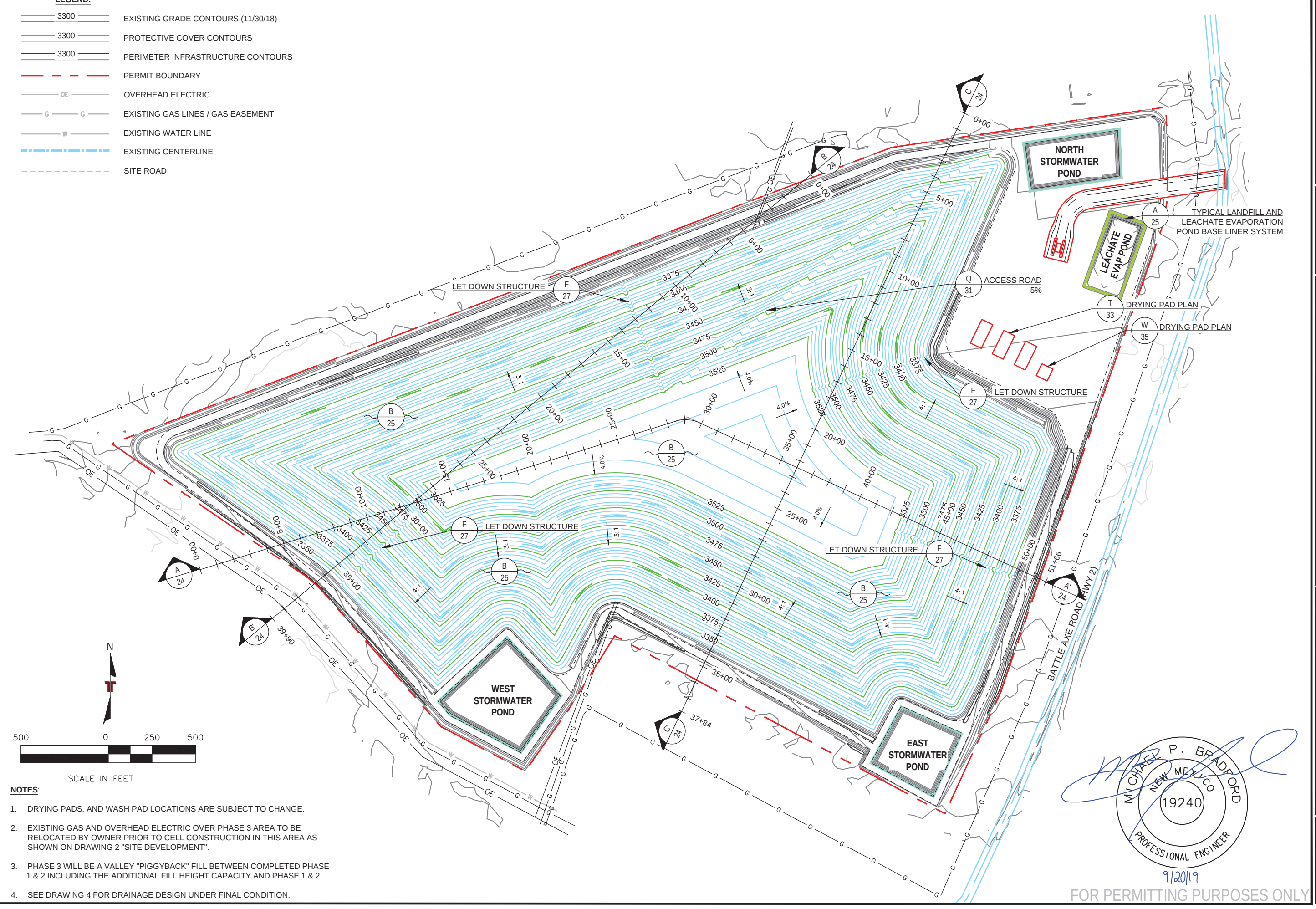
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 22

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	22 OF 39

LEGEND:

- 3300 — EXISTING GRADE CONTOURS (11/30/18)
- 3300 — PROTECTIVE COVER CONTOURS
- 3300 — PERIMETER INFRASTRUCTURE CONTOURS
- PERMIT BOUNDARY
- OE — OVERHEAD ELECTRIC
- G — G — EXISTING GAS LINES / GAS EASEMENT
- W — EXISTING WATER LINE
- EXISTING CENTERLINE
- SITE ROAD



NOTES:

1. DRYING PADS, AND WASH PAD LOCATIONS ARE SUBJECT TO CHANGE.
2. EXISTING GAS AND OVERHEAD ELECTRIC OVER PHASE 3 AREA TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA AS SHOWN ON DRAWING 2 "SITE DEVELOPMENT".
3. PHASE 3 WILL BE A VALLEY "PIGGYBACK" FILL BETWEEN COMPLETED PHASE 1 & 2 INCLUDING THE ADDITIONAL FILL HEIGHT CAPACITY AND PHASE 1 & 2.
4. SEE DRAWING 4 FOR DRAINAGE DESIGN UNDER FINAL CONDITION.

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

FINAL COVER SYSTEM GRADE
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
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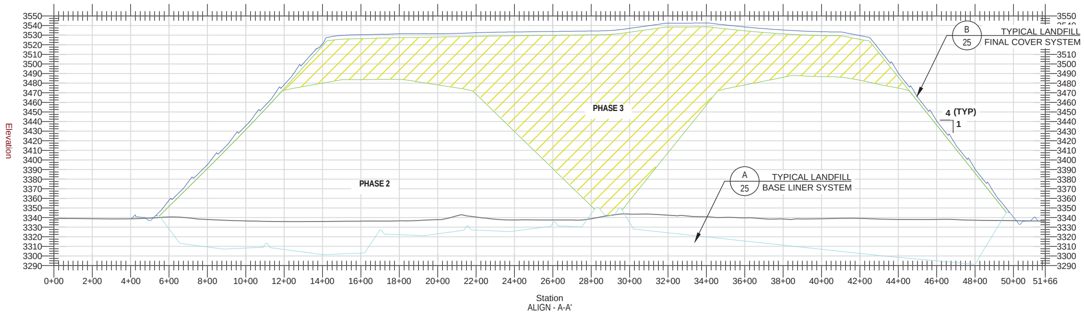
DRAWING 23

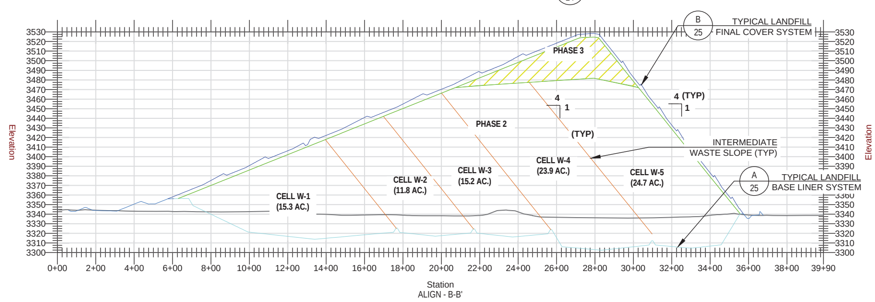
DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	23 OF 39



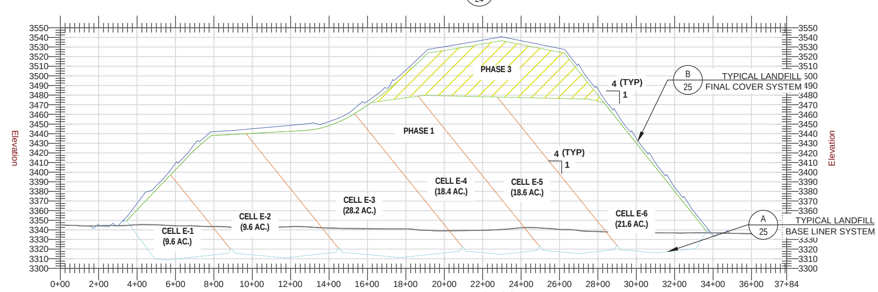
SECTION A 24

LEGEND:

- PROPOSED TOP OF FINAL COVER
- PROPOSED TOP OF WASTE
- PROPOSED TOP OF PROTECTIVE COVER
- PROPOSED TOP OF PERIMETER INFRASTRUCTURE
- PROPOSED INTERMEDIATE COVER
- EXISTING GROUND
- PHASE 3 WASTE FILL



SECTION B 24



SECTION C 24

Cell	Operational Capacity (CY)	Routine and Intermediate Soil Cover (10% of Operational Waste Capacity) (CY)	Waste Capacity (90% of Operational Capacity) (CY)
		PHASE 1	
E-1	933,202	93,320	839,882
E-2	2,111,021	211,102	1,899,919
E-3	5,116,491	511,649	4,604,842
E-4	3,939,124	393,912	3,545,212
E-5	3,840,751	384,075	3,456,676
E-6	2,564,850	256,485	2,308,365
PHASE 1	**18,505,439**	**1,850,543**	**16,654,896**
		PHASE 2	
W-1	1,108,726	110,873	997,853
W-2	1,322,275	132,228	1,190,048
W-3	2,075,688	207,569	1,868,119
W-4	4,148,670	414,867	3,733,803
W-5	4,679,514	467,951	4,211,563
PHASE 2	**13,334,873**	**1,333,493**	**12,001,391**
PHASE 3	**8,424,012**	**842,401**	**7,581,611**
TOTAL	**40,264,324**	**4,026,432**	**36,237,892**

NOTES:

1. OPERATIONAL = WASTE PLUS ROUTINE AND INTERIM SOIL COVER.

SCALES:
1" = 500' (HORIZONTAL)
1" = 100' (VERTICAL)
VERTICAL EXAGGERATION = x 5

500 0 250 500

SCALE IN FEET

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NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

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FINAL COVER SYSTEM GRADE SECTION VIEW
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DRAWING 24

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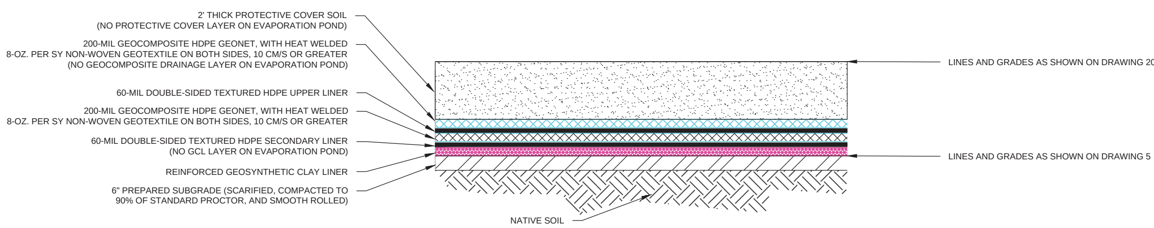
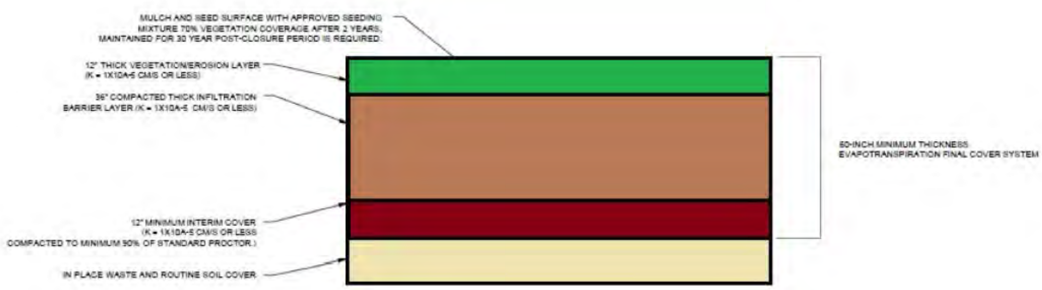
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	24 OF 39



TYPICAL LANDFILL AND LEACHATE EVAPORATION POND BASE LINER SYSTEM

DETAIL A/25
N.T.S.



TYPICAL LANDFILL FINAL COVER SYSTEM

DETAIL B/25
N.T.S.

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LINER AND FINAL COVER DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
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DRAWING 25

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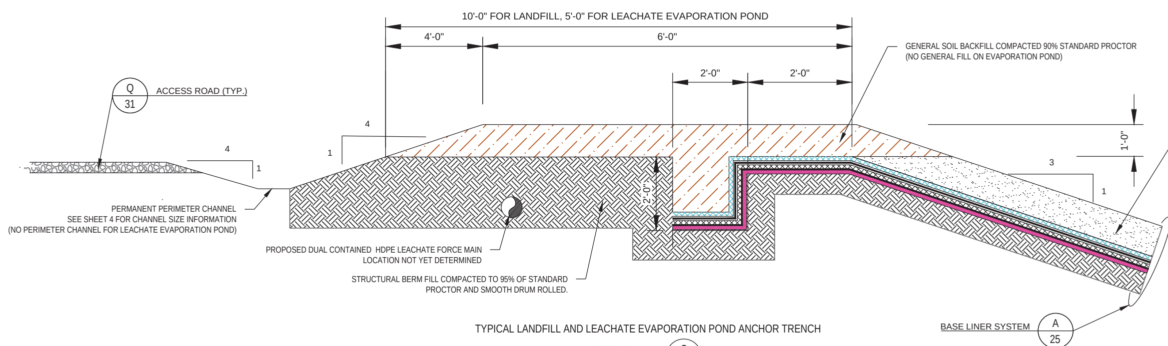
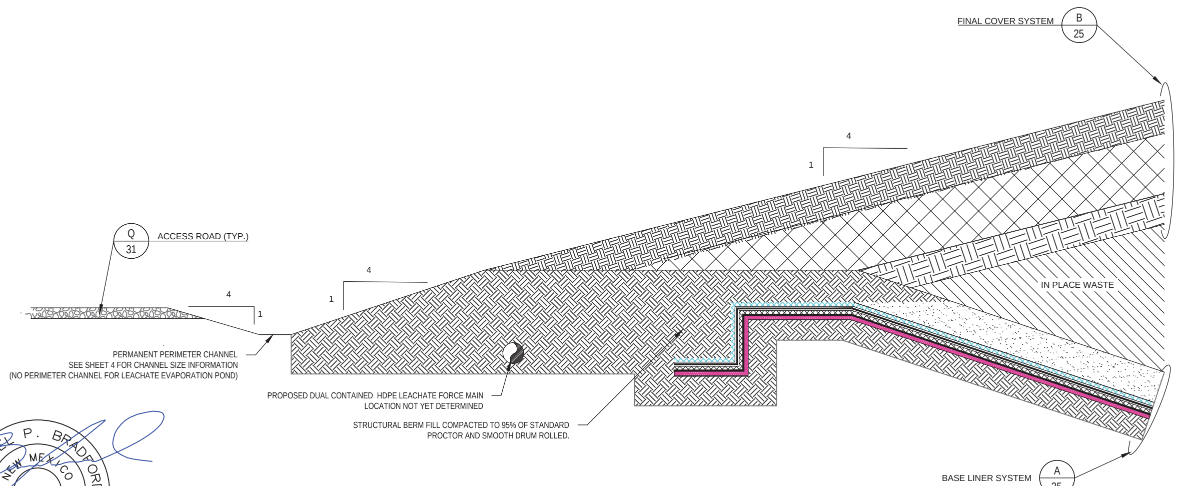
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	25 OF 39



TYPICAL LANDFILL AND LEACHATE EVAPORATION POND ANCHOR TRENCH

DETAIL C/26
N.T.S.



TYPICAL LANDFILL FINAL COVER SYSTEM ANCHOR TRENCH

DETAIL D/26
N.T.S.

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ANCHOR TRENCH DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
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DRAWING 26

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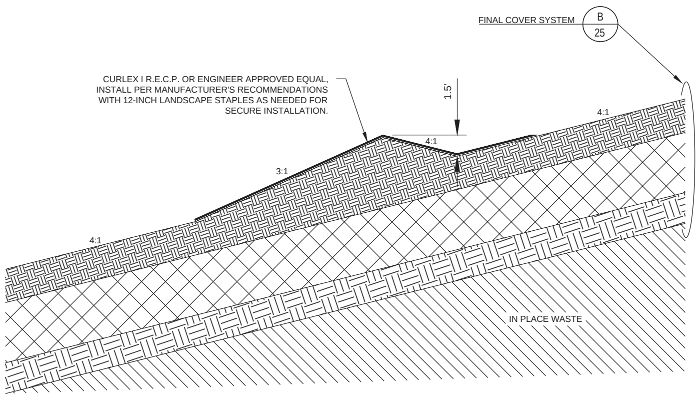
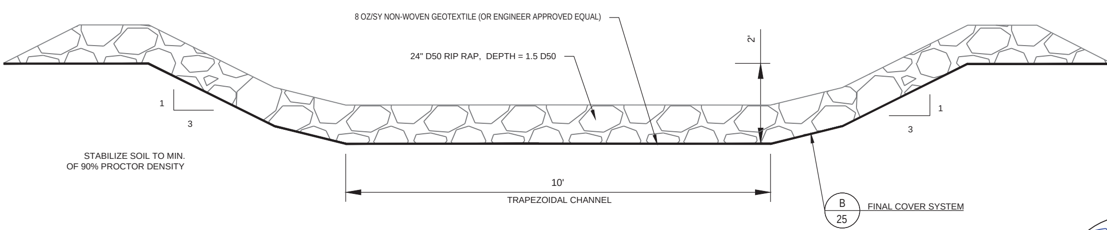
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	26 OF 39



FINAL COVER SIDE SLOPE STORMWATER DIVERSION BERM

DETAIL E 27
N.T.S.



FINAL COVER SIDE SLOPE LET DOWN STRUCTURE

DETAIL F 27
N.T.S.

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9/20/19

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FINAL COVER STORMWATER STRUCTURE DETAILS
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DRAWING 27

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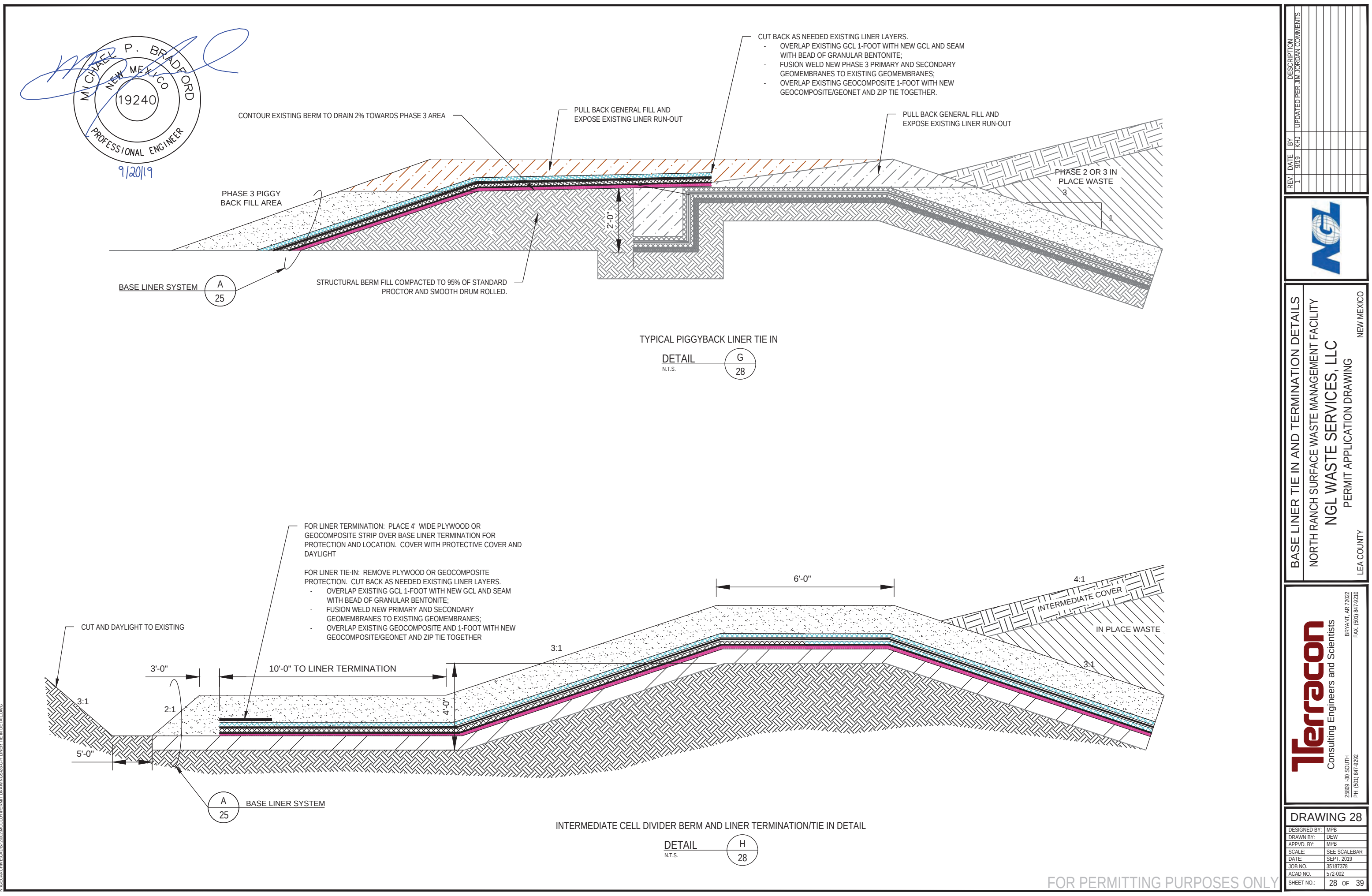
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	27 OF 39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19240
PROFESSIONAL ENGINEER
9/20/19
CUT BACK AS NEEDED EXISTING LINER LAYERS.
- OVERLAP EXISTING GCL 1-FOOT WITH NEW GCL AND SEAM WITH BEAD OF GRANULAR BENTONITE;
- FUSION WELD NEW PHASE 3 PRIMARY AND SECONDARY GEOMEMBRANES TO EXISTING GEOMEMBRANES;
- OVERLAP EXISTING GEOCOMPOSITE 1-FOOT WITH NEW GEOCOMPOSITE/GEONET AND ZIP TIE TOGETHER.
CONTOUR EXISTING BERM TO DRAIN 2% TOWARDS PHASE 3 AREA
PULL BACK GENERAL FILL AND EXPOSE EXISTING LINER RUN-OUT
PULL BACK GENERAL FILL AND EXPOSE EXISTING LINER RUN-OUT
PHASE 2 OR 3 IN PLACE WASTE
3
1
PHASE 3 PIGGY BACK FILL AREA
2'-0"
BASE LINER SYSTEM
A
25
STRUCTURAL BERM FILL COMPACTED TO 95% OF STANDARD PROCTOR AND SMOOTH DRUM ROLLED.
TYPICAL PIGGYBACK LINER TIE IN
DETAIL
N.T.S.
G
28
FOR LINER TERMINATION: PLACE 4' WIDE PLYWOOD OR GEOCOMPOSITE STRIP OVER BASE LINER TERMINATION FOR PROTECTION AND LOCATION. COVER WITH PROTECTIVE COVER AND DAYLIGHT
FOR LINER TIE-IN: REMOVE PLYWOOD OR GEOCOMPOSITE PROTECTION. CUT BACK AS NEEDED EXISTING LINER LAYERS.
- OVERLAP EXISTING GCL 1-FOOT WITH NEW GCL AND SEAM WITH BEAD OF GRANULAR BENTONITE;
- FUSION WELD NEW PRIMARY AND SECONDARY GEOMEMBRANES TO EXISTING GEOMEMBRANES;
- OVERLAP EXISTING GEOCOMPOSITE AND 1-FOOT WITH NEW GEOCOMPOSITE/GEONET AND ZIP TIE TOGETHER
6'-0"
4:1
INTERMEDIATE COVER
IN PLACE WASTE
3:1
3:1
CUT AND DAYLIGHT TO EXISTING
3'-0"
10'-0" TO LINER TERMINATION
4'-0"
3:1
2:1
5'-0"
A
25
BASE LINER SYSTEM
INTERMEDIATE CELL DIVIDER BERM AND LINER TERMINATION/TIE IN DETAIL
DETAIL
N.T.S.
H
28
FOR PERMITTING PURPOSES ONLY
REV. DATE BY DESCRIPTION
1 9/19 KHJ UPDATED PER JIM JORDAN COMMENTS
BASE LINER TIE IN AND TERMINATION DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
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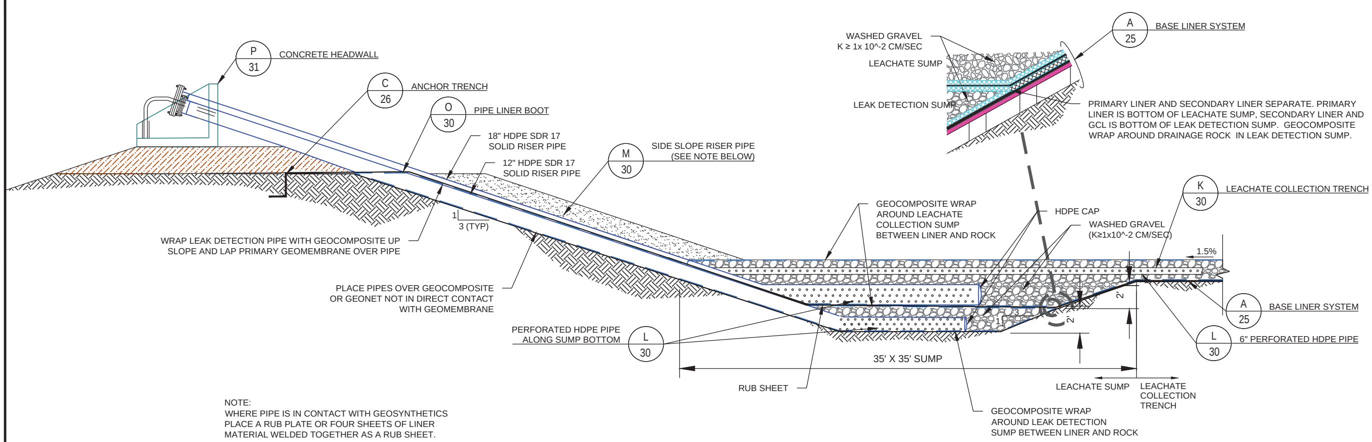
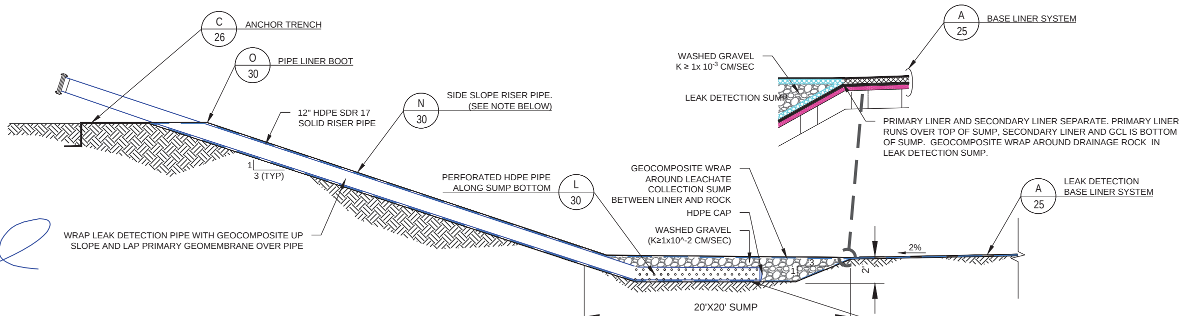
DRAWING 28
DESIGNED BY: MPB
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
ACAD NO. 572-002
SHEET NO.: 28 OF 39



NOTE:
WHERE PIPE IS IN CONTACT WITH GEOSYNTHETICS PLACE A RUB PLATE OR FOUR SHEETS OF LINER MATERIAL WELDED TOGETHER AS A RUB SHEET.

LEACHATE COLLECTION AND RECOVERY SUMP WITH LEAK DETECTION SUMP

DETAIL I/29
N.T.S.



NOTE:
WHERE PIPE IS IN CONTACT WITH GEOSYNTHETICS PLACE A RUB PLATE OR FOUR SHEETS OF LINER MATERIAL WELDED TOGETHER AS A RUB SHEET.

EVAPORATION POND LEAK DETECTION SUMP

DETAIL J/29
N.T.S.

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LEACHATE AND LEAK DETECTION SUMP DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
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DRAWING 29

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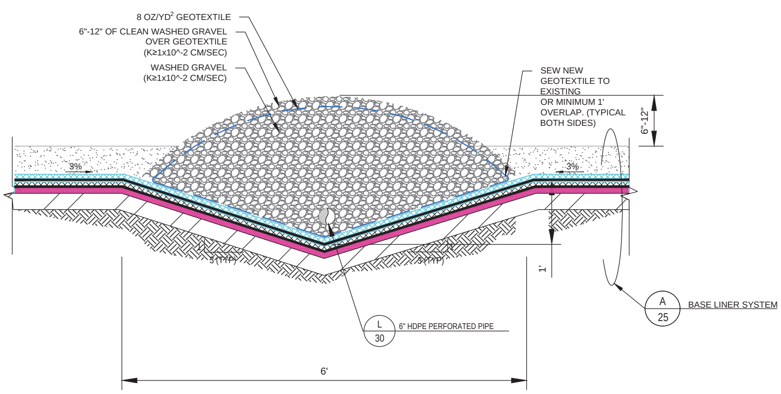
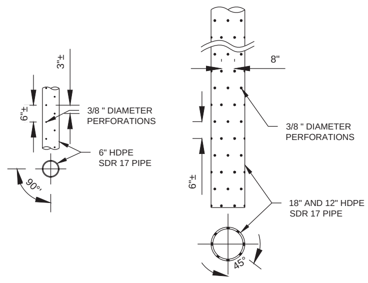
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	29 OF 39



LEACHATE COLLECTION PIPE AND TRENCH

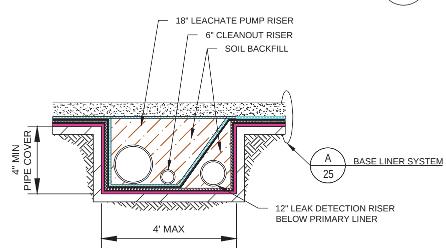
DETAIL K 30
N.T.S.



NOTE:
PERFORATIONS BUILT TO MANUFACTURER STANDARD.

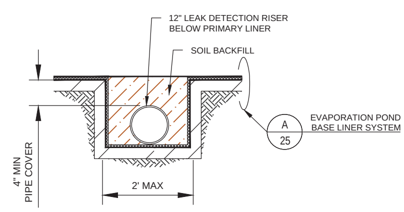
PIPE PERFORATION DETAIL

DETAIL L 30
N.T.S.



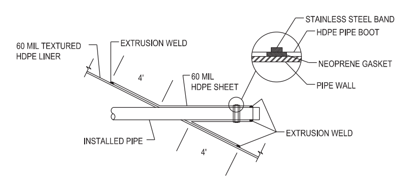
LANDFILL LEACHATE AND LEAK DETECTION SUMP RISER PIPE TRENCH

DETAIL M 30
N.T.S.



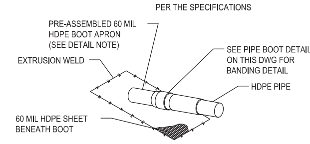
EVAPORATION POND LEAK DETECTION SUMP RISER PIPE TRENCH

DETAIL N 30
N.T.S.



HDPE LINER PIPE BOOT DETAIL – PROFILE VIEW

NOTE:
CONTRACTOR SHALL PROVIDE PRE-ASSEMBLED AND TESTED/ CERTIFIED PIPE BOOTS FOR EACH PIPE PENETRATION AS PER THE SPECIFICATIONS



PIPE BOOT DETAIL – ISOMETRIC VIEW

GEOMEMBRANE PIPE BOOT

DETAIL O 30
N.T.S.

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19240
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MISCELLANEOUS LINER DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
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DRAWING 30

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SCALE:	SEE SCALEBAR
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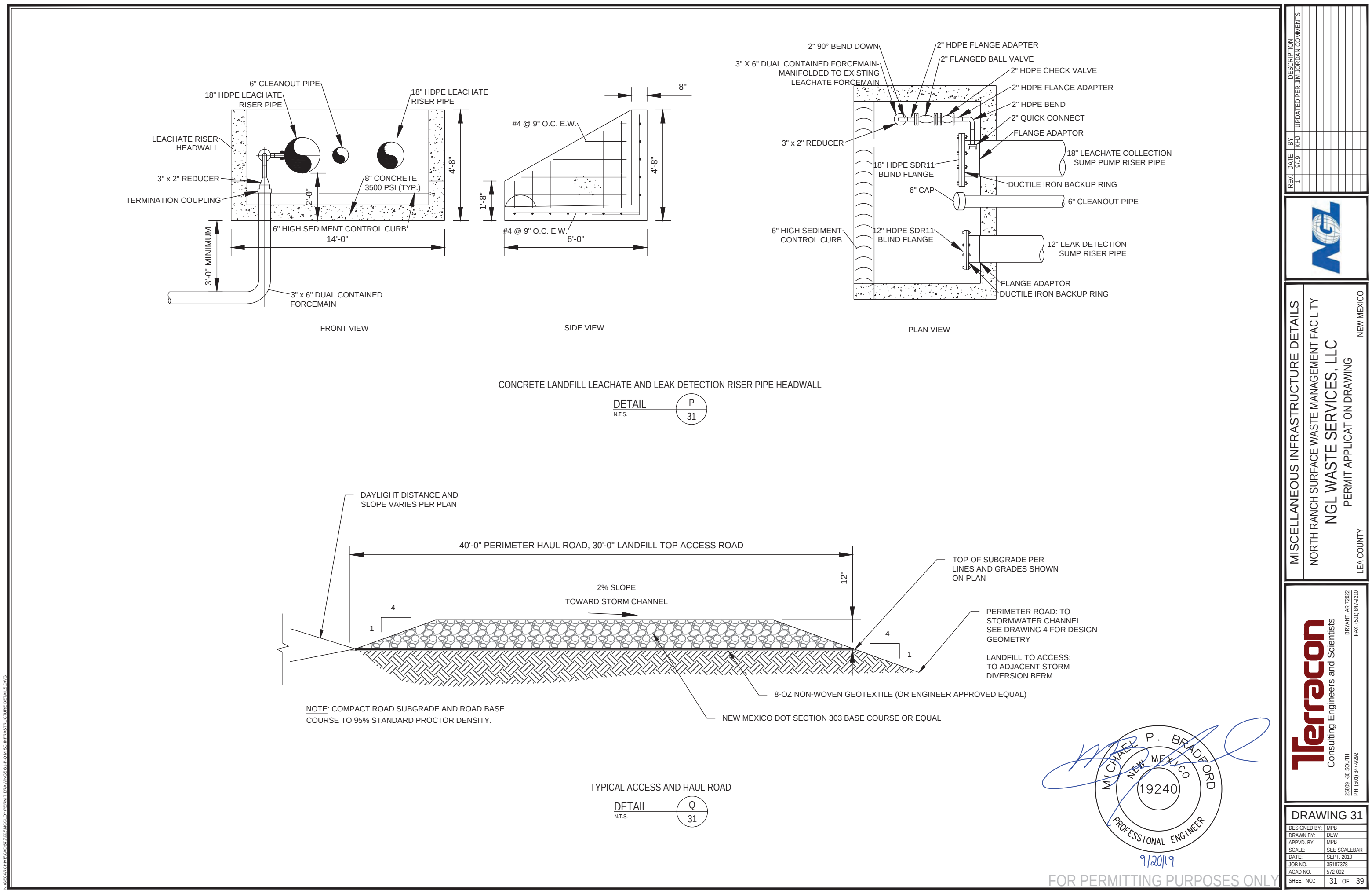
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	30 OF 39


2" 90° BEND DOWN
2" HDPE FLANGE ADAPTER
2" FLANGED BALL VALVE
3" X 6" DUAL CONTAINED FORCEMAIN-MANIFOLDED TO EXISTING LEACHATE FORCEMAIN
2" HDPE CHECK VALVE
2" HDPE FLANGE ADAPTER
2" HDPE BEND
2" QUICK CONNECT
FLANGE ADAPTOR
3" x 2" REDUCER
18" LEACHATE COLLECTION SUMP PUMP RISER PIPE
18" HDPE SDR11 BLIND FLANGE
DUCTILE IRON BACKUP RING
6" CAP
6" CLEANOUT PIPE
6" HIGH SEDIMENT CONTROL CURB
12" HDPE SDR11 BLIND FLANGE
12" LEAK DETECTION SUMP RISER PIPE
FLANGE ADAPTOR
DUCTILE IRON BACKUP RING
6" CLEANOUT PIPE
18" HDPE LEACHATE RISER PIPE
18" HDPE LEACHATE RISER PIPE
LEACHATE RISER HEADWALL
3" x 2" REDUCER
TERMINATION COUPLING
8" CONCRETE 3500 PSI (TYP.)
6" HIGH SEDIMENT CONTROL CURB
14'-0"
4'-8"
2'-0"
3'-0" MINIMUM
3" x 6" DUAL CONTAINED FORCEMAIN
8"
#4 @ 9" O.C. E.W.
#4 @ 9" O.C. E.W.
1'-8"
4'-8"
6'-0"
FRONT VIEW
SIDE VIEW
PLAN VIEW
CONCRETE LANDFILL LEACHATE AND LEAK DETECTION RISER PIPE HEADWALL
DETAIL P 31
N.T.S.
DAYLIGHT DISTANCE AND SLOPE VARIES PER PLAN
40'-0" PERIMETER HAUL ROAD, 30'-0" LANDFILL TOP ACCESS ROAD
12"
2% SLOPE
TOWARD STORM CHANNEL
4
1
4
1
TOP OF SUBGRADE PER LINES AND GRADES SHOWN ON PLAN
PERIMETER ROAD: TO STORMWATER CHANNEL SEE DRAWING 4 FOR DESIGN GEOMETRY
LANDFILL TO ACCESS: TO ADJACENT STORM DIVERSION BERM
8-OZ NON-WOVEN GEOTEXTILE (OR ENGINEER APPROVED EQUAL)
NEW MEXICO DOT SECTION 303 BASE COURSE OR EQUAL
NOTE: COMPACT ROAD SUBGRADE AND ROAD BASE COURSE TO 95% STANDARD PROCTOR DENSITY.
TYPICAL ACCESS AND HAUL ROAD
DETAIL Q 31
N.T.S.
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NEW MEXICO
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9/20/19
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MISCELLANEOUS INFRASTRUCTURE DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
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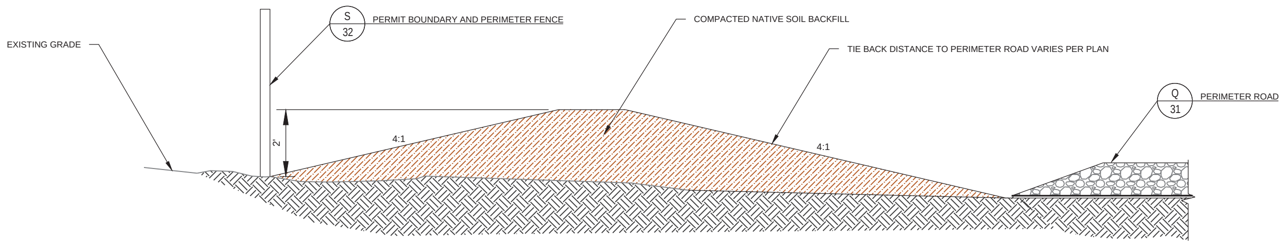
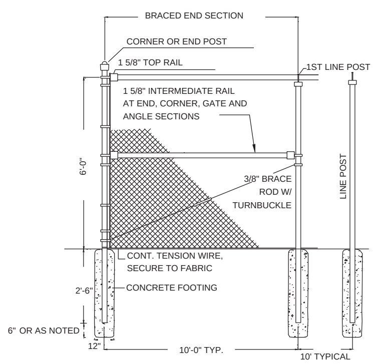
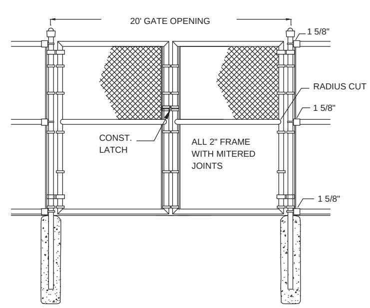
DRAWN BY: DEW
APPVD. BY: MPB
SCALE: SEE SCALEBAR
DATE: SEPT. 2019
JOB NO. 35187378
SHEET NO.: 31 OF 39



PERIMETER BERM

DETAIL R 32
N.T.S.





NOTES: USE 11 GUAGE FABRIC TYP. USE 9 GUAGE AT ALL BACKSTOPS, 10' FENCES (EXCEPT TENNIS COURTS) AND DUGOUTS.

1. USE 3" GATE, CORNER AND END POSTS WITH 2 1/2" LINE POSTS.
2. ALL JOINTS WITH CONTINUOUS FILLET WELD AND GROUND SMOOTH AND RE-GALVANIZED.
3. CONSTRUCT BRACED END SECTION AT BOTH SIDES OF GATES, CORNERS, ANGLES AND AT ALL FENCE ENDS.
4. ALL PIPE SCH. 40. ALL FENCE FABRIC AND FENCE MEMBERS HOT DIPPED GALVANIZED
5. SET ALL SECTIONS PLUMB & IN LINE, 1" MAX.
6. DEVIATION ON TENNIS COURTS USE 11 GA W/ COLD FUSION BLACK VINYL COATING

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9/20/19

PERIMETER CHAIN LINK FENCE

DETAIL S 32
N.T.S.

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MISCELLANEOUS INFRASTRUCTURE DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
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DRAWING 32

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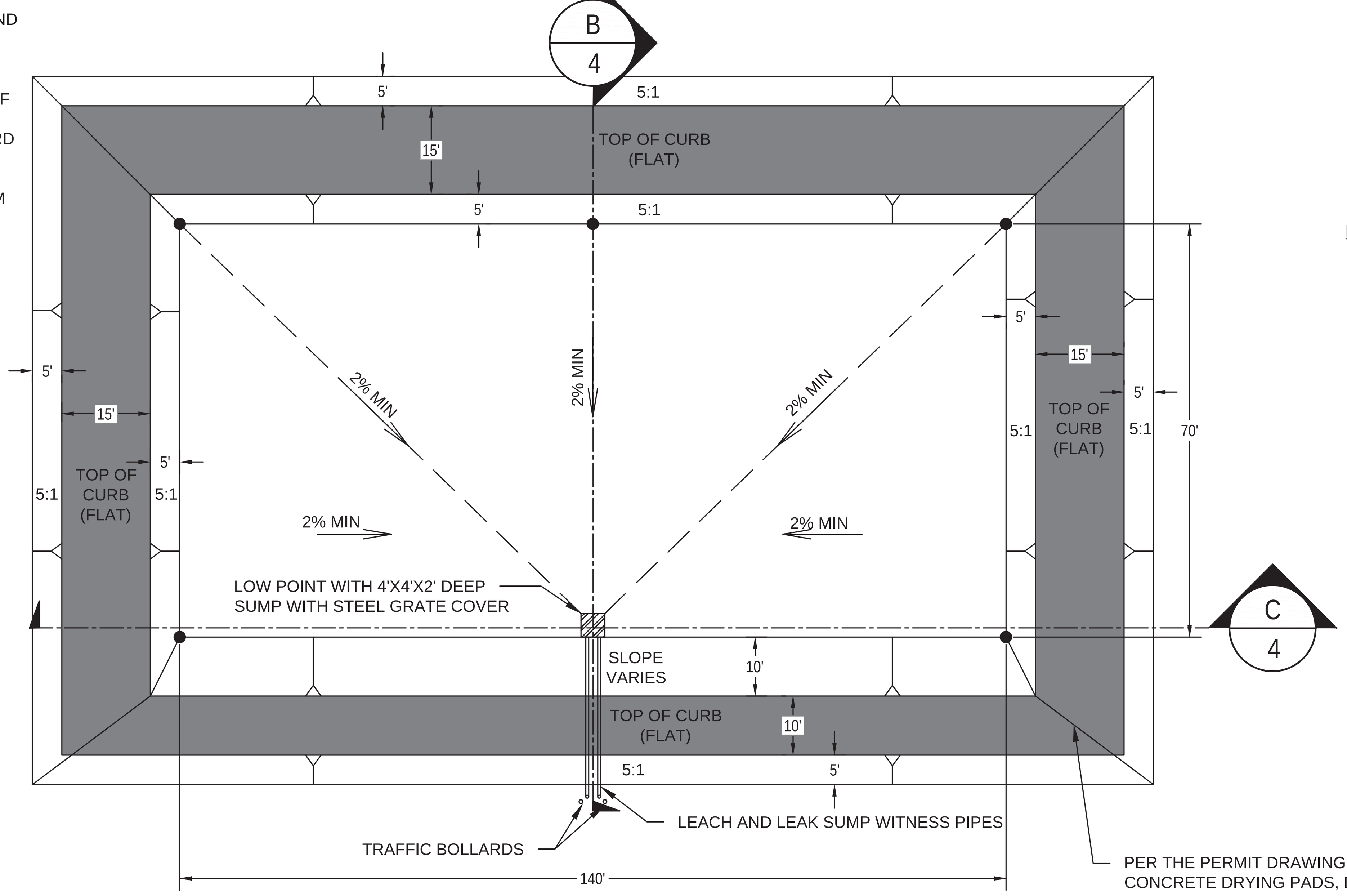
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	32 OF 39

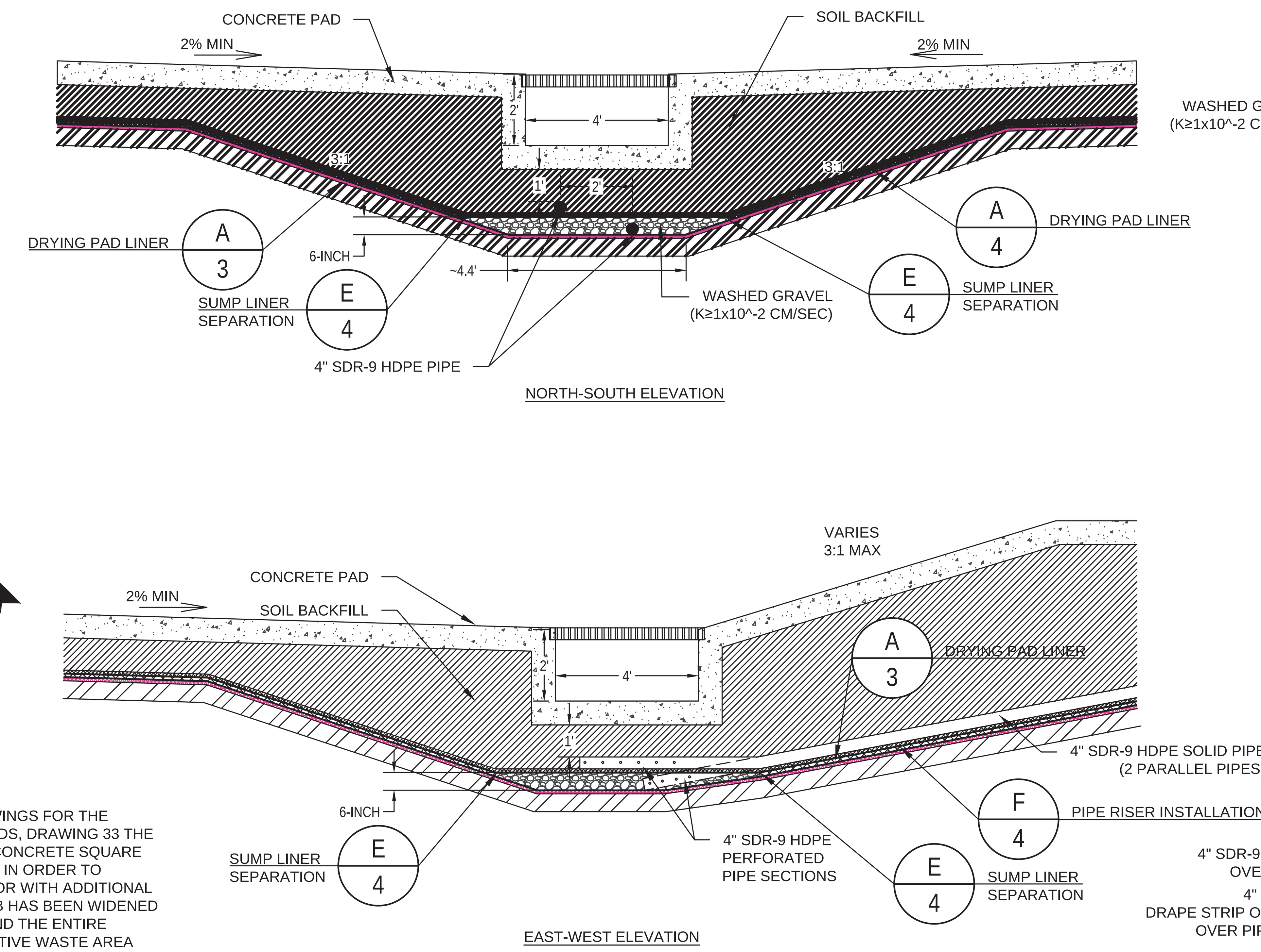
NOTE:
1. TOP OF CURB SHALL BE AND THE CORNERS INDICATED BY THIS SYMBOL ● SHALL BE AT SET AT THE SAME ELEVATION. THE FLOOR OF THE CONTAINMENT IS GRADED RADIALLY TOWARD THE SUMP WHICH IS SET ~2-FEET LOWER THAN THE CORNERS WITH A MINIMUM SLOPE OF 2%.



PER THE PERMIT DRAWINGS FOR THE CONCRETE DRYING PADS, DRAWING 33 THE OVERALL PERMITTED CONCRETE SQUARE FOOTAGE IS 11,900 SF. IN ORDER TO PROVIDE THE OPERATOR WITH ADDITIONAL PAD ACCESS THE CURB HAS BEEN WIDENED AND EXTENDED AROUND THE ENTIRE PERIMETER OF THE ACTIVE WASTE AREA INCREASING THE OVERALL CONCRETE SQUARE FOOTAGE TO 22,800 SF. NOTE THAT THE PROPOSED ACTIVE WASTE AREA PROVIDED IS PER THE PERMITTED PLAN OF 140-FT X 70-FT OR 9,800 SF.

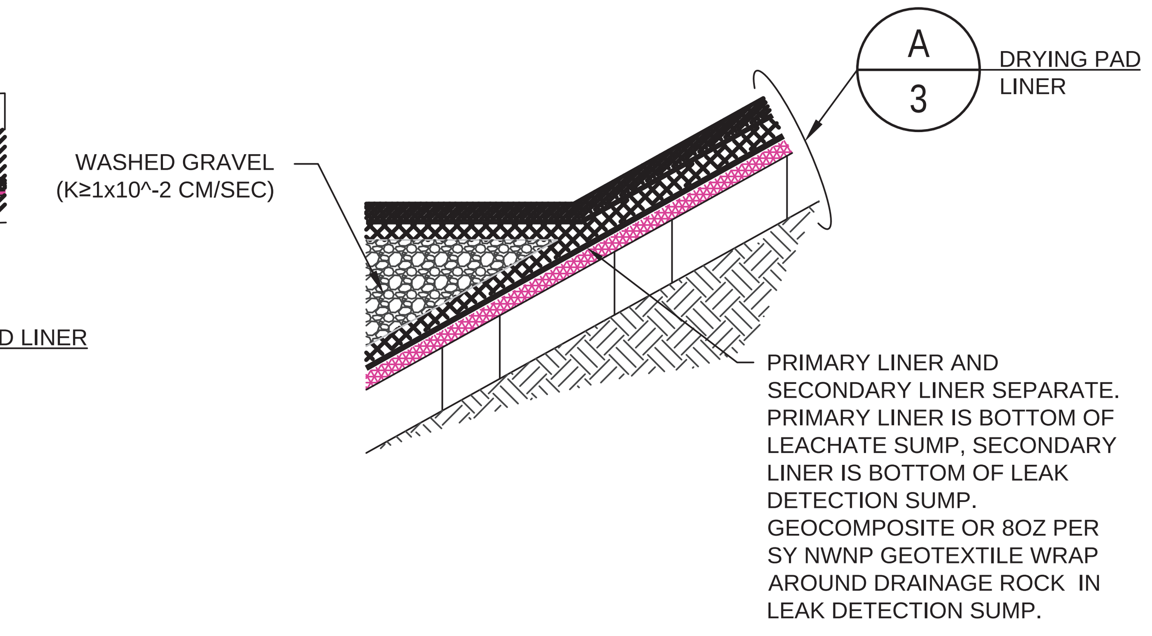
DRYING PAD DIMENSIONS PLAN

DETAIL A/4
SCALE: NOT TO SCALE



DRYING PAD SUMP DETAIL

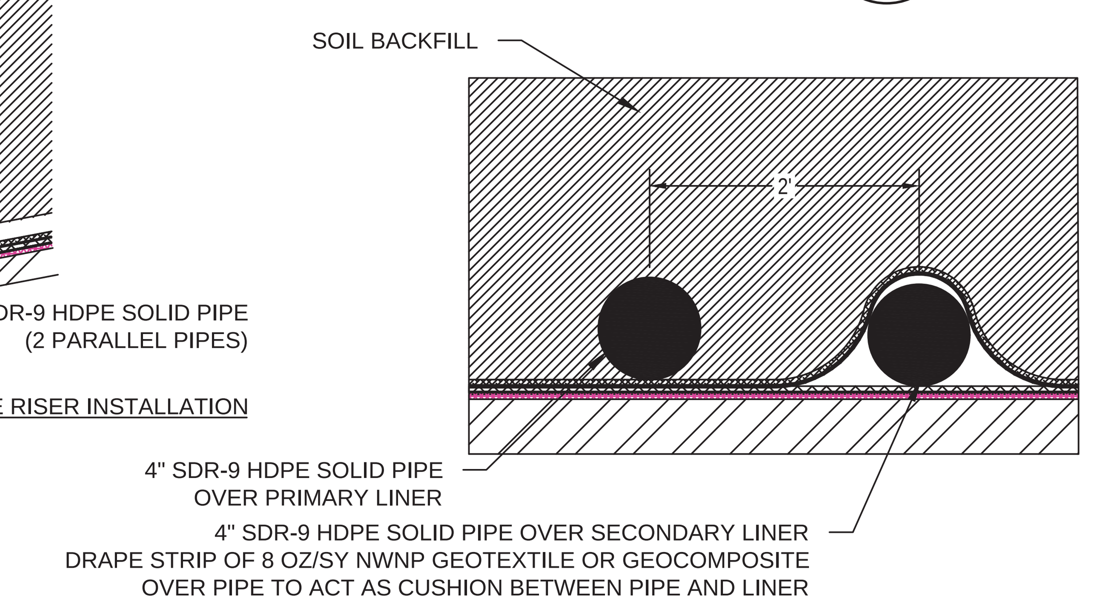
DETAIL D/4
SCALE: NOT TO SCALE



PRIMARY LINER AND SECONDARY LINER SEPARATE. PRIMARY LINER IS BOTTOM OF LEACHATE SUMP, SECONDARY LINER IS BOTTOM OF LEAK DETECTION SUMP. GEOCOMPOSITE OR 8OZ PER SY NWNP GEOTEXTILE WRAP AROUND DRAINAGE ROCK IN LEAK DETECTION SUMP.

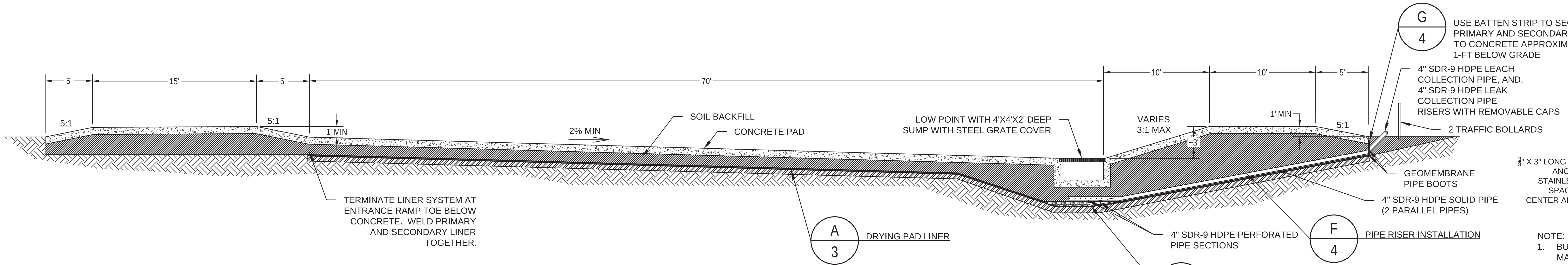
SUMP LINER SEPARATION

DETAIL E/4
SCALE: NOT TO SCALE



DRYING PAD WITNESS PIPE RISER DETAIL

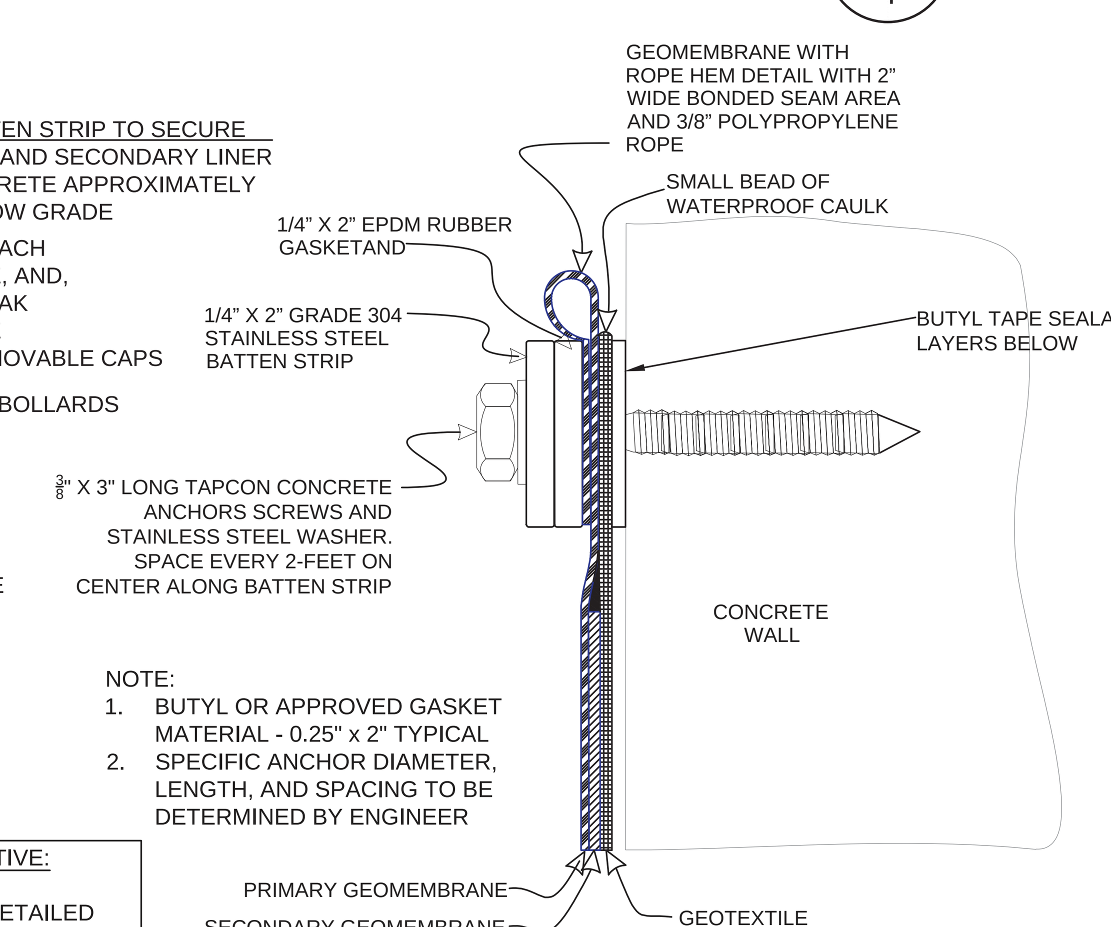
DETAIL F/4
SCALE: NOT TO SCALE



NOTE:
1. ALL CONCRETE OR ROCK - TO - GEOMEMBRANE INTERFACES MUST BE LINED WITH 8-OZ PER SQUARE YARD NON-WOVEN GEOTEXTILE

DRYING PAD DIMENSION PROFILE

DETAIL B/4
SCALE: 1"=4'



NOTE:
1. BUTYL OR APPROVED GASKET MATERIAL - 0.25" x 2" TYPICAL
2. SPECIFIC ANCHOR DIAMETER, LENGTH, AND SPACING TO BE DETERMINED BY ENGINEER

ACCEPTABLE ALTERNATIVE:
ENGINEER APPROVED ALTERNATIVE TO THE DETAILED CONCRETE BATTEN STRIP IS A CONCRETE EMBEDDED HDPE EXTRUSION WELDING STRIP, AGRU TRI-LOCK HDPE OR ENGINEER APPROVED EQUAL.

CONCRETE BATTEN STRIP WITH ROPE HEM

DETAIL G/4
SCALE: NOT TO SCALE

NOTE:
1. ALL CONCRETE OR ROCK - TO - GEOMEMBRANE INTERFACES MUST BE LINED WITH 8-OZ PER SQUARE YARD NON-WOVEN GEOTEXTILE

DRYING PAD DIMENSION PROFILE

DETAIL C/4
SCALE: 1"=4'

MICHAEL P. BRADFORD
NEW MEXICO
19240
11/15/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: DRYING PAD EXCAVATION PLAN

PROJECT TITLE: CELL E-1 DRYING PAD CONSTRUCTION PLANS
ANTELOPE DRAW SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

CLIENT: WASTE CONNECTIONS, INC.

SCS ENGINEERS
ENVIRONMENTAL CONSULTANTS
8799 BALBOA AVENUE, SUITE 290
SAN DIEGO, CA 92123
(858) 571-5500 FAX. (562) 427-0805

PROJ. NO. 01223193.00 | DWN. BY: WH | CHK. BY: MPB | DSN. BY: WH | APP. BY: MPB | ACAD FILE: -

DATE: NOVEMBER2023

SCALE:

SHEET: DWG 33

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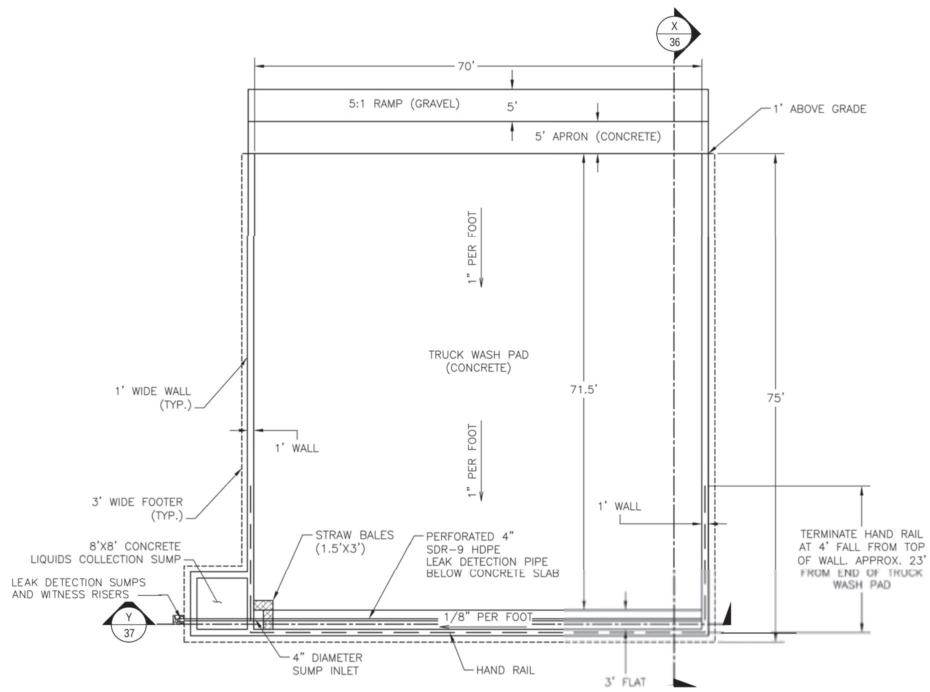


TRUCK WASH PAD PLAN

DETAIL W 35
N.T.S.

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

TRUCK WASH PAD PLAN VIEW

NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

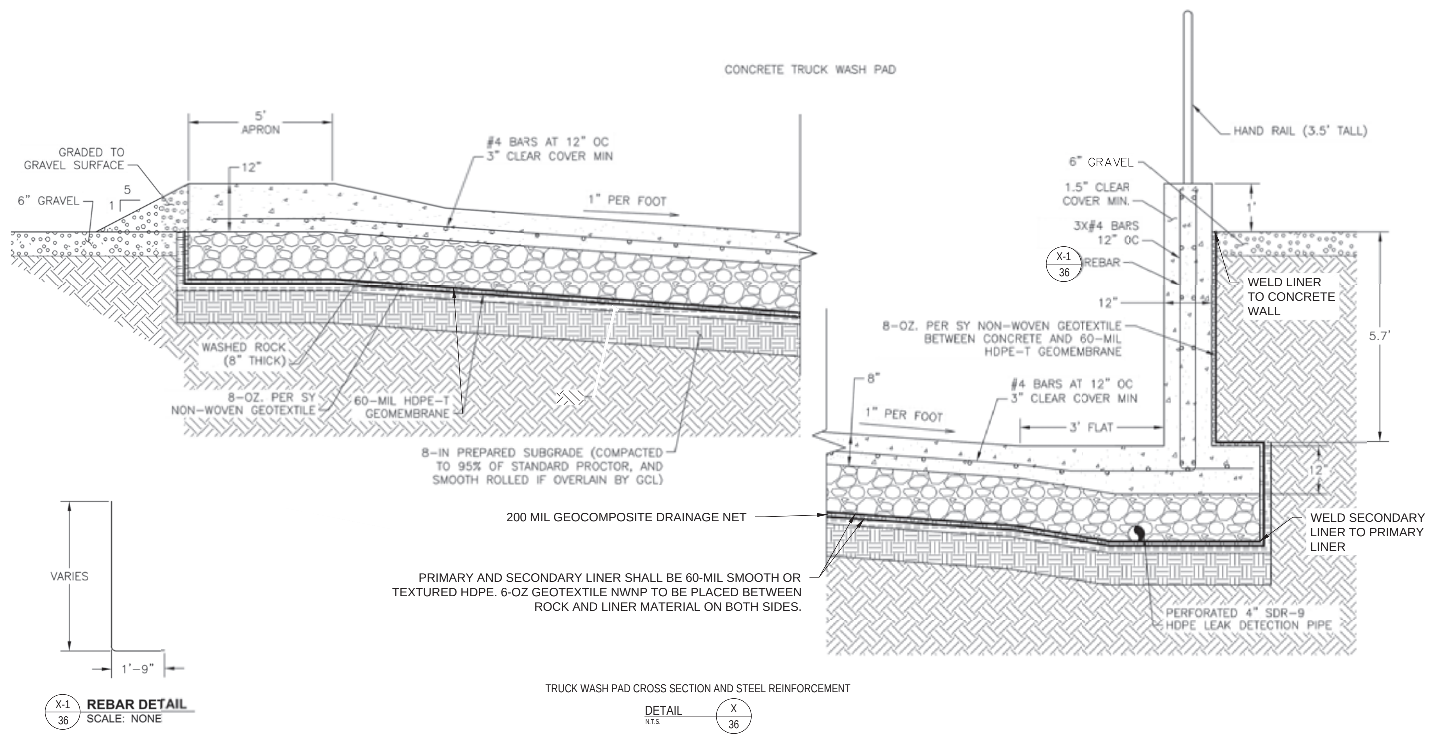
PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 35

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	35 OF 39



NOTES:

1. REBAR NOT TO BE FIELD-BENT
2. CONCRETE SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,500 POUND PER SQUARE INCH (PSI), A 28-DAY FLEXURAL STRENGTH OF 650 PSI, AND CONTAIN 5% TO 7% ENTRAINED AIR.
3. GCL SUBGRADE AREA SHALL BE SMOOTH DRUM ROLLED AND CLEAR OF DEBRIS IN EXCESS OF 0.5" IN MAXIMUM DIAMETER.

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

FOR PERMITTING PURPOSES ONLY

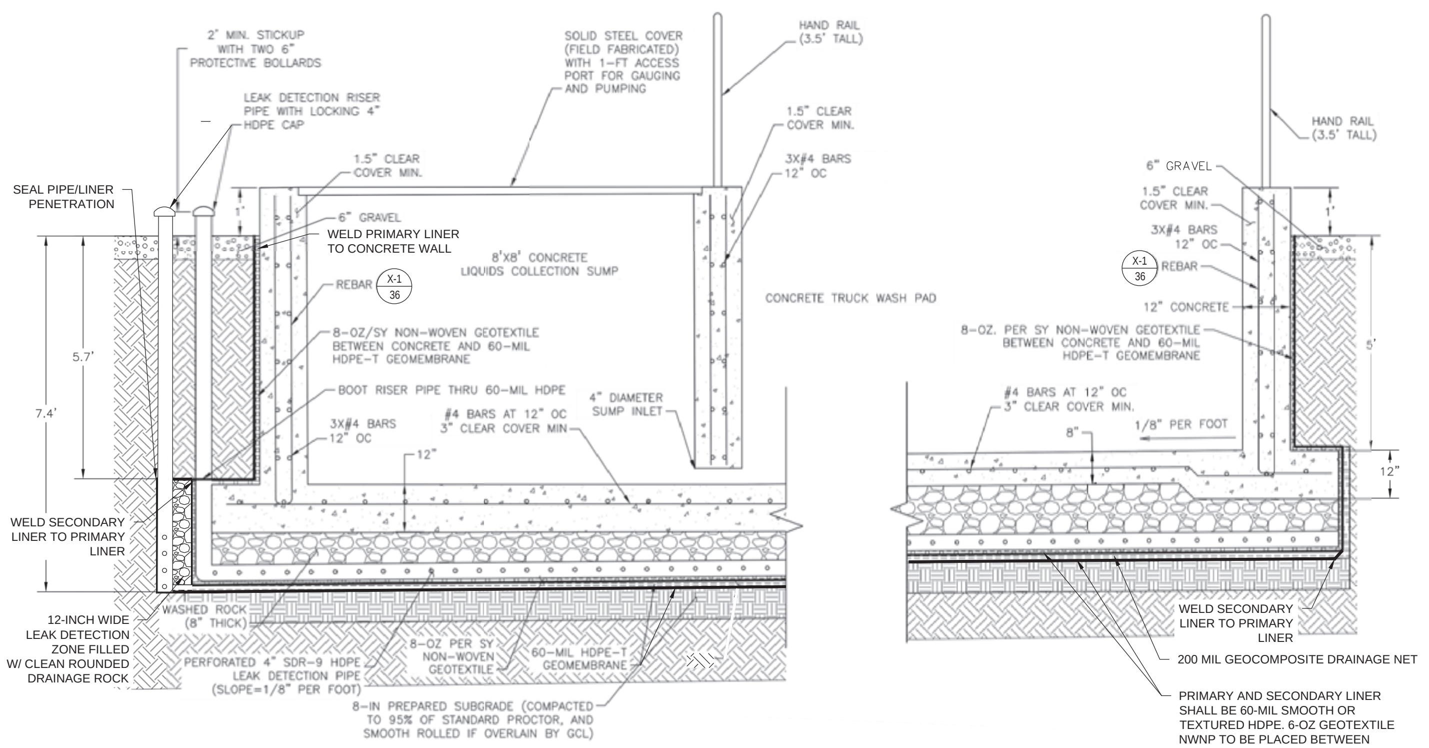
REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

TRUCK WASH PAD CROSS SECTION (1 OF 2)
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 36

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	36 OF 39



TRUCK WASH PAD CROSS SECTION AND STEEL REINFORCEMENT

DETAIL Y/37
N.T.S.

NOTES:

1. REBAR NOT TO BE FIELD-BENT
2. CONCRETE SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,500 POUND PER SQUARE INCH (PSI), A 28-DAY FLEXURAL STRENGTH OF 650 PSI, AND CONTAIN 5% TO 7% ENTRAINED AIR.
3. GCL SUBGRADE AREA SHALL BE SMOOTH DRUM ROLLED AND CLEAR OF DEBRIS IN EXCESS OF 0.5" IN MAXIMUM DIAMETER.

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19

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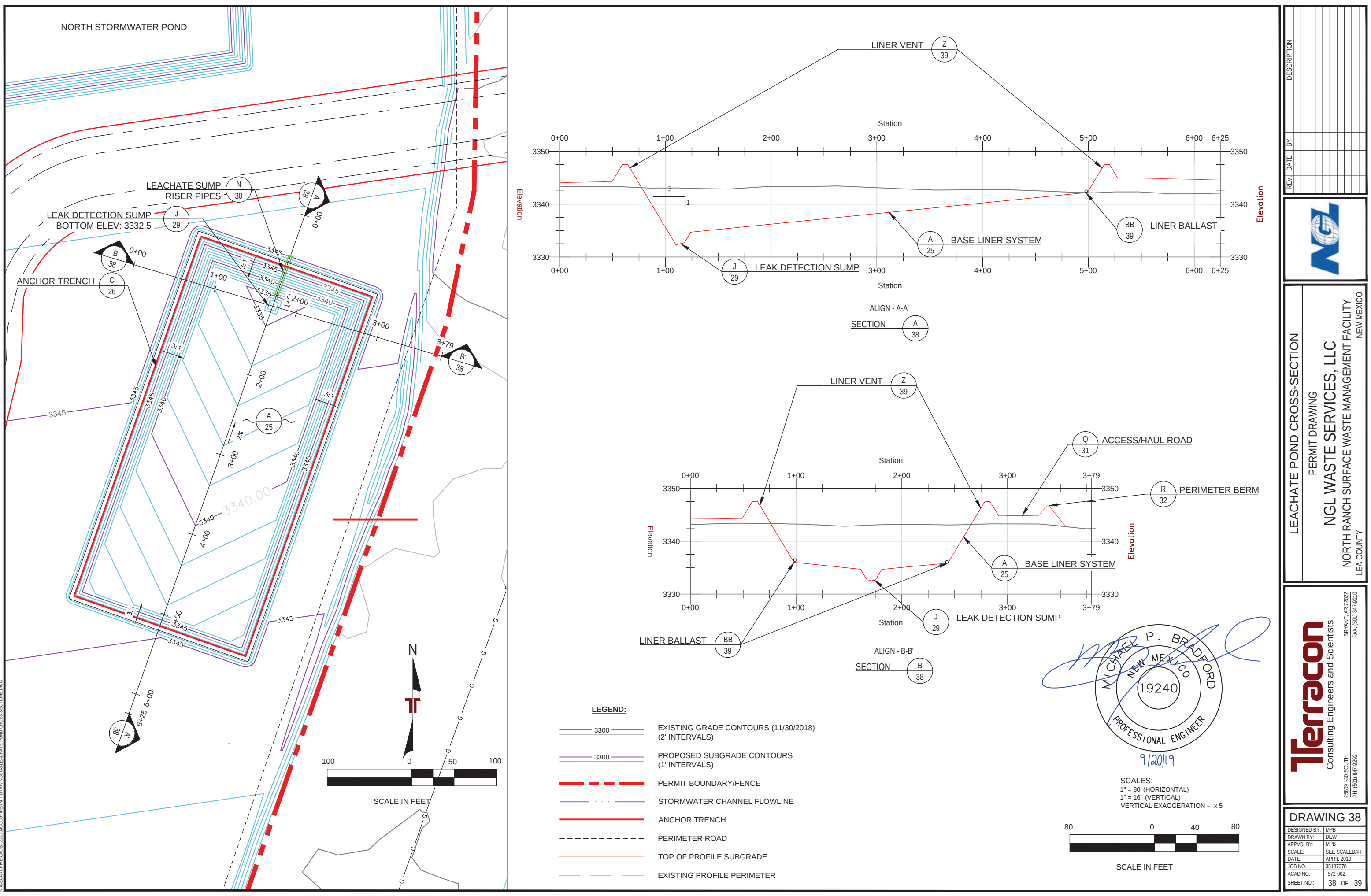
REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

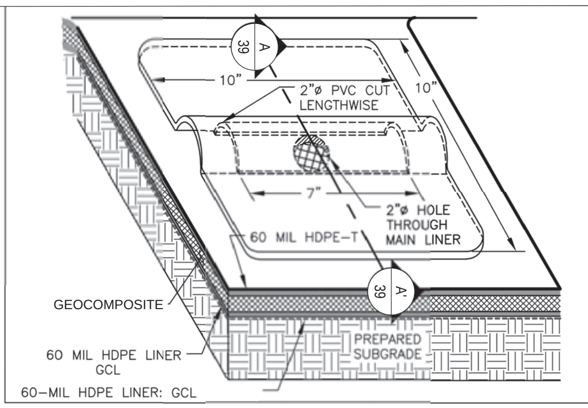
TRUCK WASH PAD CROSS SECTION (2 OF 2)
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 37

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	37 OF 39


NORTH STORMWATER POND
LEACHATE SUMP RISER PIPES
LEAK DETECTION SUMP
BOTTOM ELEV: 3332.5
ANCHOR TRENCH
LINER VENT
LEAK DETECTION SUMP
BASE LINER SYSTEM
LINER BALLAST
ALIGN - A-A'
SECTION
LINER VENT
ACCESS/HAUL ROAD
PERIMETER BERM
BASE LINER SYSTEM
LINER BALLAST
LEAK DETECTION SUMP
ALIGN - B-B'
SECTION
Station
Elevation
SCALE IN FEET
LEGEND:
EXISTING GRADE CONTOURS (11/30/2018) (2' INTERVALS)
PROPOSED SUBGRADE CONTOURS (1' INTERVALS)
PERMIT BOUNDARY/FENCE
STORMWATER CHANNEL FLOWLINE
ANCHOR TRENCH
PERIMETER ROAD
TOP OF PROFILE SUBGRADE
EXISTING PROFILE PERIMETER
MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER
9/20/19
SCALES:
1" = 80' (HORIZONTAL)
1" = 16' (VERTICAL)
VERTICAL EXAGGERATION = x 5
LEACHATE POND CROSS-SECTION
PERMIT DRAWING
NGL WASTE SERVICES, LLC
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY
NEW MEXICO
Terracon
Consulting Engineers and Scientists
DRAWING 38
38 OF 39

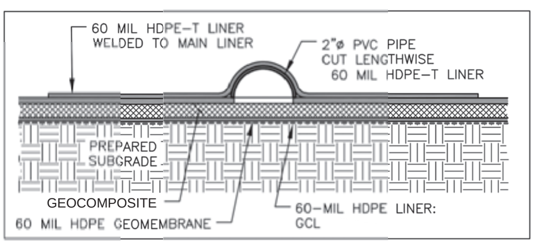


AIR VENT SCHEMATIC

DETAIL Z/39
N.T.S.

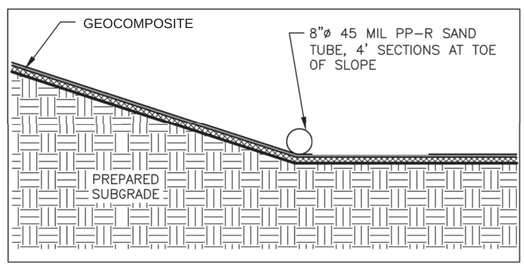
NOTE:

VENTS TO BE SPACED 25' ALONG ENTIRE TOP OF SLOPE.



AIR VENT PROFILE

DETAIL AA/39
N.T.S.



LINER BALLAST

DETAIL BB/39
N.T.S.

MICHAEL P. BRADFORD
NEW MEXICO
19240
PROFESSIONAL ENGINEER

9/20/19

FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION
1	9/19	KHJ	UPDATED PER JIM JORDAN COMMENTS

LEACHATE POND DETAILS
NORTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY
NEW MEXICO

Terracon
Consulting Engineers and Scientists

DRAWING 39

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	SEPT. 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	39 OF 39

Appendix L

North Ranch Surface Waste Management Facility

Stormwater Pollution Prevention Plan

Stormwater Pollution Prevention Plan (SWP3)

for:

North Ranch Surface Waste Management Facility
Battle Axe Road,
Jal, NM 88252

NGL Waste Services, LLC
3773 Cherry Creek North Drive, Suite 1000
Denver, CO 80209
(303) 370-7100

SWP3 Contact(s):

NGL Waste Services, LLC
Craig Rutland
14100 San Pedro STE: 501
San Antonio, Texas 78232
Office: 210-495-0452 Ext. 3
Craig.Rutland@nglep.com

SWP3 Prepared By:

Bear Creek Consultants
1320 E. 9th Street, Suite 2
Edmond, OK 73034
(405) 531-0600
vchoquette@bearcreekconsultants.com

SWP3 Preparation Date:

April 17, 2019

Project Start Date: 05/15/2019
Project Completion Date: 07/15/2029

Table of Contents

Section 1: Site Evaluation, Assessment, and Planning

1.1 Project/Site Information

Facility Location:

Near Jal, New Mexico in Lea County, Zip: 88252
32.144875° N, 103.4624139° W (Facility Centroid, using GPS)

Is the project located in Indian country? No
Is this project considered a federal facility? No
NPDES ID: NMR10022R

Facility Information (If the facility lacks a street address, indicate the general location of the facility)		
Name of Facility: North Ranch Surface Waste Management Facility		
Street: From Jal, NM take NM-128 W for about 13.8 miles, turn South, staying on Battle Axe Road for about 5 miles. Turn Right.		
City: Jal	State: NM	ZIP Code: 88252
County: Lea		
Latitude/Longitude (Facility Centroid)		
Latitude: 32.144875° N	Longitude: 103.4624139° W	
Method for determining latitude/longitude (check one):		
___ ✓ GPS	☐ EPA My WATERS Mapper	☐ USGS National Map
Is this project considered a federal facility? No		

1.2 Contact Information/Responsible Parties

See Appendix A – Site Map for geographic area of control.

OPERATOR	
Contact Information	**Geographic Area of Control**
NGL Waste Services, LLC Garrett Clemons, VP, EHS 3773 Cherry Creek N. Dr. Ste. 1000 Denver, CO 80209 Office Phone: (303) 370-7106 Email: garrett.clemons@nglep.com	

Project Manager:
PM Contact Name (Primary): TBD
Telephone number:
Email address:
Address: NA

SWP3 Contact:

SWP3 Contact Name (Primary): Craig Rutland

Telephone number: 210-495-0452 Ext. 3

Email address: Craig.Rutland@nglep.com

Address: 14100 San Pedro STE: 501, San Antonio, Texas 78232

SWP3 Prepared by:

SWP3 Contact Name (Primary): Vern Choquette

Telephone number: (405) 531-0600

Email address: vchoquette@bearkcreekconsultants.com

Address: 1320 E. 9th St. Ste.2
Edmond, OK 73034

Emergency 24-Hour Contact:

SWP3 Contact Name (Primary): TBD

Site Phone:

Cellular Phone:

SUBCONTRACTOR(S)	
Contact Information	**Subcontracted Responsibilities**
TBD	TBD
See Appendix D – Subcontractor Certifications/Agreements	

1.3 Nature and Sequence of Construction Activity

NGL Waste Services, LLC is planning to build a surface waste management facility on Battle Axe Rd. near Jal, Lea County, New Mexico. During construction, approximately 270.25 acres of soil will be disturbed. Soil disturbing activities will include: clearing and grubbing; installing stabilized construction exits; installing erosion and sediment controls; grading; excavation.

What is the function of the construction activity?

[ ] Residential [ ] Commercial [**X**] Industrial [ ] Road [ ] Construction [ ] Linear [ ] Utility

[ ] Other (please specify):

Estimated Project Start Date: 2019-05-15

Estimated Project Completion Date: 2029-06-15

As NGL Waste Services, LLC has not yet awarded the development work to a contractor, a general timeline cannot be provided at this time. When a Timeline of Activity is determined, the SWP3 will be updated and the change will be noted in Section 6.2.

Table 1. Timeline of Activity: NGL Waste Services, LLC will follow the sequence described below for major construction activities and BMP installation

Estimated Timeline of Activity	Construction Activity and BMP Descriptions
5/15/19 to 6/1/19	Site Mobilization -Contractor equipment (heavy equipment, job trailers, etc.) and any off-site construction materials (geosynthetics, off-site soils, etc.) are brought to the site and set up and stored in a designated area.
6/1/19 to 7/1/19	Stormwater Controls - Stormwater and erosion controls are set up prior to earthwork. Driveways are constructed and covered in crushed rock, sediment ponds are constructed.
7/1/19 to 7/15/29	In the cell construction area, soil is excavated or filled to meet design grades as required. The excavated soil is placed in a designated stockpile area. If fill soil is required and is unable to be obtained from the construction area soils, a borrow area will be used. Once the design subgrade elevations are met, the surface of the subgrade soils is conditioned and re-compacted to design specifications. Following completion of subgrade, geosynthetic materials (Geosythetic Clay Liner, HDPE Geomembrane, Geotextile, and Geocomposite) are installed. Lastly, a protective soil layer is placed over the geosynthetic materials. Outside of the cell area, additional construction may take place to install HDPE leachate force main, construct concrete headwalls, perimeter ditches, roads, etc. Following all earthwork, disturbed areas are seeded.
See Appendix D – Subcontractor Certifications/Agreements	

1.4 Soil, Slopes, Vegetation, and Current Drainage Patterns

Soil Types

The current soil type of the site consists of Ratliff-Wink fine sandy loams, pyote and maljamar fine sands, and Wink loamy fine sand.

Slopes

The site slopes very slightly to the south. Site is lower than surrounding property on all sides.

Drainage Patterns

Within the site, drainage flows south. The site is lower than surrounding property on all sides.

Vegetation

The site is populated by dry desert brush and grasses.

1.5 Construction Site Estimates

Total Project area:	275 ac.
Construction site area to be disturbed:	270.25 ac.
Percentage impervious area before construction:	< 1%
Runoff coefficient before construction:	0.15
Percentage impervious area after construction:	< 5%
Runoff coefficient after construction:	0.20

1.6 Receiving Waters

There are no nearby creeks, bodies of water, or storm sewer systems. The site is lower than surrounding property on all sides.

1.7 Site Features and Sensitive Areas to be Protected

The site has no unique natural features that warrant preservation.

1.8 Potential Sources of Pollution

Potential sources of sediment to stormwater runoff:

- Clearing and grubbing operations
- Grading and excavation operations
- Vehicle tracking
- Vehicle wash pad

Other potential pollutants to stormwater:

- Combined Staging Area—Small fueling activities, minor equipment maintenance, sanitary facilities.

Material	Physical Description	Stormwater pollutants	Location
Hydraulic oil/fluids	Brown, oily petroleum hydrocarbon	Mineral oil	Equipment leaks
Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	Benzene, ethyl benzene, toluene, xylene, MTBE	Secondary containment/ staging area
Diesel Fuel	Clear, blue-green to yellow liquid	Petroleum distillate, oil & grease, naphthalene, xylenes	Secondary containment/ staging area

1.9 Endangered Species Certification

According to the USFWS Information for Planning and Conservation (IPaC) Environmental Conservation Online System, only one federally protected species is located in the area—the Northern Aplomado Falcon (Falco femoralis septentrionalis). There is no critical habitat located in the project area.

1.10 Historic Preservation

There are no historic sites on or near the construction site. A search was performed on http://nmhistoricsites.org/index/maps-and-directions, New Mexico's online index of historic sites.

1.11 Applicable Federal, Tribal, State or Local Programs

No federal, tribal, state, or county programs were found to pertain to the site.

1.12 Maps

See Appendix A

Section 2: Erosion and Sediment Control BMPs

2.1 Minimize Disturbed Area and Protect Natural Features and Soil

The disturbed area on the site is necessary for the site's industrial application. No unique natural features have been identified for protection. As needed, topsoil will be stockpiled in areas that do not interfere with construction phases and at least 15 feet away from areas of concentrated flow and pavement. Stockpile slopes will be roughened by equipment tracking and will not exceed 2:1 to prevent erosion.

2.2 Phase Construction Activity

Contractor equipment (heavy equipment, job trailers, etc.) and any off-site construction materials (geosynthetics, off-site soils, etc.) are brought to the site and set up and stored in a designated area. Temporary stormwater and erosion controls are set up prior to earthwork. In the cell construction area, soil is excavated or filled to meet design grades as required. The excavated soil is placed in a designated stockpile area (no steeper than 2:1). If fill soil is required and is unable to be obtained from the construction area soils, a borrow area will be used. Once the design subgrade elevations are met, the surface of the subgrade soils is conditioned and re-compacted to design specifications. Following completion of subgrade, geosynthetic materials (Geosynthetic Clay Liner, HDPE Geomembrane, Geotextile, and Geocomposite) are installed. Lastly, a protective soil layer is placed over the geosynthetic materials. Outside of the cell area, additional construction may take place to install HDPE leachate force main, construct concrete headwalls, perimeter ditches, roads, etc. Following all earthwork, disturbed areas are seeded.

2.3 Control Stormwater Flowing onto and through the Project

Where required, ditches (i.e., trapezoidal channels) of depth 3 feet and base width of 10 feet (for channel Type 1) and 6 feet (for channel Type 2) will be constructed along the perimeter of the site, directing run on and run off the stormwater ponds (see Maps Appendix A).

2.4 Stabilize Soils

As needed, temporary stormwater and erosion controls are set up prior to earthwork. Following all earthwork, disturbed areas are seeded.

2.5 Protect Slopes

As needed, geosynthetic materials (Geosynthetic Clay Liner, HDPE Geomembrane, Geotextile, and Geocomposite) are installed to protect slopes. A protective soil layer is placed over the geosynthetic materials. Geosynthetic materials will be installed according to the manufacturer's instructions. Landfill side slopes and let down slopes are 4:1 (See Map in 1.12).

2.6 Protect Storm Drain Inlets

There are no storm drains near the site.

2.7 Establish Perimeter Controls and Sediment Barriers

As needed, run off and run on diversion channels surround the site. Sediment will be diverted to stormwater ponds. Temporary stormwater and erosion controls are set up prior to earth work. Silt fences will be installed as deemed necessary by regular inspections. Given the scale of the site and the permanent stormwater controls on the perimeter of the site, silt fencing is neither feasible nor effective for the perimeter of the entire property.

2.8 Retain Sediment On-Site

As needed, sediment will be retained in the three stormwater ponds, which can contain a minimum of 3.5’ freeboard over 25-yr, 24 hour event high water mark.

2.9 Establish Stabilized Construction Exits

As needed, stone anti-tracking pads will be installed at the construction exit (NE corner) to mitigate off-site tracking. A proposed wash pad and drying pads will be installed in the Northeast corner of the site to remove sediment before equipment leaves the site.

2.10 Additional BMPs

Based on regular erosion and sediment inspections, appropriate BMPs will be implemented with consideration for the site’s surroundings on an as needed basis.

Section 3: Good Housekeeping BMPs

This section describes all areas at my facility where industrial materials or activities are exposed to stormwater or from which allowable non-stormwater discharges originate.

3.1 Material Handling and Waste Management

All waste materials, trash, and construction debris will be collected and disposed of appropriately on site. Waste materials, trash, and construction debris will be stored away from stormwater conveyances and meet all local and state solid-waste management regulations. Special attention will be given to hazardous waste materials, which will be stored in sealed containers with sufficient secondary containment. All personnel will be instructed, during tailgate training sessions, regarding the correct procedure for disposal of trash and construction debris. The individual who manages day-to-day site operations will be responsible for seeing that these practices are followed.

3.2 Establish Proper Building Material Staging Areas

Equipment and construction materials will be temporarily stored in the designated staging and material storage area. Hazardous materials such as oil filters, petroleum products, and equipment maintenance fluids will be stored in sealed, structurally sound containers.

3.3 Designated Washout Areas

The site will not have any designated concrete washout areas. Vehicle washing will occur on a proposed wash pad.

3.4 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices

Several types of vehicles and equipment will be used on-site throughout the project, including graders, scrapers, excavators, loaders, paving, rollers, trucks and trailers, backhoes. Major equipment will be performed off-site. A small fuel tank will be kept on-site in the combined staging area. When vehicle fueling must occur on-site, the fueling activity will occur in the staging area. Only minor equipment maintenance will occur on-site. Equipment fluids generated from maintenance activities will be disposed of into sealable containers accordance with Section 3, Part 3.1. Absorbent, spill-cleanup materials and spill kits will be available at the combined staging and materials storage area.

3.5 Control Equipment/Vehicle Washing

A wash pad and drying pads are proposed for the Northeast corner of the site (see Map found in Appendix A). Run off from the pads will be collected in a channel of Type 1 (as described above) and diverted to a stormwater pond.

3.6 Spill Prevention and Control

Employee Training: employees will be trained. Vehicles and equipment will be maintained off-site. Hazardous materials will be stored in accordance with section 3 part 1. Spill kits will be available on-site. Spills will be cleaned up immediately upon discovery. Safety data sheets, inventory, and emergency contact information will be accessible electronically.

3.7 Any Additional BMPs

No additional BMPs were identified.

3.8 Allowable Non-Stormwater Discharge Management

Water Used to Control Dust

Dust control will be implemented as needed by spraying water onto dirt surfaces during high winds.

Uncontaminated Excavation Dewatering

Because sub-grade construction activities will occur in the dry season, dewatering is not expected.

All Other Discharges

All other non-stormwater discharges will be diverted to the perimeter channels and subsequently to the stormwater ponds.

Section 4: Selecting Post-Construction BMPs

As described above, 3 permanent stormwater ponds will be built on the site to accommodate the 25 year, 24-hour event with sufficient freeboard. Permanent diversion channels will direct run off and run on water to the stormwater ponds. An earthen berm to divert stormwater will be added in later phases as cells are added to the facility. Letdown structures will direct stormwater down the slopes to the channels.

Slopes will be maintained at 4:1 to prevent erosion. When required, geosynthetic materials will be installed as described in section 2.5.

All devices mentioned in this section will be inspected regularly and after storm events. Adjustments to permanent stormwater controls will be implemented as necessary based on observed erosion.

Section 5: Inspections

5.1 Inspections

Inspection Personnel

Mr. Craig Rutland is responsible for site compliance with this SWP3 and EPA's Construction General Permit. Mr. Rutland will oversee the inspection program for all areas of the site disturbed by construction activity, areas used for storage of materials that are exposed to precipitation, discharge points, and construction exits.

Qualifications

Mr. Rutland is an experienced compliance professional. He is overseeing the development and implementation of the SWP3.

Inspection Schedule and Procedures

Inspections will be performed at least once every 14 days and within 24 hours of the end of a storm event of one-half inch or greater. The inspections will verify that all BMPs required in Sections 2 and 3 are implemented, maintained, and effectively minimizing pollutants in stormwater runoff from the project site.

If corrective actions are identified during an inspection, staff will notify and submit a copy of the inspection report to the Project Manager. The Project Manager will be responsible for initiating the corrective action within 72 hours of the report and completing maintenance as soon as possible or before the next storm event.

For a copy of the inspection report, see Appendix D.

5.2 Delegation of Authority

Duly Authorized Representative or Position:

NGL Waste Services, LLC
Craig Rutland
14100 San Pedro STE: 501
San Antonio, Texas 78232
Office: 210-495-0452 Ext. 3
Craig.Rutland@nglep.com

5.3 Corrective Action Log

See Appendix D – Corrective Action Log

Section 6: Recordkeeping and Training

6.1 Recordkeeping

Records will be kept for a minimum of 3 years after the permit is terminated.

Date(s) when major grading, construction activities, and stabilization activities occur:

See Appendix D – Grading and Stabilization Activities Log

6.2 Log of Changes to the SWP3

See Appendix D – SWP3 Amendment Log

6.3 Training

Individual(s) Responsible for Training:

Mr. Craig Rutland

Describe Training Conducted:

- General stormwater and BMP awareness training for staff and subcontractors:

Mr. Rutland will implement informal training for staff, including subcontractors, on the site. The training will focus on avoiding damage to stormwater BMPs and preventing illicit discharges. Training will address the following topics:

- Erosion Control BMPs;
- Sediment Control BMPs;
- Non-Stormwater BMPs;
- Waste Management and Materials Storage BMPs; and
- Emergency Procedures specific to the construction site.

(See Appendix D – Training Log)

Section 7: Final Stabilization

Once the design subgrade elevations are met, the surface of the subgrade soils is conditioned and re-compacted to design specifications. Following completion of subgrade, geosynthetic materials (Geosynthetic Clay Liner, HDPE Geomembrane, Geotextile, and Geocomposite) are installed. Lastly, a protective soil layer is placed over the geosynthetic materials. Outside of the cell area, additional construction may take place to install HDPE leachate force main, construct concrete headwalls, perimeter ditches, roads, etc. Following earthwork, disturbed areas will be seeded as needed.

Section 8: Certification and Notification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Garrett Clemons Title: VP, EHS

Signature: Garrett Clemons Date: 4-17-19

SWP3 Appendices

The following documentations are attached to the SWP3:

Appendix A – Site Maps

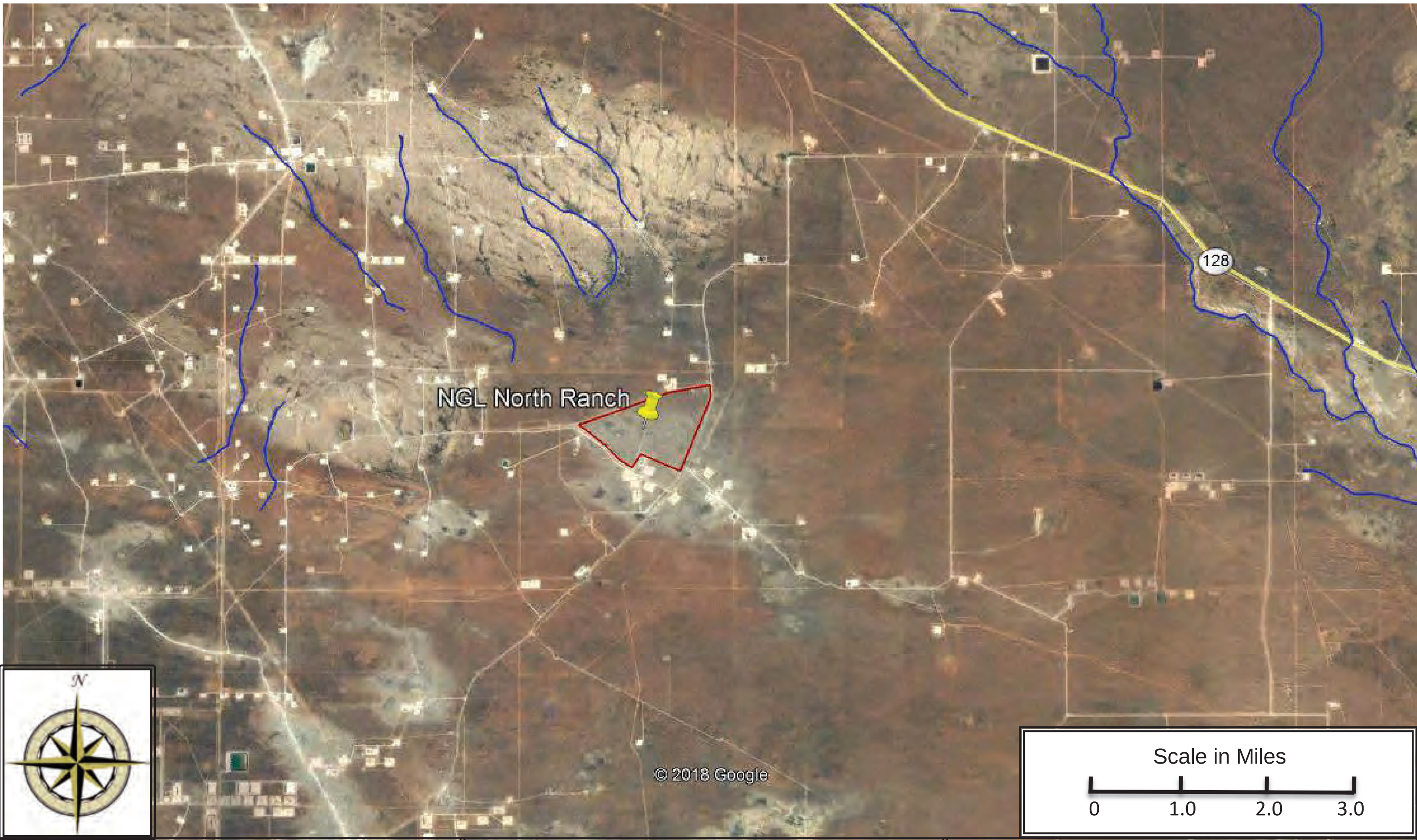
Appendix B – Construction General Permit

Appendix C – Notice of Intent (NOI)

Appendix D – Forms

Appendix E – Delegation of Authority.

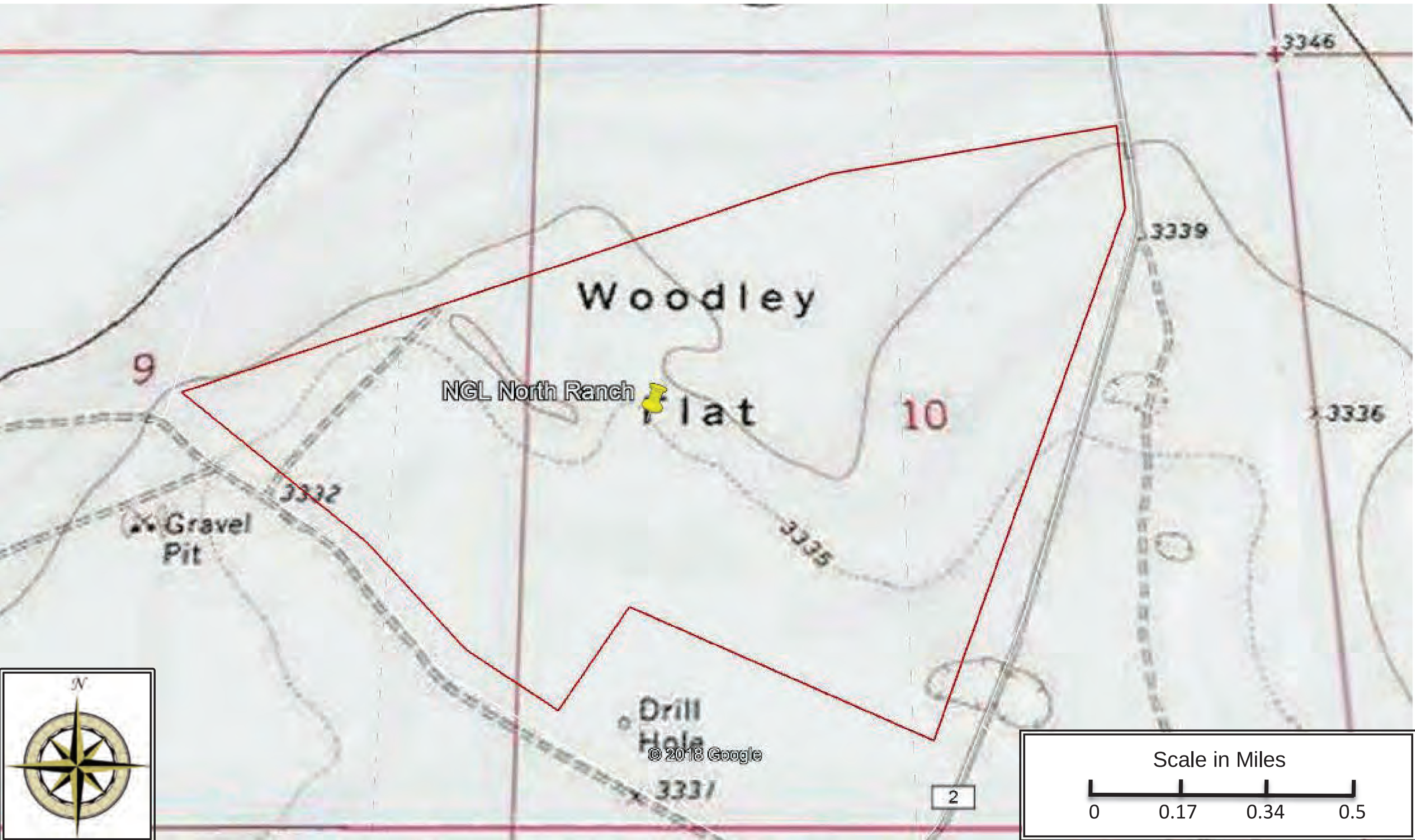
Appendix A
Site Maps



Site Location
NGL Waste Services, LLC
North Ranch SWMF
32.144875º / -103.462413º
Jal, New Mexico

BEAR CREEK CONSULTANTS
1320 E. 9th Street, Suite 2
Edmond, OK 73034

FIGURE 1
Google Earth Image
February 21, 2019



Topographic Map
NGL Waste Services, LLC
North Ranch SWMF
32.144875º / -103.462413º
Jal, New Mexico

BEAR CREEK CONSULTANTS
2524 N Broadway, Suite 317
Edmond, OK 73034

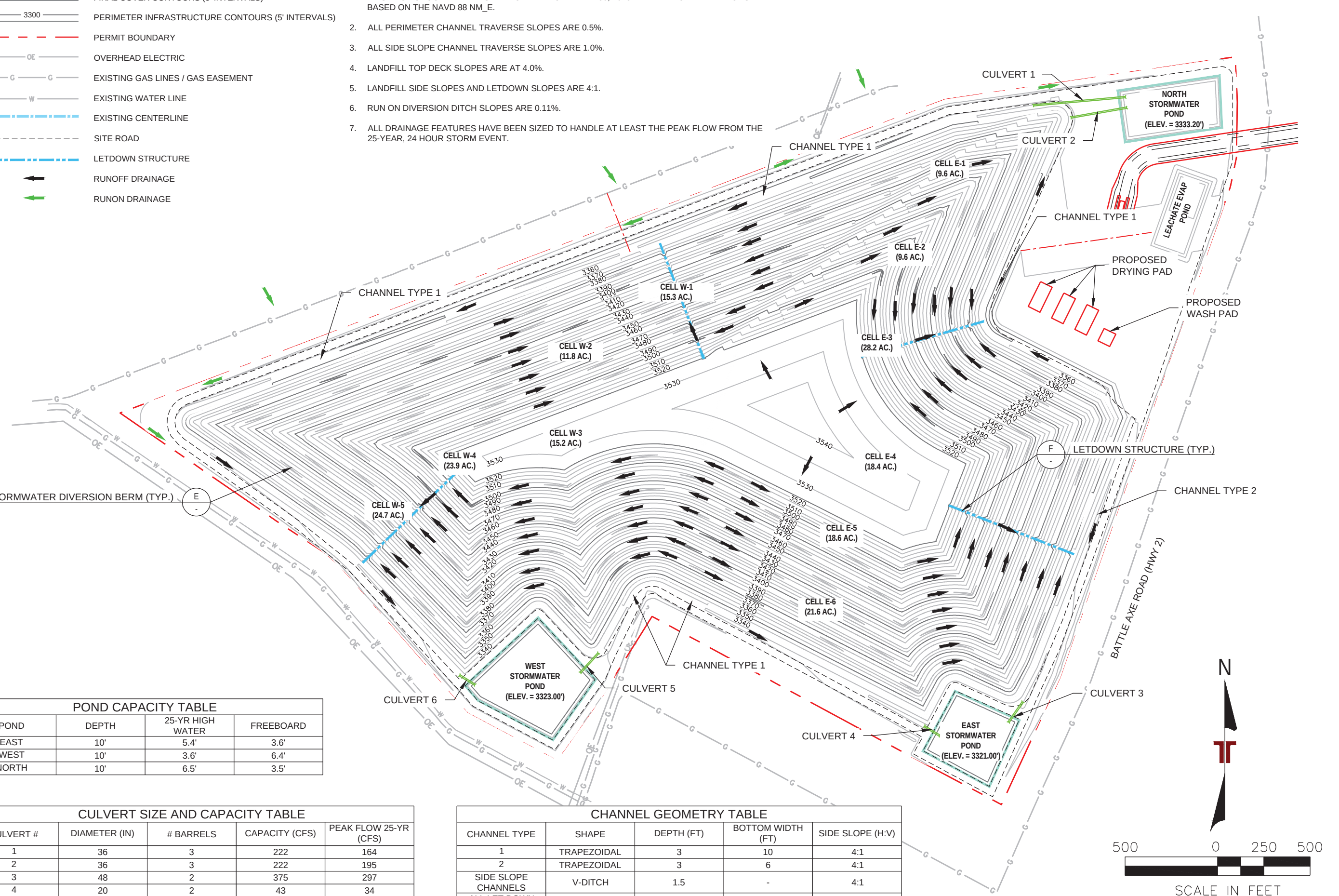
FIGURE 2
Topographic Map
April 15, 2019

LEGEND:

- 3300 — FINAL COVER CONTOURS (5' INTERVALS)
- 3300 — PERIMETER INFRASTRUCTURE CONTOURS (5' INTERVALS)
- PERMIT BOUNDARY
- OE — OVERHEAD ELECTRIC
- G — G — EXISTING GAS LINES / GAS EASEMENT
- W — EXISTING WATER LINE
- EXISTING CENTERLINE
- SITE ROAD
- LETDOWN STRUCTURE
- RUNOFF DRAINAGE
- RUNON DRAINAGE

NOTES:

1. EXISTING TOPOGRAPHY WAS PERFORMED NOVEMBER 30, 2018 AND VERTICAL ELEVATIONS ARE BASED ON THE NAVD 88 NM_E.
2. ALL PERIMETER CHANNEL TRAVERSE SLOPES ARE 0.5%.
3. ALL SIDE SLOPE CHANNEL TRAVERSE SLOPES ARE 1.0%.
4. LANDFILL TOP DECK SLOPES ARE AT 4.0%.
5. LANDFILL SIDE SLOPES AND LETDOWN SLOPES ARE 4:1.
6. RUN ON DIVERSION DITCH SLOPES ARE 0.11%.
7. ALL DRAINAGE FEATURES HAVE BEEN SIZED TO HANDLE AT LEAST THE PEAK FLOW FROM THE 25-YEAR, 24 HOUR STORM EVENT.



POND CAPACITY TABLE			
POND	DEPTH	25-YR HIGH WATER	FREEBOARD
EAST	10'	5.4'	3.6'
WEST	10'	3.6'	6.4'
NORTH	10'	6.5'	3.5'

CULVERT SIZE AND CAPACITY TABLE				
CULVERT #	DIAMETER (IN)	# BARRELS	CAPACITY (CFS)	PEAK FLOW 25-YR (CFS)
1	36	3	222	164
2	36	3	222	195
3	48	2	375	297
4	20	2	43	34
5	20	2	34	13
6	48	2	350	304

CHANNEL GEOMETRY TABLE				
CHANNEL TYPE	SHAPE	DEPTH (FT)	BOTTOM WIDTH (FT)	SIDE SLOPE (H:V)
1	TRAPEZOIDAL	3	10	4:1
2	TRAPEZOIDAL	3	6	4:1
SIDE SLOPE CHANNELS	V-DITCH	1.5	-	4:1
ALL LET DOWN CHANNEL	TRAPEZOIDAL	2	10	3:1
RUNON CHANNEL	TRAPEZOIDAL	4	7	4:1

N:\GECARCHIVE\CAD\572\002\MCCLOY\PERMIT DRAWINGS\5-FINAL DRAINAGE.DWG

REV.	DATE	BY	DESCRIPTION

FINAL DRAINAGE
PERMIT DRAWING
SURFACE WASTE MANAGEMENT FACILITY
NORTH RANCH
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 4

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	APRIL 2019
JOB NO.	572-002-35187378
ACAD NO.	005
SHEET NO.:	4 OF XX

Appendix B
Construction General Permit

National Pollutant Discharge Elimination System
General Permit for Discharges from
Construction Activities

In compliance with the provisions of the Clean Water Act, 33 U.S.C. §1251 et. seq., (hereafter CWA), as amended by the Water Quality Act of 1987, P.L. 100-4, "operators" of construction activities (defined in Appendix A) that meet the requirements of Part 1.1 of this National Pollutant Discharge Elimination System (NPDES) general permit, are authorized to discharge pollutants in accordance with the effluent limitations and conditions set forth herein. Permit coverage is required from the "commencement of construction activities" (see Appendix A) until one of the conditions for terminating CGP coverage has been met (see Part 8.2).

This permit becomes effective on **February 16, 2017**.

This permit and the authorization to discharge expire at 11:59pm, **February 16, 2022.**

Signed and issued this 11th day of January 2017

Deborah Szaro,
Acting Regional Administrator, EPA Region 1

Signed and issued this 11th day of January 2017

Javier Laureano, Ph.D.,
Director, Clean Water Division, EPA Region 2

Signed and issued this 11th day of January 2017

Jose C. Font,
Acting Director, Caribbean Environmental Protection Division, EPA Region 2.

Signed and issued this 11th day of January 2017

Dominique Lueckenhoff,
Acting Director, Water Protection Division, EPA Region 3

Signed and issued this 11th day of January 2017

César A. Zapata,
Deputy Director, Water Protection Division, EPA Region 4

Signed and issued this 11th day of January 2017

Christopher Korleski,
Director, Water Division, EPA Region 5

Signed and issued this 11th day of January 2017

William K. Honker, P.E.,
Director, Water Division, EPA Region 6

Signed and issued this 11th day of January 2017

Karen Flournoy,
Director, Water, Wetlands, and Pesticides Division, EPA Region 7

Signed and issued this 11th day of January 2017

Darcy O'Connor,
Assistant Regional Administrator, Office of Water Protection, EPA Region 8

Signed and issued this 11th day of January 2017

Kristin Gullatt
Deputy Director, Water Division, EPA Region 9

Signed and issued this 11th day of January 2017

Daniel D. Opalski,
Director, Office of Water and Watersheds, EPA Region 10

CONTENTS

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1 HOW TO OBTAIN COVERAGE UNDER THE CONSTRUCTION GENERAL PERMIT (CGP)

To be covered under this permit, you must meet the eligibility conditions and follow the requirements for obtaining permit coverage in this Part.

1.1 ELIGIBILITY CONDITIONS

1.1.1 You are an "operator" of a construction site for which discharges will be covered under this permit. For the purposes of this permit and in the context of stormwater discharges associated with construction activity, an "operator" is any party associated with a construction project that meets either of the following two criteria:

a. The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications *(e.g., in most cases this is the owner of the site);* or

b. The party has day-to-day operational control of those activities at a project that are necessary to ensure compliance with the permit conditions *(e.g., they are authorized to direct workers at a site to carry out activities required by the permit; in most cases this is the general contractor (as defined in Appendix A) of the project).*

Where there are multiple operators associated with the same project, all operators must obtain permit coverage.[1] Subcontractors generally are not considered operators for the purposes of this permit.

1.1.2 Your site's construction activities:

a. Will disturb one or more acres of land, or will disturb less than one acre of land but are part of a common plan of development or sale that will ultimately disturb one or more acres of land; or

b. Have been designated by EPA as needing permit coverage under 40 CFR 122.26(a)(1)(v) or 40 CFR 122.26(b)(15)(ii);

1.1.3 Your site is located in an area where EPA is the permitting authority (see Appendix B);

1.1.4 Discharges from your site are not:

a. Already covered by a different NPDES permit for the same discharge; or

b. In the process of having coverage under a different NPDES permit for the same discharge denied, terminated, or revoked.[2,3]

1.1.5 You are able to demonstrate that you meet one of the criteria listed in Appendix D with respect to the protection of species that are federally listed as endangered or threatened under the Endangered Species Act (ESA) and federally designated critical habitat;

---

[1] If the operator of a "construction support activity" (see Part 1.2.1c) is different than the operator of the main site, that operator must also obtain permit coverage. See Part 7.1 for clarification on the sharing of liability between and among operators on the same site and for conditions that apply to developing a SWPPP for multiple operators associated with the same site.

[2] Parts 1.1.4a and 1.1.4b do not include sites currently covered under the 2012 CGP that are in the process of obtaining coverage under this permit, nor sites covered under this permit that are transferring coverage to a different operator.

[3] Notwithstanding a site being made ineligible for coverage under this permit because it falls under the description of Parts 1.1.4a or 1.1.4b, above, EPA may waive the applicable eligibility requirement after specific review if it determines that coverage under this permit is appropriate.

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1.1.6 You have completed the screening process in Appendix E relating to the protection of historic properties; and

1.1.7 You have complied with all requirements in Part 9 imposed by the applicable state, Indian tribe, or territory in which your construction activities and/or discharge will occur.

1.1.8 For "new sources" (as defined in Appendix A) only:

a. EPA has not, prior to authorization under this permit, determined that discharges from your site will cause, have the reasonable potential to cause, or contribute to an excursion above any applicable water quality standard. Where such a determination is made prior to authorization, EPA may notify you that an individual permit application is necessary. However, EPA may authorize your coverage under this permit after you have included appropriate controls and implementation procedures designed to bring your discharge into compliance with this permit, specifically the requirement to meet water quality standards. In the absence of information demonstrating otherwise, EPA expects that compliance with the requirements of this permit, including the requirements applicable to such discharges in Part 3, will result in discharges that will not cause, have the reasonable potential to cause, or contribute to an excursion above any applicable water quality standard.

b. Discharges from your site to a Tier 2, Tier 2.5, or Tier 3 water[4] will not lower the water quality of the applicable water. In the absence of information demonstrating otherwise, EPA expects that compliance with the requirements of this permit, including the requirements applicable to such discharges in Part 3.2, will result in discharges that will not lower the water quality of such waters.

1.1.9 If you plan to add "cationic treatment chemicals" (as defined in Appendix A) to stormwater and/or authorized non-stormwater prior to discharge, you may not submit your Notice of Intent (NOI) unless and until you notify your applicable EPA Regional Office (see Appendix L) in advance and the EPA Regional Office authorizes coverage under this permit after you have included appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to discharges that cause an exceedance of water quality standards.

1.2 TYPES OF DISCHARGES AUTHORIZED[5]

1.2.1 The following stormwater discharges are authorized under this permit provided that appropriate stormwater controls are designed, installed, and maintained (see Parts 2 and 3):

a. Stormwater discharges, including stormwater runoff, snowmelt runoff, and surface runoff and drainage, associated with construction activity under 40 CFR 122.26(b)(14) or 122.26(b)(15)(i);

---

[4] Note: Your site will be considered to discharge to a Tier 2, Tier 2.5, or Tier 3 water if the first water to which you discharge is identified by a state, tribe, or EPA as a Tier 2, Tier 2.5, or Tier 3 water. For discharges that enter a storm sewer system prior to discharge, the first water of the U.S. to which you discharge is the waterbody that receives the stormwater discharge from the storm sewer system. See list of Tier 2, Tier 2.5, and Tier 3 waters in Appendix F.

[5] See "Discharge" as defined in Appendix A. Note: Any discharges not expressly authorized in this permit cannot become authorized or shielded from liability under CWA section 402(k) by disclosure to EPA, state, or local authorities after issuance of this permit via any means, including the Notice of Intent (NOI) to be covered by the permit, the SWPPP, or during an inspection.

b. Stormwater discharges designated by EPA as needing a permit under 40 CFR 122.26(a)(1)(v) or 122.26(b)(15)(ii);

c. Stormwater discharges from construction support activities *(e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas)* provided that:

   i. The support activity is directly related to the construction site required to have permit coverage for stormwater discharges;

   ii. The support activity is not a commercial operation, nor does it serve multiple unrelated construction sites;

   iii. The support activity does not continue to operate beyond the completion of the construction activity at the site it supports; and

   iv. Stormwater controls are implemented in accordance with Part 2 and Part 3 for discharges from the support activity areas.

d. Stormwater discharges from earth-disturbing activities associated with the construction of staging areas and the construction of access roads conducted prior to active mining.

1.2.2 The following non-stormwater discharges associated with your construction activity are authorized under this permit provided that, with the exception of water used to control dust and to irrigate vegetation in stabilized areas, these discharges are not routed to areas of exposed soil on your site and you comply with any applicable requirements for these discharges in Parts 2 and 3:

a. Discharges from emergency fire-fighting activities;

b. Fire hydrant flushings;

c. Landscape irrigation;

d. Water used to wash vehicles and equipment, provided that there is no discharge of soaps, solvents, or detergents used for such purposes;

e. Water used to control dust;

f. Potable water including uncontaminated water line flushings;

g. External building washdown, provided soaps, solvents, and detergents are not used, and external surfaces do not contain hazardous substances (as defined in Appendix A) *(e.g., paint or caulk containing polychlorinated biphenyls (PCBs));*

h. Pavement wash waters, provided spills or leaks of toxic or hazardous substances have not occurred (unless all spill material has been removed) and where soaps, solvents, and detergents are not used. You are prohibited from directing pavement wash waters directly into any water of the U.S., storm drain inlet, or stormwater conveyance, unless the conveyance is connected to a sediment basin, sediment trap, or similarly effective control;

i. Uncontaminated air conditioning or compressor condensate;

j. Uncontaminated, non-turbid discharges of ground water or spring water;

k. Foundation or footing drains where flows are not contaminated with process materials such as solvents or contaminated ground water; and

l. Construction dewatering water discharged in accordance with Part 2.4.

1.2.3 Also authorized under this permit are discharges of stormwater listed above in Part 1.2.1, or authorized non-stormwater discharges listed above in Part 1.2.2, commingled with a discharge authorized by a different NPDES permit and/or a discharge that does not require NPDES permit authorization.

1.3 PROHIBITED DISCHARGES[6]

1.3.1 Wastewater from washout of concrete, unless managed by an appropriate control as described in Part 2.3.4;

1.3.2 Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds, and other construction materials;

1.3.3 Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance;

1.3.4 Soaps, solvents, or detergents used in vehicle and equipment washing or external building washdown; and

1.3.5 Toxic or hazardous substances from a spill or other release.

To prevent the above-listed prohibited non-stormwater discharges, operators must comply with the applicable pollution prevention requirements in Part 2.3.

1.4 SUBMITTING YOUR NOTICE OF INTENT (NOI)

All "operators" (as defined in Appendix A) associated with your construction site, who meet the Part 1.1 eligibility requirements, and who seek coverage under this permit, must submit to EPA a complete and accurate NOI in accordance with the deadlines in **Table 1** prior to commencing construction activities.

Exception: If you are conducting construction activities in response to a public emergency *(e.g., mud slides, earthquake, extreme flooding conditions, widespread disruption in essential public services)*, and the related work requires immediate authorization to avoid imminent endangerment to human health, public safety, or the environment, or to reestablish essential public services, you may discharge on the condition that a complete and accurate NOI is submitted within 30 calendar days after commencing construction activities (see Table 1) establishing that you are eligible for coverage under this permit. You must also provide documentation in your Stormwater Pollution Prevention Plan (SWPPP) to substantiate the occurrence of the public emergency.

1.4.1 Prerequisite for Submitting Your NOI

You must develop a SWPPP consistent with Part 7 before submitting your NOI for coverage under this permit.

1.4.2 How to Submit Your NOI

You must use EPA's NPDES eReporting Tool (NeT) to electronically prepare and submit your NOI for coverage under the 2017 CGP, unless you received a waiver from your EPA Regional Office.

To access NeT, go to https://www.epa.gov/npdes/stormwater-discharges-construction-activities#ereporting.

[6] EPA includes these prohibited non-stormwater discharges here as a reminder to the operator that the only non-stormwater discharges authorized by this permit are at Part 1.2.2. Any unauthorized non-stormwater discharges must be covered under an individual permit or alternative general permit.

Waivers from electronic reporting may be granted based on one of the following conditions:

a. If your operational headquarters is physically located in a geographic area (*i.e., ZIP code or census tract*) that is identified as under-served for broadband Internet access in the most recent report from the Federal Communications Commission; or

b. If you have limitations regarding available computer access or computer capability.

If the EPA Regional Office grants you approval to use a paper NOI, and you elect to use it, you must complete the form in Appendix J.

1.4.3 Deadlines for Submitting Your NOI and Your Official Date of Permit Coverage

Table 1 provides the deadlines for submitting your NOI and the official start date of your permit coverage, which differ depending on when you commence construction activities.

Table 1 NOI Submittal Deadlines and Official Start Date for Permit Coverage.

Type of Operator	NOI Submittal Deadline[7]	Permit Authorization Date[8]
Operator of a new site (*i.e., a site where construction activities commence on or after February 16, 2017*)	At least 14 calendar days before commencing construction activities.	14 calendar days after EPA notifies you that it has received a complete NOI, unless EPA notifies you that your authorization is delayed or denied.
Operator of an existing site (*i.e., a site with 2012 CGP coverage where construction activities commenced prior to February 16, 2017*)	No later than **May 17, 2017**.	
New operator of a permitted site (*i.e., an operator that through transfer of ownership and/or operation replaces the operator of an already permitted construction site that is either a "new site" or an "existing site"*)	At least 14 calendar days before the date the transfer to the new operator will take place.	
Operator of an "emergency-related project" (*i.e., a project initiated in response to a public emergency (e.g., mud slides, earthquake, extreme flooding conditions, disruption in essential public services), for which the related work requires immediate authorization to avoid imminent endangerment to human health or the environment, or to reestablish essential public services*)	No later than 30 calendar days after commencing construction activities.	You are considered provisionally covered under the terms and conditions of this permit immediately, and fully covered 14 calendar days after EPA notifies you that it has received a complete NOI, unless EPA notifies you that your authorization is delayed or denied.

[7] If you miss the deadline to submit your NOI, any and all discharges from your construction activities will continue to be unauthorized under the CWA until they are covered by this or a different NPDES permit. EPA may take enforcement action for any unpermitted discharges that occur between the commencement of construction activities and discharge authorization.

[8] Discharges are not authorized if your NOI is incomplete or inaccurate or if you are not eligible for permit coverage.

1.4.4 Modifying your NOI

If after submitting your NOI you need to correct or update any fields, you may do so by submitting a "Change NOI" form using NeT. Waivers from electronic reporting may be granted as specified in Part 1.4.1. If the EPA Regional Office has granted you approval to submit a paper NOI modification, you may indicate any NOI changes on the same NOI form in Appendix J.

When there is a change to the site's operator, the new operator must submit a new NOI, and the previous operator must submit a Notice of Termination (NOT) form as specified in Part 8.3.

1.4.5 Your Official End Date of Permit Coverage

Once covered under this permit, your coverage will last until the date that:

a. You terminate permit coverage consistent with Part 8; or

b. You receive permit coverage under a different NPDES permit or a reissued or replacement version of this permit after expiring on February 16, 2022; or

c. You fail to submit an NOI for coverage under a revised or replacement version of this permit before the deadline for existing construction sites where construction activities continue after this permit has expired.

1.5 REQUIREMENT TO POST A NOTICE OF YOUR PERMIT COVERAGE

You must post a sign or other notice of your permit coverage at a safe, publicly accessible location in close proximity to the construction site. The notice must be located so that it is visible from the public road that is nearest to the active part of the construction site, and it must use a font large enough to be readily viewed from a public right-of-way.[9] At a minimum, the notice must include:

a. The NPDES ID (*i.e., permit tracking number assigned to your NOI*);

b. A contact name and phone number for obtaining additional construction site information;

c. The Uniform Resource Locator (URL) for the SWPPP (if available), or the following statement: "If you would like to obtain a copy of the Stormwater Pollution Prevention Plan (SWPPP) for this site, contact the EPA Regional Office at [*include the appropriate CGP Regional Office contact information found at https://www.epa.gov/npdes/contact-us-stormwater#regional*];" and

d. The following statement "If you observe indicators of stormwater pollutants in the discharge or in the receiving waterbody, contact the EPA through the following website: https://www.epa.gov/enforcement/report-environmental-violations."

[9] If the active part of the construction site is not visible from a public road, then place the notice of permit coverage in a position that is visible from the nearest public road and as close as possible to the construction site.

2 TECHNOLOGY-BASED EFFLUENT LIMITATIONS

You must comply with the following technology-based effluent limitations in this Part for all authorized discharges.[10]

2.1 GENERAL STORMWATER CONTROL DESIGN, INSTALLATION, AND MAINTENANCE REQUIREMENTS

You must design, install, and maintain stormwater controls required in Parts 2.2 and 2.3 to minimize the discharge of pollutants in stormwater from construction activities. To meet this requirement, you must:

2.1.1 Account for the following factors in designing your stormwater controls:

a. The expected amount, frequency, intensity, and duration of precipitation;

b. The nature of stormwater runoff and run-on at the site, including factors such as expected flow from impervious surfaces, slopes, and site drainage features. You must design stormwater controls to control stormwater volume, velocity, and peak flow rates to minimize discharges of pollutants in stormwater and to minimize channel and streambank erosion and scour in the immediate vicinity of discharge points; and

c. The soil type and range of soil particle sizes expected to be present on the site.

2.1.2 Design and install all stormwater controls in accordance with good engineering practices, including applicable design specifications.[11]

2.1.3 Complete installation of stormwater controls by the time each phase of construction activities has begun.

a. By the time construction activity in any given portion of the site begins, install and make operational any downgradient sediment controls (*e.g., buffers, perimeter controls, exit point controls, storm drain inlet protection*) that control discharges from the initial site clearing, grading, excavating, and other earth-disturbing activities.[12]

b. Following the installation of these initial controls, install and make operational all stormwater controls needed to control discharges prior to subsequent earth-disturbing activities.

---

[10] For each of the effluent limits in Part 2, as applicable to your site, you must include in your SWPPP (1) a description of the specific control(s) to be implemented to meet the effluent limit; (2) any applicable design specifications; (3) routine maintenance specifications; and (4) the projected schedule for its (their) installation/implementation. See Part 7.2.6.

[11] Design specifications may be found in manufacturer specifications and/or in applicable erosion and sediment control manuals or ordinances. Any departures from such specifications must reflect good engineering practices and must be explained in your SWPPP. You must also comply with any additional design and installation requirements specified for the effluent limits in Parts 2.2 and 2.3.

[12] Note that the requirement to install stormwater controls prior to each phase of construction activities for the site does not apply to the earth disturbance associated with the actual installation of these controls. Operators should take all reasonable actions to minimize the discharges of pollutants during the installation of stormwater controls.

2.1.4 Ensure that all stormwater controls are maintained and remain in effective operating condition during permit coverage and are protected from activities that would reduce their effectiveness.

a. Comply with any specific maintenance requirements for the stormwater controls listed in this permit, as well as any recommended by the manufacturer.[13]

b. If at any time you find that a stormwater control needs routine maintenance, you must immediately initiate the needed maintenance work, and complete such work by the close of the next business day.

c. If at any time you find that a stormwater control needs repair or replacement, you must comply with the corrective action requirements in Part 5.

2.2 EROSION AND SEDIMENT CONTROL REQUIREMENTS

You must implement erosion and sediment controls in accordance with the following requirements to minimize the discharge of pollutants in stormwater from construction activities.

2.2.1 Provide and maintain natural buffers and/or equivalent erosion and sediment controls when a water of the U.S. is located within 50 feet of the site's earth disturbances.

a. **Compliance Alternatives.** For any discharges to waters of the U.S. located within 50 feet of your site's earth disturbances, you must comply with one of the following alternatives:

i. Provide and maintain a 50-foot undisturbed natural buffer; or

ii. Provide and maintain an undisturbed natural buffer that is less than 50 feet and is supplemented by erosion and sediment controls that achieve, in combination, the sediment load reduction equivalent to a 50-foot undisturbed natural buffer; or

iii. If infeasible to provide and maintain an undisturbed natural buffer of any size, implement erosion and sediment controls to achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.

See Appendix G, Part G.2 for additional conditions applicable to each compliance alternative.

b. **Exceptions.** See Appendix G, Part G.2 for exceptions to the compliance alternatives.

2.2.2 Direct stormwater to vegetated areas and maximize stormwater infiltration and filtering to reduce pollutant discharges, unless infeasible.

2.2.3 Install sediment controls along any perimeter areas of the site that will receive pollutant discharges.[14]

a. Remove sediment before it has accumulated to one-half of the above-ground height of any perimeter control.

b. **Exception**. For areas at "linear construction sites" (as defined in Appendix A) where perimeter controls are infeasible *(e.g., due to a limited or restricted right-of-way),*

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[13] Any departures from such maintenance recommendations made by the manufacturer must reflect good engineering practices and must be explained in your SWPPP.

[14] Examples of perimeter controls include filter berms, silt fences, vegetative strips, and temporary diversion dikes.

implement other practices as necessary to minimize pollutant discharges to perimeter areas of the site.

2.2.4 Minimize sediment track-out.

a. **Restrict vehicle use to properly designated exit points;**

b. Use appropriate stabilization techniques[15] at all points that exit onto paved roads.

   i. **Exception**: Stabilization is not required for exit points at linear utility construction sites that are used only episodically and for very short durations over the life of the project, provided other exit point controls[16] are implemented to minimize sediment track-out;

c. Implement additional track-out controls[17] as necessary to ensure that sediment removal occurs prior to vehicle exit; and

d. Where sediment has been tracked-out from your site onto paved roads, sidewalks, or other paved areas outside of your site, remove the deposited sediment by the end of the same business day in which the track-out occurs or by the end of the next business day if track-out occurs on a non-business day. Remove the track-out by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal. You are prohibited from hosing or sweeping tracked-out sediment into any stormwater conveyance, storm drain inlet, or water of the U.S.[18]

2.2.5 Manage stockpiles or land clearing debris piles composed, in whole or in part, of sediment and/or soil:

a. Locate the piles outside of any natural buffers established under Part 2.2.1 and away from any stormwater conveyances, drain inlets, and areas where stormwater flow is concentrated;

b. Install a sediment barrier along all downgradient perimeter areas;[19]

c. For piles that will be unused for 14 or more days, provide cover[20] or appropriate temporary stabilization (consistent with Part 2.2.14);

d. You are prohibited from hosing down or sweeping soil or sediment accumulated on pavement or other impervious surfaces into any stormwater conveyance, storm drain inlet, or water of the U.S.

[15] Examples of appropriate stabilization techniques include the use of aggregate stone with an underlying geotextile or non-woven filter fabric, and turf mats.

[16] Examples of other exit point controls include preventing the use of exit points during wet periods; minimizing exit point use by keeping vehicles on site to the extent possible; limiting exit point size to the width needed for vehicle and equipment usage; using scarifying and compaction techniques on the soil; and avoiding establishing exit points in environmentally sensitive areas (*e.g., karst areas; steep slopes).*

[17] Examples of additional track-out controls include the use of wheel washing, rumble strips, and rattle plates.

[18] Fine grains that remain visible *(i.e., staining)* on the surfaces of off-site streets, other paved areas, and sidewalks after you have implemented sediment removal practices are not a violation of Part 2.2.4.

[19] Examples of sediment barriers include berms, dikes, fiber rolls, silt fences, sandbags, gravel bags, or straw bale.

[20] Examples of cover include tarps, blown straw and hydroseeding.

2.2.6 Minimize dust. On areas of exposed soil, minimize the generation of dust through the appropriate application of water or other dust suppression techniques.

2.2.7 Minimize steep slope disturbances. Minimize the disturbance of "steep slopes" (as defined in Appendix A).

2.2.8 Preserve native topsoil, unless infeasible.[21]

2.2.9 Minimize soil compaction.[22] In areas of your site where final vegetative stabilization will occur or where infiltration practices will be installed:

a. Restrict vehicle and equipment use in these locations to avoid soil compaction; and

b. Before seeding or planting areas of exposed soil that have been compacted, use techniques that rehabilitate and condition the soils as necessary to support vegetative growth.

2.2.10 Protect storm drain inlets.

a. Install inlet protection measures that remove sediment from discharges prior to entry into any storm drain inlet that carries stormwater flow from your site to a water of the U.S., provided you have authority to access the storm drain inlet;[23] and

b. Clean, or remove and replace, the protection measures as sediment accumulates, the filter becomes clogged, and/or performance is compromised. Where there is evidence of sediment accumulation adjacent to the inlet protection measure, remove the deposited sediment by the end of the same business day in which it is found or by the end of the following business day if removal by the same business day is not feasible.

2.2.11 Minimize erosion of stormwater conveyance channels and their embankments, outlets, adjacent streambanks, slopes, and downstream waters. Use erosion controls and velocity dissipation devices[24] within and along the length of any stormwater conveyance channel and at any outlet to slow down runoff to minimize erosion.

2.2.12 If you install a sediment basin or similar impoundment:

a. Situate the basin or impoundment outside of any water of the U.S. and any natural buffers established under Part 2.2.1;

b. Design the basin or impoundment to avoid collecting water from wetlands;

c. Design the basin or impoundment to provide storage for either:

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[21] Stockpiling topsoil at off-site locations, or transferring topsoil to other locations, is an example of a practice that is consistent with the requirements in Part 2.2.8. Preserving native topsoil is not required where the intended function of a specific area of the site dictates that the topsoil be disturbed or removed. For example, some sites may be designed to be highly impervious after construction, and therefore little or no vegetation is intended to remain, or may not have space to stockpile native topsoil on site for later use, in which case, it may not be feasible to preserve topsoil.

[22] Minimizing soil compaction is not required where the intended function of a specific area of the site dictates that it be compacted.

[23] Inlet protection measures can be removed in the event of flood conditions or to prevent erosion.

[24] Examples of velocity dissipation devices include check dams, sediment traps, riprap, and grouted riprap at outlets.

ii. The calculated volume of runoff from a 2-year, 24-hour storm (see Appendix H); or

iii. 3,600 cubic feet per acre drained.

d. Utilize outlet structures that withdraw water from the surface of the sediment basin or similar impoundment, unless infeasible;[25]

e. Use erosion controls and velocity dissipation devices to prevent erosion at inlets and outlets; and

f. Remove accumulated sediment to maintain at least one-half of the design capacity and conduct all other appropriate maintenance to ensure the basin or impoundment remains in effective operating condition.

2.2.13 If using treatment chemicals (*e.g., polymers, flocculants, coagulants*):

a. **Use conventional erosion and sediment controls before and after the application of treatment chemicals.** Chemicals may only be applied where treated stormwater is directed to a sediment control *(e.g., sediment basin, perimeter control)* before discharge.

b. **Select appropriate treatment chemicals**. Chemicals must be appropriately suited to the types of soils likely to be exposed during construction and present in the discharges being treated *(i.e., the expected turbidity, pH, and flow rate of stormwater flowing into the chemical treatment system or area).*

c. **Minimize discharge risk from stored chemicals.** Store all treatment chemicals in leak-proof containers that are kept under storm-resistant cover and surrounded by secondary containment structures *(e.g., spill berms, decks, spill containment pallets),* or provide equivalent measures designed and maintained to minimize the potential discharge of treatment chemicals in stormwater or by any other means *(e.g., storing chemicals in a covered area, having a spill kit available on site and ensuring personnel are available to respond expeditiously in the event of a leak or spill)*.

d. **Comply with state/local requirements.** Comply with applicable state and local requirements regarding the use of treatment chemicals.

e. **Use chemicals in accordance with good engineering practices and specifications of the chemical provider/supplier.** Use treatment chemicals and chemical treatment systems in accordance with good engineering practices, and with dosing specifications and sediment removal design specifications provided by the provider/supplier of the applicable chemicals, or document in your SWPPP specific departures from these specifications and how they reflect good engineering practice.

f. **Ensure proper training.** Ensure that all persons who handle and use treatment chemicals at the construction site are provided with appropriate, product-specific training. Among other things, the training must cover proper dosing requirements.

g. **Perform additional measures specified by the EPA Regional Office for the authorized use of cationic chemicals.** If you have been authorized to use cationic chemicals at your site pursuant to Part 1.1.9, you must perform all additional measures as

[25] The circumstances in which it is infeasible to design outlet structures in this manner are rare. Exceptions may include areas with extended cold weather, where using surface outlets may not be feasible during certain time periods (although they must be used during other periods). If you determine that it is infeasible to meet this requirement, you must provide documentation in your SWPPP to support your determination, including the specific conditions or time periods when this exception will apply.

conditioned by your authorization to ensure that the use of such chemicals will not cause an exceedance of water quality standards.

2.2.14 Stabilize exposed portions of the site. Implement and maintain stabilization measures (e.g., seeding protected by erosion controls until vegetation is established, sodding, mulching, erosion control blankets, hydromulch, gravel) that minimize erosion from exposed portions of the site in accordance with Parts 2.2.14a and 2.2.14b.

a. **Stabilization Deadlines:**[26]

Total Amount of Land Disturbance Occurring At Any One Time[27]	**Deadline**
i. **Five acres or less (≤5.0)** **Note: this includes sites disturbing more than five acres (>5.0) total over the course of a project, but that limit disturbance at any one time *(i.e., phase the disturbance)* to five acres or less (≤5.0)**	• Initiate the installation of stabilization measures immediately[28] in any areas of exposed soil where construction activities have permanently ceased or will be temporarily inactive for 14 or more calendar days;[29] and • Complete the installation of stabilization measures as soon as practicable, but no later than 14 calendar days after stabilization has been initiated.[30]

[26] EPA may determine, based on an inspection carried out under Part 4.8 and corrective actions required under Part 5.3, that the level of sediment discharge on the site makes it necessary to require a faster schedule for completing stabilization. For instance, if sediment discharges from an area of exposed soil that is required to be stabilized are compromising the performance of existing stormwater controls, EPA may require stabilization to correct this problem.

[27] Limiting disturbances to five (5) acres or less at any one time means that at no time during the project do the cumulative earth disturbances exceed five (5) acres. The following examples would qualify as limiting disturbances at any one time to five (5) acres or less:

1. The total area of disturbance for a project is five (5) acres or less.
2. The total area of disturbance for a project will exceed five (5) acres, but the operator ensures that no more than five (5) acres will be disturbed at any one time through implementation of stabilization measures. In this way, site stabilization can be used to "free up" land that can be disturbed without exceeding the five (5)-acre cap to qualify for the 14-day stabilization deadline. For instance, if an operator completes stabilization of two (2) acres of land on a five (5)-acre disturbance, then two (2) additional acres could be disturbed while still qualifying for the longer 14-day stabilization deadline.

[28] The following are examples of activities that would constitute the immediate initiation of stabilization:

1. Prepping the soil for vegetative or non-vegetative stabilization as long as seeding, planting, and/or installation of non-vegetative stabilization products takes place as soon as practicable, but no later than one (1) calendar day of completing soil preparation;
2. Applying mulch or other non-vegetative product to the exposed area;
3. Seeding or planting the exposed area;
4. Starting any of the activities in # 1 – 3 on a portion of the entire area that will be stabilized; and
5. Finalizing arrangements to have stabilization product fully installed in compliance with the deadlines for completing stabilization.

[29] The requirement to initiate stabilization immediately is triggered as soon as you know that construction work on a portion of the site is temporarily ceased and will not resume for 14 or more days, or as soon as you know that construction work is permanently ceased. In the context of this provision, "immediately" means as soon as practicable, but no later than the end of the next business day, following the day when the construction activities have temporarily or permanently ceased.

[30] If vegetative stabilization measures are being implemented, stabilization is considered "installed" when all activities necessary to seed or plant the area are completed. If non-vegetative stabilization measures are being implemented, stabilization is considered "installed" when all such measures are implemented or applied.

Total Amount of Land Disturbance Occurring At Any One Time[27]	Deadline
ii. **More than five acres (>5.0)**	• Initiate the installation of stabilization measures immediately[31] in any areas of exposed soil where construction activities have permanently ceased or will be temporarily inactive for 14 or more calendar days;[32] and • Complete the installation of stabilization measures as soon as practicable, but no later than seven (7) calendar days after stabilization has been initiated.[33]

iii. **Exceptions:**

(a) Arid, semi-arid, and drought-stricken areas (as defined in Appendix A)**.** If it is the seasonally dry period or a period in which drought is occurring, and vegetative stabilization measures are being used:

(i) Immediately initiate and, within 14 calendar days of a temporary or permanent cessation of work in any portion of your site, complete the installation of temporary non-vegetative stabilization measures to the extent necessary to prevent erosion;

(ii) As soon as practicable, given conditions or circumstances on the site, complete all activities necessary to seed or plant the area to be stabilized; and

(iii) If construction is occurring during the seasonally dry period, indicate in your SWPPP the beginning and ending dates of the seasonally dry period and your site conditions. Also include the schedule you will follow for initiating and completing vegetative stabilization.

(b) Operators that are affected by unforeseen circumstances[34] that delay the initiation and/or completion of vegetative stabilization:

(i) Immediately initiate and, within 14 calendar days, complete the installation of temporary non-vegetative stabilization measures to prevent erosion;

(ii) Complete all soil conditioning, seeding, watering or irrigation installation, mulching, and other required activities related to the planting and initial establishment of vegetation as soon as conditions or circumstances allow it on your site; and

(iii) Document in the SWPPP the circumstances that prevent you from meeting the deadlines in Part 2.2.14a and the schedule you will follow for initiating and completing stabilization.

(c) Discharges to a sediment- or nutrient-impaired water or to a water that is identified by your state, tribe, or EPA as Tier 2, Tier 2.5, or Tier 3 for antidegradation purposes. Complete stabilization as soon as practicable, but no later than seven (7) calendar days after stabilization has been initiated.

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[31] See footnote 27

[32] See footnote 28

[33] See footnote 29

[34] Examples include problems with the supply of seed stock or with the availability of specialized equipment and unsuitability of soil conditions due to excessive precipitation and/or flooding.

b. **Final Stabilization Criteria** (for any areas not covered by permanent structures)**:**

i. Establish uniform, perennial vegetation *(i.e., evenly distributed, without large bare areas)* that provides 70 percent or more of the cover that is provided by vegetation native to local undisturbed areas; and/or

ii. Implement permanent non-vegetative stabilization measures[35] to provide effective cover.

iii. **Exceptions:**

(a) **Arid, semi-arid, and drought-stricken areas** (as defined in Appendix A). Final stabilization is met if the area has been seeded or planted to establish vegetation that provides 70 percent or more of the cover that is provided by vegetation native to local undisturbed areas within three (3) years and, to the extent necessary to prevent erosion on the seeded or planted area, non-vegetative erosion controls have been applied that provide cover for at least three years without active maintenance.

(b) **Disturbed areas on agricultural land that are restored to their preconstruction agricultural use.** The Part 2.2.14b final stabilization criteria does not apply.

(c) **Areas that need to remain disturbed.** In limited circumstances, stabilization may not be required if the intended function of a specific area of the site necessitates that it remain disturbed, and only the minimum area needed remains disturbed *(e.g., dirt access roads, utility pole pads, areas being used for storage of vehicles, equipment, materials).*

2.3 POLLUTION PREVENTION REQUIREMENTS[36]

You must implement pollution prevention controls in accordance with the following requirements to minimize the discharge of pollutants in stormwater and to prevent the discharge of pollutants from spilled or leaked materials from construction activities.

2.3.1 For equipment and vehicle fueling and maintenance:

a. Provide an effective means of eliminating the discharge of spilled or leaked chemicals, including fuels and oils, from these activities;[37]

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[35] Examples of permanent non-vegetative stabilization measures include riprap, gravel, gabions, and geotextiles.

[36] Under this permit, you are not required to minimize exposure for any products or materials where the exposure to precipitation and to stormwater will not result in a discharge of pollutants, or where exposure of a specific material or product poses little risk of stormwater contamination (such as final products and materials intended for outdoor use).

[37] Examples of effective means include:

- Locating activities away from waters of the U.S. and stormwater inlets or conveyances so that stormwater coming into contact with these activities cannot reach waters of the U.S.;
- Providing secondary containment (*e.g., spill berms, decks, spill containment pallets*) and cover where appropriate; and
- Having a spill kit available on site and ensuring personnel are available to respond expeditiously in the event of a leak or spill.

b. If applicable, comply with the Spill Prevention Control and Countermeasures (SPCC) requirements in 40 CFR part 112 and Section 311 of the CWA;

c. Ensure adequate supplies are available at all times to handle spills, leaks, and disposal of used liquids;

d. Use drip pans and absorbents under or around leaky vehicles;

e. Dispose of or recycle oil and oily wastes in accordance with other federal, state, tribal, or local requirements; and

f. Clean up spills or contaminated surfaces immediately, using dry clean up measures (do not clean contaminated surfaces by hosing the area down), and eliminate the source of the spill to prevent a discharge or a continuation of an ongoing discharge.

2.3.2 For equipment and vehicle washing:

a. Provide an effective means of minimizing the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other types of wash waters;[38]

b. Ensure there is no discharge of soaps, solvents, or detergents in equipment and vehicle wash water; and

c. For storage of soaps, detergents, or solvents, provide either (1) cover *(e.g., plastic sheeting, temporary roofs)* to minimize the exposure of these detergents to precipitation and to stormwater, or (2) a similarly effective means designed to minimize the discharge of pollutants from these areas.

2.3.3 For storage, handling, and disposal of building products, materials, and wastes:

a. *For building materials and building products*[39], provide either (1) cover (*e.g., plastic sheeting, temporary roofs*) to minimize the exposure of these products to precipitation and to stormwater, or (2) a similarly effective means designed to minimize the discharge of pollutants from these areas.

b. *For pesticides, herbicides, insecticides, fertilizers, and landscape materials:*

   i. In storage areas, provide either (1) cover (*e.g., plastic sheeting, temporary roofs*) to minimize the exposure of these chemicals to precipitation and to stormwater, or (2) a similarly effective means designed to minimize the discharge of pollutants from these areas; and

   ii. Comply with all application and disposal requirements included on the registered pesticide, herbicide, insecticide, and fertilizer label (see also Part 2.3.5).

c. *For diesel fuel, oil, hydraulic fluids, other petroleum products, and other chemicals*:

   i. Store chemicals in water-tight containers, and provide either (1) cover *(e.g., plastic sheeting, temporary roofs)* to minimize the exposure of these containers to precipitation and to stormwater, or (2) a similarly effective means designed to minimize the discharge of pollutants from these areas *(e.g., having a spill kit available on site and ensuring personnel are available to respond expeditiously in*

[38] Examples of effective means include locating activities away from waters of the U.S. and stormwater inlets or conveyances and directing wash waters to a sediment basin or sediment trap, using filtration devices, such as filter bags or sand filters, or using other similarly effective controls.

[39] Examples of building materials and building products typically present at construction sites include asphalt sealants, copper flashing, roofing materials, adhesives, concrete admixtures, and gravel and mulch stockpiles.

the event of a leak or spill), or provide secondary containment *(e.g., spill berms, decks, spill containment pallets)*; and

ii. Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly. You are prohibited from hosing the area down to clean surfaces or spills. Eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge.

d. *For hazardous or toxic wastes*:[40]

i. Separate hazardous or toxic waste from construction and domestic waste;

ii. Store waste in sealed containers, which are constructed of suitable materials to prevent leakage and corrosion, and which are labeled in accordance with applicable Resource Conservation and Recovery Act (RCRA) requirements and all other applicable federal, state, tribal, or local requirements;

iii. Store all outside containers within appropriately-sized secondary containment (*e.g., spill berms, decks, spill containment pallets*) to prevent spills from being discharged, or provide a similarly effective means designed to prevent the discharge of pollutants from these areas *(e.g., storing chemicals in a covered area, having a spill kit available on site);*

iv. Dispose of hazardous or toxic waste in accordance with the manufacturer's recommended method of disposal and in compliance with federal, state, tribal, and local requirements;

v. Clean up spills immediately, using dry clean-up methods, and dispose of used materials properly. You are prohibited from hosing the area down to clean surfaces or spills. Eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge; and

vi. Follow all other federal, state, tribal, and local requirements regarding hazardous or toxic waste.

e. *For construction and domestic wastes*:[41]

i. Provide waste containers *(e.g., dumpster, trash receptacle)* of sufficient size and number to contain construction and domestic wastes;

ii. Keep waste container lids closed when not in use and close lids at the end of the business day for those containers that are actively used throughout the day. For waste containers that do not have lids, provide either (1) cover *(e.g., a tarp, plastic sheeting, temporary roof)* to minimize exposure of wastes to precipitation, or (2) a similarly effective means designed to minimize the discharge of pollutants *(e.g., secondary containment)*;

iii. On business days, clean up and dispose of waste in designated waste containers; and

iv. Clean up immediately if containers overflow.

[40] Examples of hazardous or toxic waste that may be present at construction sites include paints, caulks, sealants, fluorescent light ballasts, solvents, petroleum-based products, wood preservatives, additives, curing compounds, and acids.

[41] Examples of construction and domestic waste include packaging materials, scrap construction materials, masonry products, timber, pipe and electrical cuttings, plastics, styrofoam, concrete, demolition debris; and other trash or building materials.

f. *For sanitary waste*, position portable toilets so that they are secure and will not be tipped or knocked over, and located away from waters of the U.S. and stormwater inlets or conveyances.

2.3.4 For washing applicators and containers used for stucco, paint, concrete, form release oils, curing compounds, or other materials:

a. Direct wash water into a leak-proof container or leak-proof and lined pit designed so that no overflows can occur due to inadequate sizing or precipitation;

b. Handle washout or cleanout wastes as follows:

   i. Do not dump liquid wastes in storm sewers or waters of the U.S.;

   ii. Dispose of liquid wastes in accordance with applicable requirements in Part 2.3.3; and

   iii. Remove and dispose of hardened concrete waste consistent with your handling of other construction wastes in Part 2.3.3; and

c. Locate any washout or cleanout activities as far away as possible from waters of the U.S. and stormwater inlets or conveyances, and, to the extent feasible, designate areas to be used for these activities and conduct such activities only in these areas.

2.3.5 For the application of fertilizers:

a. Apply at a rate and in amounts consistent with manufacturer's specifications, or document in the SWPPP departures from the manufacturer specifications where appropriate in accordance with Part 7.2.6.b.ix;

b. Apply at the appropriate time of year for your location, and preferably timed to coincide as closely as possible to the period of maximum vegetation uptake and growth;

c. Avoid applying before heavy rains that could cause excess nutrients to be discharged;

d. Never apply to frozen ground;

e. Never apply to stormwater conveyance channels; and

f. Follow all other federal, state, tribal, and local requirements regarding fertilizer application.

2.3.6 Emergency Spill Notification Requirements

Discharges of toxic or hazardous substances from a spill or other release are prohibited, consistent with Part 1.3.5. Where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR 110, 40 CFR 117, or 40 CFR 302 occurs during a 24-hour period, you must notify the National Response Center (NRC) at (800) 424-8802 or, in the Washington, DC metropolitan area, call (202) 267-2675 in accordance with the requirements of 40 CFR 110, 40 CFR 117, and 40 CFR 302 as soon as you have knowledge of the release. You must also, within seven (7) calendar days of knowledge of the release, provide a description of the release, the circumstances leading to the release, and the date of the release. State, tribal, or local requirements may necessitate additional reporting of spills or discharges to local emergency response, public health, or drinking water supply agencies.

2.4 CONSTRUCTION DEWATERING REQUIREMENTS

Comply with the following requirements to minimize the discharge of pollutants in ground water or accumulated stormwater that is removed from excavations, trenches, foundations, vaults, or other similar points of accumulation, in accordance with Part 1.2.2.[42]

2.4.1 Treat dewatering discharges with controls to minimize discharges of pollutants;[43]

2.4.2 Do not discharge visible floating solids or foam;

2.4.3 Use an oil-water separator or suitable filtration device (such as a cartridge filter) that is designed to remove oil, grease, or other products if dewatering water is found to contain these materials;

2.4.4 To the extent feasible, use vegetated, upland areas of the site to infiltrate dewatering water before discharge. You are prohibited from using waters of the U.S. as part of the treatment area;

2.4.5 At all points where dewatering water is discharged, comply with the velocity dissipation requirements of Part 2.2.11;

2.4.6 With backwash water, either haul it away for disposal or return it to the beginning of the treatment process; and

2.4.7 Replace and clean the filter media used in dewatering devices when the pressure differential equals or exceeds the manufacturer's specifications.

3 WATER QUALITY-BASED EFFLUENT LIMITATIONS

3.1 GENERAL EFFLUENT LIMITATION TO MEET APPLICABLE WATER QUALITY STANDARDS

Discharges must be controlled as necessary to meet applicable water quality standards. Discharges must also comply with any additional state or tribal requirements that are in Part 9.

In the absence of information demonstrating otherwise, EPA expects that compliance with the conditions in this permit will result in stormwater discharges being controlled as necessary to meet applicable water quality standards. If at any time you become aware, or EPA determines, that discharges are not being controlled as necessary to meet applicable water quality standards, you must take corrective action as required in Parts 5.1 and 5.2, and document the corrective actions as required in Part 5.4.

EPA may insist that you install additional controls (to meet the narrative water quality-based effluent limit above) on a site-specific basis, or require you to obtain coverage under an individual permit, if information in your NOI or from other sources indicates that your discharges are not controlled as necessary to meet applicable water quality

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[42] Uncontaminated, clear (non-turbid) dewatering water can be discharged without being routed to a control.

[43] Appropriate controls include sediment basins or sediment traps, sediment socks, dewatering tanks, tube settlers, weir tanks, filtration systems (*e.g., bag or sand filters*), and passive treatment systems that are designed to remove sediment. Appropriate controls to use downstream of dewatering controls to minimize erosion include vegetated buffers, check dams, riprap, and grouted riprap at outlets.

standards. This includes situations where additional controls are necessary to comply with a wasteload allocation in an EPA-established or approved TMDL.

If during your coverage under a previous permit, you were required to install and maintain stormwater controls specifically to meet the assumptions and requirements of an EPA-approved or established TMDL (for any parameter) or to otherwise control your discharge to meet water quality standards, you must continue to implement such controls as part of your coverage under this permit.

3.2 DISCHARGE LIMITATIONS FOR SITES DISCHARGING TO SENSITIVE WATERS[44]

For any portion of the site that discharges to a sediment or nutrient-impaired water or to a water that is identified by your state, tribe, or EPA as Tier 2, Tier 2.5, or Tier 3 for antidegradation purposes, you must comply with the inspection frequency specified in 4.3 and you must comply with the stabilization deadline specified in Part 2.2.14.a.iii.(c).[45]

If you discharge to a water that is impaired for a parameter other than a sediment-related parameter or nutrients, EPA will inform you if any additional controls are necessary for your discharge to be controlled as necessary to meet water quality standards, including for it to be consistent with the assumptions of any available wasteload allocation in any applicable TMDL, or if coverage under an individual permit is necessary.

In addition, on a case-by-case basis, EPA may notify operators of new sites or operators of existing sites with increased discharges that additional analyses, stormwater controls, or other measures are necessary to comply with the applicable antidegradation requirements, or notify you that an individual permit application is necessary.

If you discharge to a water that is impaired for polychlorinated biphenyls (PCBs) and are engaging in demolition of any structure with at least 10,000 square feet of floor space built or renovated before January 1, 1980, you must:

[44] Sensitive waters include waters that are impaired and Tier 2, Tier 2.5, and Tier 3 waters.

"Impaired waters" are those waters identified by the state, tribe, or EPA as not meeting an applicable water quality standard and (1) requires development of a TMDL (pursuant to section 303(d) of the CWA; or (2) is addressed by an EPA-approved or established TMDL; or (3) is not in either of the above categories but the waterbody is covered by a pollution control program that meets the requirements of 40 CFR 130.7(b)(1). Your construction site will be considered to discharge to an impaired water if the first water of the U.S. to which you discharge is an impaired water for the pollutants contained in the discharge from your site. For discharges that enter a storm sewer system prior to discharge, the first water of the U.S. to which you discharge is the waterbody that receives the stormwater discharge from the storm sewer system. For assistance in determining whether your site discharges to impaired waters, EPA has developed a tool that is available both within the electronic NOI form in NeT, and at https://www.epa.gov/npdes/epas-stormwater-discharge-mapping-tools.

Tiers 2, 2.5 and 3 refer to waters either identified by the state as high quality waters or Outstanding National Resource Waters under 40 CFR 131.12(a)(2) and (3). For the purposes of this permit, you are considered to discharge to a Tier 2, Tier 2.5, or Tier 3 water if the first water of the U.S. to which you discharge is identified by a state, tribe, or EPA as Tier 2, Tier 2.5, or Tier 3. For discharges that enter a storm sewer system prior to discharge, the water of the U.S. to which you discharge is the first water of the U.S. that receives the stormwater discharge from the storm sewer system. See list of Tier 2, Tier 2.5, and Tier 3 waters in Appendix F.

EPA may determine on a case-by-case basis that a site discharges to a sensitive water.

[45] If you qualify for any of the reduced inspection frequencies in Part 4.4, you may conduct inspections in accordance with Part 4.4 for any portion of your site that discharges to a sensitive water.

a. Implement controls[46] to minimize the exposure of PCB-containing building materials, including paint, caulk, and pre-1980 fluorescent lighting fixtures, to precipitation and to stormwater; and

b. Ensure that disposal of such materials is performed in compliance with applicable state, federal, and local laws.

4 SITE INSPECTION REQUIREMENTS

4.1 PERSON(S) RESPONSIBLE FOR INSPECTING SITE

The person(s) inspecting your site may be a person on your staff or a third party you hire to conduct such inspections. You are responsible for ensuring that the person who conducts inspections is a "qualified person."[47]

4.2 FREQUENCY OF INSPECTIONS.[48]

At a minimum, you must conduct a site inspection in accordance with one of the two schedules listed below, unless you are subject to the Part 4.3 site inspection frequency for discharges to sensitive waters or qualify for a Part 4.4 reduction in the inspection frequency:

4.2.1 At least once every seven (7) calendar days; *or*

4.2.2 Once every 14 calendar days *and* within 24 hours of the occurrence of a storm event of 0.25 inches or greater, or the occurrence of runoff from snowmelt sufficient to cause a discharge.[49] To determine if a storm event of 0.25 inches or greater has occurred on your site, you must either keep a properly maintained rain gauge on your site, or obtain the storm event information from a weather station that is representative of your location. For any day of rainfall during normal business hours that measures 0.25 inches or greater, you must record the total rainfall measured for that day in accordance with Part 4.7.1d.

4.3 INCREASE IN INSPECTION FREQUENCY FOR SITES DISCHARGING TO SENSITIVE WATERS.

For any portion of the site that discharges to a sediment or nutrient-impaired water or to a water that is identified by your state, tribe, or EPA as Tier 2, Tier 2.5, or Tier 3 for antidegradation purposes (see Part 3.2), instead of the inspection frequency specified in

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[46] Examples of controls to minimize exposure of PCBs to precipitation and stormwater include separating work areas from non-work areas and selecting appropriate personal protective equipment and tools, constructing a containment area so that all dust or debris generated by the work remains within the protected area, using tools that minimize dust and heat (<212°F). For additional information, refer to Part 2.3.3 of the CGP Fact Sheet.

[47] A "qualified person" is a person knowledgeable in the principles and practice of erosion and sediment controls and pollution prevention, who possesses the appropriate skills and training to assess conditions at the construction site that could impact stormwater quality, and the appropriate skills and training to assess the effectiveness of any stormwater controls selected and installed to meet the requirements of this permit.

[48] Inspections are only required during the site's normal working hours.

[49] "Within 24 hours of the occurrence of a storm event" means that you must conduct an inspection within 24 hours once a storm event has produced 0.25 inches within a 24-hour period, even if the storm event is still continuing. Thus, if you have elected to inspect bi-weekly in accordance with Part 4.2.2 and there is a storm event at your site that continues for multiple days, and each day of the storm produces 0.25 inches or more of rain, you must conduct an inspection within 24 hours of the first day of the storm and within 24 hours after the end of the storm.

Part 4.2, you must conduct inspections in accordance with the following inspection frequencies:

Once every seven (7) calendar days *and* within 24 hours of the occurrence of a storm event of 0.25 inches or greater, or the occurrence of runoff from snowmelt sufficient to cause a discharge. To determine if a storm event of 0.25 inches or greater has occurred on your site, you must either keep a properly maintained rain gauge on your site, or obtain the storm event information from a weather station that is representative of your location. For any day of rainfall during normal business hours that measures 0.25 inches or greater, you must record the total rainfall measured for that day in accordance with Part 4.7.1d.

4.4 REDUCTIONS IN INSPECTION FREQUENCY

4.4.1 Stabilized areas.

a. You may reduce the frequency of inspections to twice per month for the first month, no more than 14 calendar days apart, then once per month in any area of your site where the stabilization steps in 2.2.14a have been completed. If construction activity resumes in this portion of the site at a later date, the inspection frequency immediately increases to that required in Parts 4.2 and 4.3, as applicable. You must document the beginning and ending dates of this period in your SWPPP.

b. **Exception.** For “linear construction sites” (as defined in Appendix A) where disturbed portions have undergone final stabilization at the same time active construction continues on others, you may reduce the frequency of inspections to twice per month for the first month, no more than 14 calendar days apart, in any area of your site where the stabilization steps in 2.2.14a have been completed. After the first month, inspect once more within 24 hours of the occurrence of a storm event of 0.25 inches or greater. If there are no issues or evidence of stabilization problems, you may suspend further inspections. If “wash-out” of stabilization materials and/or sediment is observed, following re-stabilization, inspections must resume at the inspection frequency required in Part 4.4.1a Inspections must continue until final stabilization is visually confirmed following a storm event of 0.25 inches or greater.

4.4.2 Arid, semi-arid, or drought-stricken areas (as defined in Appendix A). If it is the seasonally dry period or a period in which drought is occurring, you may reduce the frequency of inspections to once per month and within 24 hours of the occurrence of a storm event of 0.25 inches or greater. You must document that you are using this reduced schedule and the beginning and ending dates of the seasonally dry period in your SWPPP. To determine if a storm event of 0.25 inches or greater has occurred on your site, you must either keep a properly maintained rain gauge on your site, or obtain the storm event information from a weather station that is representative of your location. For any day of rainfall during normal business hours that measures 0.25 inches or greater, you must record the total rainfall measured for that day in accordance with Part 4.7.1d.

4.4.3 Frozen conditions:

a. If you are suspending construction activities due to frozen conditions, you may temporarily suspend inspections on your site until thawing conditions (as defined in Appendix A) begin to occur if:

i. Runoff is unlikely due to continuous frozen conditions that are likely to continue at your site for at least three (3) months based on historic seasonal averages. If unexpected weather conditions (such as above freezing temperatures or rain events) make discharges likely, you must immediately resume your regular inspection frequency as described in Parts 4.2 and 4.3, as applicable;

ii. Land disturbances have been suspended; and

iii. All disturbed areas of the site have been stabilized in accordance with Part 2.2.14a.

b. If you are still conducting construction activities during frozen conditions, you may reduce your inspection frequency to once per month if:

i. Runoff is unlikely due to continuous frozen conditions that are likely to continue at your site for at least three (3) months based on historic seasonal averages. If unexpected weather conditions (such as above freezing temperatures or rain events) make discharges likely, you must immediately resume your regular inspection frequency as described in Parts 4.2 and 4.3, as applicable; and

ii. Except for areas in which you are actively conducting construction activities, disturbed areas of the site have been stabilized in accordance with Part 2.2.14a.

You must document the beginning and ending dates of this period in your SWPPP.

4.5 AREAS THAT MUST BE INSPECTED

During your site inspection, you must at a minimum inspect the following areas of your site:

4.5.1 All areas that have been cleared, graded, or excavated and that have not yet completed stabilization consistent with Part 2.2.14a;

4.5.2 All stormwater controls (including pollution prevention controls) installed at the site to comply with this permit;[50]

4.5.3 Material, waste, borrow, and equipment storage and maintenance areas that are covered by this permit;

4.5.4 All areas where stormwater typically flows within the site, including drainageways designed to divert, convey, and/or treat stormwater;

4.5.5 All points of discharge from the site; and

4.5.6 All locations where stabilization measures have been implemented.

You are not required to inspect areas that, at the time of the inspection, are considered unsafe to your inspection personnel.

4.6 REQUIREMENTS FOR INSPECTIONS

During your site inspection, you must at a minimum:

4.6.1 Check whether all stormwater controls *(i.e., erosion and sediment controls and pollution prevention controls)* are properly installed, appear to be operational, and are working as intended to minimize pollutant discharges;

[50] This includes the requirement to inspect for sediment that has been tracked out from the site onto paved roads, sidewalks, or other paved areas consistent with Part 2.2.4.

4.6.2 Check for the presence of conditions that could lead to spills, leaks, or other accumulations of pollutants on the site;

4.6.3 Identify any locations where new or modified stormwater controls are necessary to meet the requirements of Parts 2 and/or 3;

4.6.4 Check for signs of visible erosion and sedimentation *(i.e., sediment deposits)* that have occurred and are attributable to your discharge at points of discharge and, if applicable, the banks of any waters of the U.S. flowing within or immediately adjacent to the site;

4.6.5 Identify any incidents of noncompliance observed;

4.6.6 If a discharge is occurring during your inspection:

a. Identify all discharge points at the site; and

b. Observe and document the visual quality of the discharge, and take note of the characteristics of the stormwater discharge, including color; odor; floating, settled, or suspended solids; foam; oil sheen; and other indicators of stormwater pollutants.

4.6.7 Based on the results of your inspection, complete any necessary maintenance under Part 2.1.4 and corrective action under Part 5.

4.7 INSPECTION REPORT

4.7.1 You must complete an inspection report within 24 hours of completing any site inspection. Each inspection report must include the following:

a. The inspection date;

b. Names and titles of personnel making the inspection;

c. A summary of your inspection findings, covering at a minimum the observations you made in accordance with Part 4.6, including any necessary maintenance or corrective actions;

d. If you are inspecting your site at the frequency specified in Part 4.2.2, Part 4.3, or Part 4.4.1b, and you conducted an inspection because of rainfall measuring 0.25 inches or greater, you must include the applicable rain gauge or weather station readings that triggered the inspection; and

e. If you determined that it is unsafe to inspect a portion of your site, you must describe the reason you found it to be unsafe and specify the locations to which this condition applies.

4.7.2 Each inspection report must be signed in accordance with Appendix I, Part I.11 of this permit.

4.7.3 You must keep a copy of all inspection reports at the site or at an easily accessible location, so that it can be made available at the time of an on-site inspection or upon request by EPA.

4.7.4 You must retain all inspection reports completed for this Part for at least three (3) years from the date that your permit coverage expires or is terminated.

4.8 INSPECTIONS BY EPA

You must allow EPA, or an authorized representative of EPA, to conduct the following activities at reasonable times. To the extent that you are utilizing shared controls that are not on site to comply with this permit, you must make arrangements for EPA to have access at all reasonable times to those areas where the shared controls are located.

4.8.1 Enter onto all areas of the site, including any construction support activity areas covered by this permit, any off-site areas where shared controls are utilized to comply with this permit, discharge locations, adjoining waterbodies, and locations where records are kept under the conditions of this permit;

4.8.2 Access and copy any records that must be kept under the conditions of this permit;

4.8.3 Inspect your construction site, including any construction support activity areas covered by this permit (see Part 1.2.1c), any stormwater controls installed and maintained at the site, and any off-site shared controls utilized to comply with this permit; and

4.8.4 Sample or monitor for the purpose of ensuring compliance.

5 CORRECTIVE ACTIONS

5.1 CONDITIONS TRIGGERING CORRECTIVE ACTION.

You must take corrective action to address any of the following conditions identified at your site:

5.1.1 A stormwater control needs repair or replacement (beyond routine maintenance required under Part 2.1.4); or

5.1.2 A stormwater control necessary to comply with the requirements of this permit was never installed, or was installed incorrectly; or

5.1.3 Your discharges are causing an exceedance of applicable water quality standards; or

5.1.4 A prohibited discharge has occurred (see Part 1.3).

5.2 CORRECTIVE ACTION DEADLINES

For any corrective action triggering conditions in Part 5.1, you must:

5.2.1 Immediately take all reasonable steps to address the condition, including cleaning up any contaminated surfaces so the material will not discharge in subsequent storm events;

5.2.2 When the problem does not require a new or replacement control or significant repair, the corrective action must be completed by the close of the next business day;

5.2.3 When the problem requires a new or replacement control or significant repair, install the new or modified control and make it operational, or complete the repair, by no later than seven (7) calendar days from the time of discovery. If it is infeasible to complete the installation or repair within seven (7) calendar days, you must document in your records why it is infeasible to complete the installation or repair within the 7-day timeframe and document your schedule for installing the stormwater control(s) and making it operational as soon as feasible after the 7-day timeframe. Where these actions result in changes to any of the stormwater controls or procedures documented in your SWPPP, you must modify your SWPPP accordingly within seven (7) calendar days of completing this work.

5.3 CORRECTIVE ACTION REQUIRED BY EPA

You must comply with any corrective actions required by EPA as a result of permit violations found during an inspection carried out under Part 4.8.

5.4 CORRECTIVE ACTION REPORT

For each corrective action taken in accordance with this Part, you must complete a report in accordance with the following:

5.4.1 Within 24 hours of identifying the corrective action condition, document the specific condition and the date and time it was identified.

5.4.2 Within 24 hours of completing the corrective action (in accordance with the deadlines in Part 5.2), document the actions taken to address the condition, including whether any SWPPP modifications are required.

5.4.3 Each corrective action report must be signed in accordance with Appendix I, Part I.11 of this permit.

5.4.4 You must keep a copy of all corrective action reports at the site or at an easily accessible location, so that it can be made available at the time of an on-site inspection or upon request by EPA.

5.4.5 You must retain all corrective action reports completed for this Part for at least three (3) years from the date that your permit coverage expires or is terminated.

6 STAFF TRAINING REQUIREMENTS

Each operator, or group of multiple operators, must assemble a "stormwater team" to carry out compliance activities associated with the requirements in this permit.

6.1 Prior to the commencement of construction activities, you must ensure that the following personnel[51] on the stormwater team understand the requirements of this permit and their specific responsibilities with respect to those requirements:

a. Personnel who are responsible for the design, installation, maintenance, and/or repair of stormwater controls (including pollution prevention controls);
b. Personnel responsible for the application and storage of treatment chemicals (if applicable);
c. Personnel who are responsible for conducting inspections as required in Part 4.1; and
d. Personnel who are responsible for taking corrective actions as required in Part 5.

[51] If the person requiring training is a new employee who starts after you commence construction activities, you must ensure that this person has the proper understanding as required above prior to assuming particular responsibilities related to compliance with this permit.

For emergency-related projects, the requirement to train personnel prior to commencement of construction activities does not apply, however, such personnel must have the required training prior to NOI submission.

6.2 You are responsible for ensuring that all activities on the site comply with the requirements of this permit. You are not required to provide or document formal training for subcontractors or other outside service providers, but you must ensure that such personnel understand any requirements of this permit that may be affected by the work they are subcontracted to perform.

6.3 At a minimum, members of the stormwater team must be trained to understand the following if related to the scope of their job duties *(e.g., only personnel responsible for conducting inspections need to understand how to conduct inspections*):

a. The permit deadlines associated with installation, maintenance, and removal of stormwater controls and with stabilization;

b. The location of all stormwater controls on the site required by this permit and how they are to be maintained;

c. The proper procedures to follow with respect to the permit's pollution prevention requirements; and

d. When and how to conduct inspections, record applicable findings, and take corrective actions.

6.4 Each member of the stormwater team must have easy access to an electronic or paper copy of applicable portions of this permit, the most updated copy of your SWPPP, and other relevant documents or information that must be kept with the SWPPP.

7 STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

7.1 GENERAL REQUIREMENTS

All operators associated with a construction site under this permit must develop a SWPPP consistent with the requirements in Part 7 prior to their submittal of the NOI.[52, 53] The SWPPP must be kept up-to-date throughout coverage under this permit.

[52] The SWPPP does not establish the effluent limits that apply to your site's discharges; these limits are established in this permit in Parts 2 and 3.

[53] You have the option of developing a group SWPPP where you are one of several operators at your site. For instance, if both the owner and the general contractor of the construction site are operators and thus are both required to obtain a permit, the owner may be the party undertaking SWPPP development, and the general contractor (or any other operator at the site) can choose to use this same SWPPP, as long as the SWPPP addresses the general contractor's (or other operator's) scope of construction work and functions to be performed under the SWPPP. Regardless of whether there is a group SWPPP or several individual SWPPPs, all operators would be jointly and severally liable for compliance with the permit.

Where there are multiple operators associated with the same site through a common plan of development or sale, operators may assign to themselves various permit-related functions under the SWPPP provided that each SWPPP, or a group SWPPP, documents which operator will perform each function under the SWPPP. However, dividing the functions to be performed under each SWPPP, or a single group SWPPP, does not relieve an individual operator from liability for complying with the permit should another operator fail to implement any measures that are necessary for that individual operator to comply with the permit, e.g., the installation and maintenance of any shared controls. In addition, all operators must ensure, either directly or through coordination with other operators, that their activities do not cause a violation and/or render any other operators' controls and/or any shared controls ineffective. All operators who rely on a shared control to comply with the permit are jointly and severally liable for violations of the permit resulting from the failure to properly install, operate and/or maintain the shared control.

If a SWPPP was prepared under a previous version of this permit, the operator must review and update the SWPPP to ensure that this permit's requirements are addressed prior to submitting an NOI for coverage under this permit.

7.2 SWPPP CONTENTS

At a minimum, the SWPPP must include the information specified in this Part and as specified in other parts of this permit.

7.2.1 All Site Operators. Include a list of all other operators who will be engaged in construction activities at the site, and the areas of the site over which each operator has control.

7.2.2 Stormwater Team. Identify the personnel (by name or position) that are part of the stormwater team, as well as their individual responsibilities, including which members are responsible for conducting inspections.

7.2.3 Nature of Construction Activities.[54] Include the following:

a. A description of the nature of your construction activities, including the age or dates of past renovations for structures that are undergoing demolition;

b. The size of the property (in acres or length in miles if a linear construction site);

c. The total area expected to be disturbed by the construction activities (to the nearest quarter acre or nearest quarter mile if a linear construction site);

d. A description of any on-site and off-site construction support activity areas covered by this permit (see Part 1.2.1c);

e. The maximum area expected to be disturbed at any one time, including on-site and off-site construction support activity areas;

f. A description and projected schedule for the following:

   i. Commencement of construction activities in each portion of the site, including clearing and grubbing, mass grading, demolition activities, site preparation (*i.e., excavating, cutting and filling*), final grading, and creation of soil and vegetation stockpiles requiring stabilization;

   ii. Temporary or permanent cessation of construction activities in each portion of the site;

   iii. Temporary or final stabilization of exposed areas for each portion of the site; and

   iv. Removal of temporary stormwater controls and construction equipment or vehicles, and the cessation of construction-related pollutant-generating activities.

g. A list and description of all pollutant-generating activities[55] on the site. For each pollutant-generating activity, include an inventory of pollutants or pollutant constituents (*e.g., sediment, fertilizers, pesticides, paints, caulks, sealants, fluorescent light ballasts, contaminated substrates, solvents, fuels*) associated with that activity, which could be discharged in stormwater from your construction site. You must take

[54] If plans change due to unforeseen circumstances or for other reasons, the requirement to describe the sequence and estimated dates of construction activities is not meant to "lock in" the operator to meeting these dates. When departures from initial projections are necessary, this should be documented in the SWPPP itself, or in associated records, as appropriate.

[55] Examples of pollutant-generating activities include paving operations; concrete, paint, and stucco washout and waste disposal; solid waste storage and disposal; and dewatering operations.

into account where potential spills and leaks could occur that contribute pollutants to stormwater discharges, and any known hazardous or toxic substances, such as PCBs and asbestos, that will be disturbed or removed during construction;

h. Business days and hours for the project;

i. If you are conducting construction activities in response to a public emergency (see Part 1.4), a description of the cause of the public emergency *(e.g., mud slides, earthquake, extreme flooding conditions, widespread disruption in essential public services)*, information substantiating its occurrence *(e.g., state disaster declaration or similar state or local declaration)*, and a description of the construction necessary to reestablish affected public services.

7.2.4 Site Map. Include a legible map, or series of maps, showing the following features of the site:

a. Boundaries of the property;

b. Locations where construction activities will occur, including:

   i. Locations where earth-disturbing activities will occur (note any phasing), including any demolition activities;

   ii. Approximate slopes before and after major grading activities (note any steep slopes (as defined in Appendix A));

   iii. Locations where sediment, soil, or other construction materials will be stockpiled;

   iv. Any water of the U.S. crossings;

   v. Designated points where vehicles will exit onto paved roads;

   vi. Locations of structures and other impervious surfaces upon completion of construction; and

   vii. Locations of on-site and off-site construction support activity areas covered by this permit (see Part 1.2.1c).

c. Locations of all waters of the U.S. within and one mile downstream of the site's discharge point. Also identify if any are listed as impaired, or are identified as a Tier 2, Tier 2.5, or Tier 3 water;

d. Areas of federally listed critical habitat within the site and/or at discharge locations;

e. Type and extent of pre-construction cover on the site (*e.g., vegetative cover, forest, pasture, pavement, structures*);

f. Drainage patterns of stormwater and authorized non-stormwater before and after major grading activities;

g. Stormwater and authorized non-stormwater discharge locations, including:

   i. Locations where stormwater and/or authorized non-stormwater will be discharged to storm drain inlets;[56] and

   ii. Locations where stormwater or authorized non-stormwater will be discharged directly to waters of the U.S.

h. Locations of all potential pollutant-generating activities identified in Part 7.2.3g;

[56] The requirement to show storm drain inlets in the immediate vicinity of the site on your site map only applies to those inlets that are easily identifiable from your site or from a publicly accessible area immediately adjacent to your site.

i. Locations of stormwater controls, including natural buffer areas and any shared controls utilized to comply with this permit; and

j. Locations where polymers, flocculants, or other treatment chemicals will be used and stored.

7.2.5 Non-Stormwater Discharges. Identify all authorized non-stormwater discharges in Part 1.2.2 that will or may occur.

7.2.6 Description of Stormwater Controls.

a. For each of the Part 2.2 erosion and sediment control effluent limits, Part 2.3 pollution prevention effluent limits, and Part 2.4 construction dewatering effluent limits, as applicable to your site, you must include the following:

i. A description of the specific control(s) to be implemented to meet the effluent limit;

ii. Any applicable stormwater control design specifications (including references to any manufacturer specifications and/or erosion and sediment control manuals/ordinances relied upon);[57]

iii. Routine stormwater control maintenance specifications; and

iv. The projected schedule for stormwater control installation/implementation.

b. You must also include any of the following additional information as applicable.

i. **Natural buffers and/or equivalent sediment controls** (see Part 2.2.1 and Appendix G). You must include the following:

(a) The compliance alternative to be implemented;

(b) If complying with alternative 2, the width of natural buffer retained;

(c) If complying with alternative 2 or 3, the erosion and sediment control(s) you will use to achieve an equivalent sediment reduction, and any information you relied upon to demonstrate the equivalency;

(d) If complying with alternative 3, a description of why it is infeasible for you to provide and maintain an undisturbed natural buffer of any size;

(e) For "linear construction sites" where it is infeasible to implement compliance alternative 1, 2, or 3, a rationale for this determination, and a description of any buffer width retained and/or supplemental erosion and sediment controls installed; and

(f) A description of any disturbances that are exempt under Part 2.2.1 that occur within 50 feet of a water of the U.S.

ii. **Perimeter controls for a "linear construction site"** (see Part 2.2.3). For areas where perimeter controls are not feasible, include documentation to support this determination and a description of the other practices that will be implemented to minimize discharges of pollutants in stormwater associated with construction activities.

Note: Routine maintenance specifications for perimeter controls documented in the SWPPP must include the Part 2.2.3a requirement that sediment be removed

[57] Design specifications may be found in manufacturer specifications and/or in applicable erosion and sediment control manuals or ordinances. Any departures from such specifications must reflect good engineering practice and must be explained in the SWPPP.

before it has accumulated to one-half of the above-ground height of any perimeter control.

iii. **Sediment track-out controls** (see Parts 2.2.4b and 2.2.4c)**.** Document the specific stabilization techniques and/or controls that will be implemented to remove sediment prior to vehicle exit.

iv. **Sediment basins** (see Part 2.2.12). In circumstances where it is infeasible to utilize outlet structures that withdraw water from the surface, include documentation to support this determination, including the specific conditions or time periods when this exception will apply.

v. **Treatment chemicals** (see Part 2.2.13), you must include the following:

(a) A listing of the soil types that are expected to be exposed during construction in areas of the project that will drain to chemical treatment systems. Also include a listing of soil types expected to be found in fill material to be used in these same areas, to the extent you have this information prior to construction;

(b) A listing of all treatment chemicals to be used at the site and why the selection of these chemicals is suited to the soil characteristics of your site;

(c) If the applicable EPA Regional Office authorized you to use cationic treatment chemicals for sediment control, include the specific controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to an exceedance of water quality standards;

(d) The dosage of all treatment chemicals to be used at the site or the methodology to be used to determine dosage;

(e) Information from any applicable Safety Data Sheet (SDS);

(f) Schematic drawings of any chemically enhanced stormwater controls or chemical treatment systems to be used for application of the treatment chemicals;

(g) A description of how chemicals will be stored consistent with Part 2.2.13c;

(h) References to applicable state or local requirements affecting the use of treatment chemicals, and copies of applicable manufacturer's specifications regarding the use of your specific treatment chemicals and/or chemical treatment systems; and

(i) A description of the training that personnel who handle and apply chemicals have received prior to permit coverage, or will receive prior to use of the treatment chemicals at your site.

vi. **Stabilization measures** (see Part 2.2.14). You must include the following:

(a) The specific vegetative and/or non-vegetative practices that will be used;

(b) The stabilization deadline that will be met in accordance with Part 2.2.14.a.i-ii;

(c) If complying with the deadlines for sites in arid, semi-arid, or drought-stricken areas, the beginning and ending dates of the seasonally dry period and the schedule you will follow for initiating and completing vegetative stabilization; and

(d) If complying with deadlines for sites affected by unforeseen circumstances that delay the initiation and/or completion of vegetative stabilization, document the circumstances and the schedule for initiating and completing stabilization.

vii. **Spill prevention and response procedures** (see Part 1.3.5 and Part 2.3). You must include the following:

(a) Procedures for expeditiously stopping, containing, and cleaning up spills, leaks, and other releases. Identify the name or position of the employee(s) responsible for detection and response of spills or leaks; and

(b) Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity consistent with Part 2.3.6 and established under either 40 CFR 110, 40 CFR 117, or 40 CFR 302, occurs during a 24-hour period. Contact information must be in locations that are readily accessible and available to all employees.

You may also reference the existence of Spill Prevention Control and Countermeasure (SPCC) plans developed for the construction activity under Part 311 of the CWA, or spill control programs otherwise required by an NPDES permit for the construction activity, provided that you keep a copy of that other plan on site.[58]

viii. **Waste management procedures** (see Part 2.3.3). Describe the procedures you will follow for handling, storing and disposing of all wastes generated at your site consistent with all applicable federal, state, tribal, and local requirements, including clearing and demolition debris, sediment removed from the site, construction and domestic waste, hazardous or toxic waste, and sanitary waste.

ix. **Application of fertilizers** (see Part 2.3.5). Document any departures from the manufacturer specifications where appropriate.

7.2.7 Procedures for Inspection, Maintenance, and Corrective Action. Describe the procedures you will follow for maintaining your stormwater controls, conducting site inspections, and, where necessary, taking corrective actions, in accordance with Part 2.1.4, Part 4, and Part 5 of this permit. Also include:

a. The inspection schedule you will follow, which is based on whether your site is subject to Part 4.2 or Part 4.3, or whether your site qualifies for any of the reduced inspection frequencies in Part 4.4;

b. If you will be conducting inspections in accordance with the inspection schedule in Part 4.2.2, Part 4.3, or Part 4.4.1b, the location of the rain gauge or the address of the weather station you will be using to obtain rainfall data;

c. If you will be reducing your inspection frequency in accordance with Part 4.4.1b, the beginning and ending dates of the seasonally defined arid period for your area or the valid period of drought;

d. If you will be reducing your inspection frequency in accordance with Part 4.4.3, the beginning and ending dates of frozen conditions on your site; and

e. Any maintenance or inspection checklists or other forms that will be used.

[58] Even if you already have an SPCC or other spill prevention plan in existence, your plans will only be considered adequate if they meet all of the requirements of this Part, either as part of your existing plan or supplemented as part of the SWPPP.

7.2.8 Staff Training. Include documentation that the required personnel were, or will be, trained in accordance with Part 6.

7.2.9 Compliance with Other Requirements.

a. **Threatened and Endangered Species Protection.** Include documentation required in Appendix D supporting your eligibility with regard to the protection of threatened and endangered species and designated critical habitat.

b. **Historic Properties.** Include documentation required in Appendix E supporting your eligibility with regard to the protection of historic properties.

c. **Safe Drinking Water Act Underground Injection Control (UIC) Requirements for Certain Subsurface Stormwater Controls.** If you are using any of the following stormwater controls at your site, document any contact you have had with the applicable state agency[59] or EPA Regional Office responsible for implementing the requirements for underground injection wells in the Safe Drinking Water Act and EPA's implementing regulations at 40 CFR 144 -147. Such controls would generally be considered Class V UIC wells:

i. Infiltration trenches (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system);

ii. Commercially manufactured pre-cast or pre-built proprietary subsurface detention vaults, chambers, or other devices designed to capture and infiltrate stormwater flow; and

iii. Drywells, seepage pits, or improved sinkholes (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system).

7.2.10 SWPPP Certification. You must sign and date your SWPPP in accordance with Appendix I, Part I.11.

7.2.11 Post-Authorization Additions to the SWPPP. Once you are authorized for coverage under this permit, you must include the following documents as part of your SWPPP:

a. A copy of your NOI submitted to EPA along with any correspondence exchanged between you and EPA related to coverage under this permit;

b. A copy of the acknowledgment letter you receive from NeT assigning your NPDES ID (*i.e., permit tracking number*);

c. A copy of this permit (an electronic copy easily available to the stormwater team is also acceptable).

7.3 ON-SITE AVAILABILITY OF YOUR SWPPP

You must keep a current copy of your SWPPP at the site or at an easily accessible location so that it can be made available at the time of an on-site inspection or upon request by EPA; a state, tribal, or local agency approving stormwater management plans; the operator of a storm sewer system receiving discharges from the site; or representatives of the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS).

[59] For state UIC program contacts, refer to the following EPA website: https://www.epa.gov/uic.

EPA may provide access to portions of your SWPPP to a member of the public upon request. Confidential Business Information (CBI) will be withheld from the public, but may not be withheld from EPA, USFWS, or NMFS.[60]

If an on-site location is unavailable to keep the SWPPP when no personnel are present, notice of the plan's location must be posted near the main entrance of your construction site.

7.4 SWPPP MODIFICATIONS

7.4.1 You must modify your SWPPP, including the site map(s), within seven (7) days of any of the following conditions:

a. Whenever new operators become active in construction activities on your site, or you make changes to your construction plans, stormwater controls, or other activities at your site that are no longer accurately reflected in your SWPPP. This includes changes made in response to corrective actions triggered under Part 5. You do not need to modify your SWPPP if the estimated dates in Part 7.2.3f change during the course of construction;

b. To reflect areas on your site map where operational control has been transferred (and the date of transfer) since initiating permit coverage;

c. If inspections or investigations by EPA or its authorized representatives determine that SWPPP modifications are necessary for compliance with this permit;

d. Where EPA determines it is necessary to install and/or implement additional controls at your site in order to meet the requirements of this permit, the following must be included in your SWPPP:

   i. A copy of any correspondence describing such measures and requirements; and

   ii. A description of the controls that will be used to meet such requirements.

e. To reflect any revisions to applicable federal, state, tribal, or local requirements that affect the stormwater controls implemented at the site; and

f. If applicable, if a change in chemical treatment systems or chemically enhanced stormwater control is made, including use of a different treatment chemical, different dosage rate, or different area of application.

7.4.2 You must maintain records showing the dates of all SWPPP modifications. The records must include the name of the person authorizing each change (see Part 7.2.10 above) and a brief summary of all changes.

7.4.3 All modifications made to the SWPPP consistent with Part 7.4 must be authorized by a person identified in Appendix I, Part I.11.b.

7.4.4 Upon determining that a modification to your SWPPP is required, if there are multiple operators covered under this permit, you must immediately notify any operators who may be impacted by the change to the SWPPP.

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[60] Information covered by a claim of confidentiality will be disclosed by EPA only to the extent of, and by means of, the procedures set forth in 40 CFR Part 2, Subpart B. In general, submitted information protected by a business confidentiality claim may be disclosed to other employees, officers, or authorized representatives of the United States concerned with implementing the CWA. The authorized representatives, including employees of other executive branch agencies, may review CBI during the course of reviewing draft regulations.

8 HOW TO TERMINATE COVERAGE

Until you terminate coverage under this permit, you must comply with all conditions and effluent limitations in the permit. To terminate permit coverage, you must submit to EPA a complete and accurate Notice of Termination (NOT), which certifies that you have met the requirements for terminating in Part 8.

8.1 MINIMUM INFORMATION REQUIRED IN NOT

8.1.1 NPDES ID (*i.e., permit tracking number)* provided by EPA when you received coverage under this permit;

8.1.2 Basis for submission of the NOT (see Part 8.2);

8.1.3 Operator contact information;

8.1.4 Name of site and address (or a description of location if no street address is available); and

8.1.5 **NOT certification.**

8.2 CONDITIONS FOR TERMINATING CGP COVERAGE

You must terminate CGP coverage only if one or more of the following conditions has occurred:

8.2.1 You have completed all construction activities at your site and, if applicable, construction support activities covered by this permit (see Part 1.2.1c), and you have met the following requirements:

a. For any areas that (1) were disturbed during construction, (2) are not covered over by permanent structures, and (3) over which you had control during the construction activities, you have met the requirements for final vegetative or non-vegetative stabilization in Part 2.2.14b;

b. You have removed and properly disposed of all construction materials, waste and waste handling devices, and have removed all equipment and vehicles that were used during construction, unless intended for long-term use following your termination of permit coverage;

c. You have removed all stormwater controls that were installed and maintained during construction, except those that are intended for long-term use following your termination of permit coverage or those that are biodegradable; and

d. You have removed all potential pollutants and pollutant-generating activities associated with construction, unless needed for long-term use following your termination of permit coverage; or

8.2.2 You have transferred control of all areas of the site for which you are responsible under this permit to another operator, and that operator has submitted an NOI and obtained coverage under this permit; or

8.2.3 Coverage under an individual or alternative general NPDES permit has been obtained.

8.3 HOW TO SUBMIT YOUR NOT

You must use EPA's NPDES eReporting Tool (NeT) to electronically prepare and submit your NOT for the 2017 CGP.

To access NeT, go to https://www.epa.gov/npdes/stormwater-discharges-construction-activities#ereporting.

Waivers from electronic reporting may be granted as specified in Part 1.4.1. If the EPA Regional Office grants you approval to use a paper NOT, and you elect to use it, you must complete the form in Appendix K.

8.4 DEADLINE FOR SUBMITTING THE NOT

You must submit your NOT within 30 calendar days after any one of the conditions in Part 8.2 occurs.

8.5 EFFECTIVE DATE OF TERMINATION OF COVERAGE

Your authorization to discharge under this permit terminates at midnight of the calendar day that a complete NOT is submitted to EPA.

9 PERMIT CONDITIONS APPLICABLE TO SPECIFIC STATES, INDIAN COUNTRY LANDS, OR TERRITORIES

The provisions in this Part provide modifications or additions to the applicable conditions of this permit to reflect specific additional conditions required as part of the state or tribal CWA Section 401 certification process, or the Coastal Zone Management Act (CZMA) certification process, or as otherwise established by the permitting authority. The specific additional revisions and requirements only apply to activities in those specific states, Indian country, and areas in certain states subject to construction projects by Federal Operators. States, Indian country, and areas subject to construction by Federal Operators not included in this Part do not have any modifications or additions to the applicable conditions of this permit.

9.1 EPA REGION 1

9.1.1 NHR100000 State of New Hampshire

a. If you disturb 100,000 square feet or more of contiguous area, you must also apply for an Alteration of Terrain (AoT) permit from DES pursuant to RSA 485- A:17 and Env-Wq 1500. This requirement also applies to a lower disturbance threshold of 50,000 square feet or more when construction occurs within the protected shoreline under the Shoreland Water Quality Protection Act (see RSA 483-B and Env-Wq 1400). A permit application must also be filed if your project disturbs an area of greater than 2,500 square feet, is within 50 feet of any surface water, and has a flow path of 50 feet or longer disturbing a grade of 25 percent or greater. Project sites with disturbances smaller than those discussed above, that have the potential to adversely affect state surface waters, are subject to the conditions of an AoT General Permit by Rule.

b. You must determine that any excavation dewatering discharges are not contaminated before they will be authorized as an allowable non-stormwater discharge under this permit (see Part 1.2.2). The water is considered uncontaminated if there is no groundwater contamination within 1,000 feet of the groundwater dewatering location. Information on groundwater contamination can be generated over the Internet via the NHDES web site http://des.nh.gov/ by using the One Stop Data Mapper at http://des.nh.gov/onestop/gis.htm. If it is determined that the groundwater to be dewatered is near a remediation or other waste site you must apply for the Remediation General Permit (see https://www3.epa.gov/region1/npdes/rgp.html.)

c. You must treat any uncontaminated excavation dewatering discharges as necessary to remove suspended solids and turbidity. The discharges must be sampled at least once per week during weeks when discharges occur. Samples must be analyzed for total suspended solids (TSS) or turbidity and must meet monthly average and daily maximum limits of 50 milligrams per liter (mg/L) and 100 mg/L, respectively for TSS or 33 mg/l and 67 mg/l, respectively for turbidity. TSS (a.k.a. Residue, Nonfilterable) or turbidity sampling and analysis must be performed in accordance with Tables IB and II in 40 CFR 136.3 (http://www.ecfr.gov/cgi-bin/text-idx?SID=0243e3c4283cbd7d8257eb6afc7ce9a2&mc=true&node=se40.25.136_13&rgn=div8). Records of any sampling and analysis must be maintained and kept with the SWPPP for at least three years after final site stabilization.

d. Construction site owners and operators must consider opportunities for post-construction groundwater recharge using infiltration best management practices (BMPs) during site design and preparation of the SWPPP. If your construction site is in a town that is required to obtain coverage under the NPDES General Permit for discharges from Municipal Separate Storm Sewer Systems (MS4) you may be required to use such practices. The SWPPP must include a description of any on-site infiltration that will be installed as a post-construction stormwater management measure or reasons for not employing such measures such as 1) The facility is located in a wellhead protection area as defined in RSA 485- C:2; or 2) The facility is located in an area where groundwater has been reclassified to GAA, GAI or GA2 pursuant to RSA 485-C and Env-DW 901; or 3) Any areas that would be exempt from the groundwater recharge requirements contained in Env-Wq 1507.04(e), including all land uses or activities considered to be a “High-load Area” (see Env-Wq 1502.26). For design considerations for infiltration measures see Volume II of the NH Stormwater Manual.

e. Appendix F contains a list of Tier 2, or high quality waters. Although there is no official list of tier 2 waters, it can be assumed that all NH surface waters are tier 2 for turbidity unless 1) the surface water that you are proposing to discharge into is listed as impaired for turbidity in the states listing of impaired waters (see Surface Water Quality - Watershed Report Cards at http://des.nh.gov/organization/divisions/water/wmb/swqa/report_cards.htm) or 2) sampling upstream of the proposed discharge location shows turbidity values greater than 10 NTU. A single grab sample collected during dry weather (no precipitation within 48 hours) is acceptable.

f. To ensure compliance with RSA 485-C, RSA 485-A, RSA 485-A:13, I(a), Env-Wq 1700 and Env-Wq 302, the following information may be requested by NHDES. This information must be kept on site unless you receive a written request from NHDES that it be sent to the address shown in Part 9.1.4 (g).

   i. A site map required in Part 7.2.4, showing the type and location of all post-construction infiltration BMPs utilized at the facility or the reason(s) why none were installed;

   ii. A list of all non-stormwater discharges that occur at the facility, including their source locations and the control measures being used (see Part 1.2.2).

iii. Records of sampling and analysis of TSS required for construction dewatering discharges (see Part 9.1.4 (c)).

g. All required or requested documents must be sent to:

NH Department of Environmental Services, Wastewater Engineering Bureau,
Permits & Compliance Section
P.O. Box 95
Concord, NH 03302-0095

9.2 EPA REGION 3

9.2.1 DCR100000 District of Columbia

a. The permittee must comply with the District of Columbia Water Pollution Control Act of 1984, as amended, (D.C. Official Code §8-103.01 *et seq.*) and its implementing regulations in Title 21, Chapters 11 and 19 of the District of Columbia Municipal Regulations. Nothing in this permit will be construed to preclude the institution of any legal action or relieve the permitee from any responsibilities, liabilities, or penalties established pursuant to District of Columbia laws and regulations.

b. The permittee must comply with the District of Columbia Stormwater Management, and Soil Erosion and Sediment Control in Chapter 5 of Title 21 of the District of Columbia Municipal Regulations.

c. The permittee must comply with the District of Columbia Flood Management control in Chapter 31 of Title 20 of the District of Columbia Municipal Regulations.

d. The Department may request a copy of the Stormwater Pollution Prevention Plan (SWPPP) and the permittee is required to submit the SWPPP to the Department with 14 days of such request. The Department may conduct an inspection of any facility covered by this permit to ensure compliance with District's law requirements including water quality.

9.2.2 DER10F000 Areas in the State of Delaware subject to construction by a Federal Operator

a. Federal agencies engaging in construction activities must submit, to DNREC, a sediment and stormwater management (S&S) plan and obtain approval from DNREC in accordance with 7 Del. C. §4010, 7 DE Admin. Code 5101, and 7 DE Admin. Code 7201.

b. Federal agencies engaging in construction activities must provide for construction review by a certified construction reviewer in accordance with 7 Del. C. §§4010 & 4013 and 7 DE Admin. Code 5101, subsection 6.1.6.

c. Federal agencies engaging in construction activities must certify that all responsible personnel involved in the construction project will have attended the blue card training prior to initiation of any land disturbing activity – *see* 7 Del. C. §§ 4002 & 4014 and 7 DE Admin. Code 5101.

9.3 EPA REGION 5

9.3.1 MNR10I000 Indian country within the State of Minnesota

9.3.1.1 Fond du Lac Band of Lake Superior Chippewa. The following conditions apply only to discharges on the Fond du Lac Band of Lake Superior Chippewa Reservation:

a. A copy of the Stormwater Pollution Prevention Plan (SWPPP) must be submitted to the Office of Water Protection at least fifteen (15) days in advance of sending the Notice of Intent (NOI) to EPA. The SWPPP can be submitted electronically to richardgitar@FDLREZ.com or by hardcopy sent to:

   Fond du Lac Reservation
   Office of Water Protection
   1720 Big Lake Road
   Cloquet, MN 55720

   CGP applicants are encouraged to work with the FDL Office of Water Protection in the identification of all proposed receiving.

b. Copies of the Notice of Intent (NOI) and the Notice of Termination (NOT) must be sent to the Fond du Lac Office of Water Protection at the same time they are submitted to EPA.

c. The turbidity limit shall NOT exceed 10% of natural background within the receiving water(s) as determined by Office of Water Protection staff.

d. Turbidity sampling must take place within 24 hours of a ½-inch or greater rainfall event. The results of the sampling must be reported to the Office of Water Protection within 7 days of the sample collection. All sample reporting must include the date and time, location (GPS: UTM/Zone 15), and NTU. CGP applicants are encouraged to work with the Office of Water Protection in determining the most appropriate location(s) for sampling.

e. Receiving waters with open water must be sampled for turbidity prior to any authorized discharge as determined by Office of Water Protection staff. This requirement only applies to receiving waters in which no ambient turbidity data exists.

f. This Certification does not pertain to any new discharge to Outstanding Reservation Resource Waters (ORRW) as described in §105 b.3. of the Fond du Lac Water Quality Standards (Ordinance #12/98, as amended). Although additional waters may be designated in the future, currently Perch Lake, Rice Portage Lake, Miller Lake, Deadfish Lake, and Jaskari Lake are designated as ORRWs. New dischargers wishing to discharge to an ORRW must obtain an individual permit from EPA for stormwater discharges from large and small construction activities.

g. All work shall be carried out in such a manner as will prevent violations of water quality criteria as stated in the Water Quality Standards of the Fond du Lac Reservation, Ordinance 12/98, as amended. This includes, but is not limited to, the prevention of any discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of water of the Fond du Lac Reservation for any of the uses designated in the Water Quality Standards of the Fond du Lac Reservation. These uses include wildlife, aquatic life, warm water fisheries, cold water fisheries, subsistence fishing (netting), primary contact recreation, secondary contact recreation, cultural, wild rice areas, aesthetic waters, agriculture, navigation, and commercial.

h. Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the Fond du Lac Reservation. All spills must be reported to the appropriate emergency management agency (National Response Center AND the State Duty Officer), and measures shall be taken immediately to prevent the pollution of waters of the Fond du Lac Reservation, including groundwater. The Fond du Lac Office of Water Protection must also be notified immediately of any spill regardless of size.

i. This certification does not authorize impacts to cultural, historical, or archeological features or sites, or properties that may be eligible for such listing.

9.3.1.2 Grand Portage Band of Lake Superior Chippewa. The following conditions apply only to discharges on the Grand Portage Band of Lake Superior Chippewa Reservation:

a. The CGP authorization is for construction activities that may occur within the exterior boundaries of the Grand Portage Reservation in accordance to the Grand Portage Land Use Ordinance. The CGP regulates stormwater discharges associated with construction sites of one acre or more in size. Only those activities specifically authorized by the CGP are authorized by this certification (the "Certification"). This Certification does not authorize impacts to cultural, historical, or archeological features or sites, or properties that may be eligible for listing as such.

b. All construction stormwater discharges authorized by the CGP must comply with the Water Quality Standards and Water Resources Ordinance, as well as Applicable Federal Standards (as defined in the Water Resources Ordinance). As such, appropriate steps must be taken to ensure that petroleum products or other chemical pollutants are prevented from entering the Waters of the Reservation (as defined in the Water Resources Ordinance). All spills must be reported to the appropriate emergency-management agency, and measures must be taken to prevent the pollution of the Waters of the Reservation, including groundwater.

c. The 2017 CGP requires inspections and monitoring reports of the construction site stormwater discharges by a qualified person. Monitoring and inspection reports must comply with the minimum requirements contained in the 2017 CGP. The monitoring plan must be prepared and incorporated into the Stormwater Pollution Prevention Plan (the "SWPPP"). A copy of the SWPPP must be submitted to the Board at least 30 days in advance of sending the requisite Notice of Intent to EPA. The SWPPP should be sent to:

   Grand Portage Environmental Resources Board
   P.O. Box 428
   Grand Portage, MN 55605

   Copies of the Notice of Intent and Notice of Termination required under the CGP must be submitted to the Board at the address above at the same time they are submitted to the EPA.

d. If requested by the Grand Portage Environmental Department, the permittee must provide additional information necessary for a case-by-case eligibility determination to assure compliance with the Water Quality Standards and any Applicable Federal Standards.

e. Discharges that the Board has determined to be or that may reasonably be expected to be contributing to a violation of Water Quality Standards or Applicable Federal Standards are not authorized by this Certification.

f. The Board retains full authority provided by the Water Resources Ordinance to ensure compliance with and to enforce the provisions of the Water Resource Ordinance and Water Quality Standards, Applicable Federal Standards, and these Certification conditions.

g. Appeals related to Board actions taken in accordance with any of the preceding conditions may be heard by the Grand Portage Tribal Court.

9.3.2 WIR10I000 Indian country within the State of Wisconsin, except the Sokaogon Chippewa (Mole Lake) Community

9.3.2.1 Bad River Band of Lake Superior Tribe of Chippewa Indians: The following conditions apply only to discharges on the Bad River Band of the Lake Superior Tribe of Chippewa Indians Reservation:

a. Only those activities specifically authorized by the CGP are authorized by this Certification. This Certification does not authorize impacts to cultural properties, or historical sites, or properties that may be eligible for listing as such.[61, 62]

b. Operators are not eligible to obtain authorization under the CGP for all new discharges to an Outstanding Tribal Resource Water (or Tier 3 water).[63] Outstanding Tribal Resource Waters, or Tier 3 waters, include the following: Kakagon Slough and the lower wetland reaches of its tributaries that support wild rice, Kakagon River, Bad River Slough, Honest John Lake, Bog Lake, a portion of Bad River, from where it enters the Reservation through the confluence with the White River, and Potato River.[64]

c. Projects utilizing cationic treatment chemicals[65] within the Bad River Reservation boundaries are not eligible for coverage under the CGP.[66]

d. All projects which are eligible for coverage under the CGP and are located within the exterior boundaries of the Bad River Reservation shall be implemented in such a manner that is consistent with the Tribe's Water Quality Standards (WQS).[67]

e. An operator proposing to discharge to an Outstanding Resource Water (or Tier 2.5 water) under the CGP must comply with the antidegradation provisions of the Tribe's WQS. Outstanding Resource Waters, or Tier 2.5 waters, include the following: a portion of Bad River, from downstream the confluence with the White River to Lake Superior, White River, Marengo River, Graveyard Creek, Bear Trap Creek, Wood Creek, Brunsweiler River, Tyler Forks, Bell Creek, and Vaughn Creek.[68] The antidegradation

[61] Bad River Band of Lake Superior Tribe of Chippewa Indians Water Quality Standards adopted by Resolution No. 7-6-11-441 (hereafter, Tribe's WQS).

[62] 36 C.F.R. § 800.16(l)(2).

[63] Tribe's WQS: See provisions E.3.ii. and E.4.iv.

[64] Tribe's WQS: See provision E.2.iii.

[65] See definition of cationic treatment chemicals in Appendix A of the CGP.

[66] Tribe's WQS: See provisions E.6.ii.a. and E.6.ii.c.

[67] See footnote 61.

[68] Tribe's WQS: See provision E.2.ii.

demonstration materials described in provision E.4.iii. must be submitted to the following address:

Bad River Tribe's Natural Resources Department
Attn: Water Resources Specialist
P.O. Box 39
Odanah, WI 54861

f. An operator proposing to discharge to an Exceptional Resource Water (or Tier 2 water) under the CGP must comply with the antidegradation provisions of the Tribe's WQS. Exceptional Resource Waters, or Tier 2 waters, include the following: any surface water within the exterior boundaries of the Reservation that is not specifically classified as an Outstanding Resource Water (Tier 2.5 water) or an Outstanding Tribal Resource Water (Tier 3 water).[69] The antidegradation demonstration materials described in provision E.4.ii. must be submitted to the following address:

Bad River Tribe's Natural Resources Department
Attn: Water Resources Specialist
P.O. Box 39
Odanah, WI 54861

g. A discharge to a surface water within the Bad River Reservation boundaries shall not cause or contribute to an exceedance of the turbidity criterion included in the Tribe's WQS, which states: Turbidity shall not exceed 5 NTU over natural background turbidity when the background turbidity is 50 NTU or less, or turbidity shall not increase more than 10% when the background turbidity is more than 50 NTU.[70]

h. All projects which are eligible for coverage under the CGP within the exterior boundaries of the Bad River Reservation must comply with the Bad River Reservation Wetland and Watercourse Protection Ordinance, or Chapter 323 of the Bad River Tribal Ordinances, including the erosion and sedimentation control, natural buffer, and stabilization requirements. Questions regarding Chapter 323 and requests for permit applications can be directed to the Wetlands Specialist in the Tribe's Natural Resources Department at (715) 682-7123 or wetlands@badriver-nsn.gov.

i. An operator of a project, which is eligible for coverage under the CGP, that would result in an allowable discharge under the CGP occurring within the exterior boundaries of the Bad River Reservation must notify the Tribe prior to the commencing earth-disturbing activities.[71, 72] The operator must submit a copy of the Notice of Intent (NOI) to the following addresses at the same time it is submitted to the U.S. EPA:

Bad River Tribe's Natural Resources Department
Attn: Water Resources Specialist
P.O. Box 39
Odanah, WI 54861

[69] Tribe's WQS: See provision E.2.i.

[70] Tribe's WQS: See provision E.7.iii.

[71] See footnote 61.

[72] See footnote 62.

Bad River Tribe's Natural Resources Department
Attn: Tribal Historic Preservation Officer (THPO)
P.O. Box 39
Odanah, WI 54861

The operator must also submit a copy of the Notice of Termination (NOT) to the above addresses at the same time it is submitted to the U.S. EPA.

j. The THPO must be provided 30 days to comment on the project.[73]

k. The operator must obtain THPO concurrence in writing. This written concurrence will outline measures to be taken to prevent or mitigate effects to historic properties. For more information regarding the specifics of the cultural resources process, see 36 CFR Part 800. A best practice for an operator is to consult with the THPO during the planning stages of an undertaking.[74]

l. An operator of a project, which is eligible for coverage under the CGP, that would result in an allowable discharge under the CGP occurring within the exterior boundaries of the Bad River Reservation must submit a copy of the Stormwater Pollution Prevention Plan (SWPPP) to the following address at the same time as submitting the NOI: [75]

Bad River Tribe's Natural Resources Department
Attn: Water Resources Specialist
P.O. Box 39
Odanah, WI 54861

m. Any corrective action reports that are required under the CGP must be submitted to the following address within one (1) working day of the report completion: [76]

Bad River Tribe's Natural Resources Department
P.O. Box 39
Odanah, WI 54861

n. An operator shall be responsible for meeting any additional permit requirements imposed by the U.S. EPA necessary to comply with the Tribe's antidegradation policies if the discharge point is located upstream of waters designated by the Tribe.[77]

9.3.2.2 Lac du Flambeau Band of Lake Superior Tribe of Chippewa Indians: The following conditions apply only to discharges on the Lac du Flambeau Band of the Lake Superior Tribe of Chippewa Indians Reservation:

a. A copy of the Stormwater Pollution Prevention Plan must be submitted to the following office, for the Traival environmental review process, at least thirty (30) days in advance of sending the Notice of Intent (NOI) to EPA:

Lac du Flambeau
Tribal Land Management

[73] 36 C.F.R. § 800.3(c)(4).

[74] 36 C.F.R. § 800.3(b).

[75] See footnote 61.

[76] See footnote 61.

[77] See footnote 61.

P.O. Box 279
Lac du Flambeau, WI 54538

CGP applicants are encouraged to work with the LdF Water Resources Program in the identification of all proposed receiving waters.

b. Copies of the NOI and the Notice of Termination (NOT) must be sent to the LdF Water Resources Program at the same time they are submitted to EPA.

c. All work shall be carried out in such a manner as will prevent violations of water quality criteria as stated in the Water Quality Standards of the Lac du Flambeau Reservation. This includes, but is not limited to, the prevention of any discharge that cause a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of water of the Lac du Flambeau Reservation for any of the uses designated in the Water Quality Standards of the Lac du Flambeau Reservation.

d. Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the Lac du Flambeau Reservation. All spills must be reported to the appropriate emergency management agency, and measures shall be taken immediately to prevent the pollution of waters of the Lac du Flambeau reservation, including groundwater.

e. This certification does not authorize impacts to cultural, historical, or archeological features or sties, or properties that may be eligible for such listing.

f. Due to the significant ecological and cultural importance of the Lac du Flambeau Reservation, any operator requesting a permit for a point source discharge of pollutants (i.e., discharge) associated with the Stormwater Discharge will need a stormwater pollution prevention plan in place that does not violate Lac du Flambeau Water Quality Standards to protect Reservation Waters.

9.4 EPA REGION 6

9.4.1 NMR100000 State of New Mexico, except Indian country

a. If construction dewatering activities are anticipated at a site, permittees must complete the following steps:

   i. Investigative information must be documented in the facility SWPPP.

   ii. Refer to the GWQB Mapper at https://gis.web.env.nm.gov/GWQB/ AND the PSTB Mapper (Go Mapper) at https://gis.web.env.nm.gov/GoNM/ and check if the following sources are located within the noted distance from your anticipated construct site groundwater dewatering activity:

Project Location Relative to a Source of Potential Groundwater Contamination	***Constituents likely to be required for testing***
Within 0.5 mile of an open Leaking Underground Storage Tank (LUST) site	*BTEX (Benzene, Toluene, Ethylbenzene, and Xylene) plus additional parameters depending on site conditions.**

Project Location Relative to a Source of Potential Groundwater Contamination	***Constituents likely to be required for testing***
Within 0.5 mile of an open Voluntary Remediation site	*All parameters listed in Appendix A (or an alternate list approved by the NMED SWQB)***
Within 0.5 mile of an open RCRA Corrective Action Site	
Within 0.5 mile of an open Abatement Site	
Within 0.5 mile of an open Brownfield Site	
Within 1.0 mile or more of a Superfund site or National Priorities List (NPL) site with associated groundwater contamination.	

**For further assistance determining whether dewatering may encounter impacted groundwater, the permittee may contact the NMED Ground Water Quality Bureau at: 505-827-2965.*

***EPA approved-sufficiently sensitive methods must be used - approved methods are listed in 40 CFR Part 136.3.*

iii. If dewatering activities are anticipated, information on flow and potential to encounter impacted groundwater must be provided directly to NMED at the following address:

Program Manager, Point Source Regulation Section
NMED Surface Water Quality Bureau
PO Box 5469, Santa Fe, NM 87502

Information may also be emailed - the contact information for the program manager is located on the website at: www.env.nm.gov/swqb/PSR.

iv. Permittee must test the quality of the water being considered for discharge. Permittees must contact the Point Source Regulation Section Program Manager for information on constituents that must be monitored.

v. Permittee must send test result data to EPA Region 6 and the NMED Surface Water Quality Bureau. If the test data exceed standards, it cannot be discharged from the construction site into surface waters under this permit. Discharge to surface waters must be conducted under a separate NPDES individual permit to ensure proper treatment and disposal.

vi. If disposal will be to the ground surface or in an unlined pond, the permittee must submit an NOI/ to the NMED Ground Water Quality Bureau.

b. Operators are not eligible to obtain authorization under this permit for all new and existing storm water discharges to outstanding national resource waters (ONRWs) (also referred to as "Tier 3" waters.)

i. Although state WQS provide for temporary and short-term degradation of water quality in an ONRW under very limited circumstances if approved by the Water Quality Control Commission as specified at 20.6.4.8.A NMAC, the approval process required for these activities does not lend itself for use for projects covered under this general permit. This condition is necessary to ensure that no degradation is allowed in ONRWs by requiring proposed storm water discharges to be reviewed under the individual permit process. Tier 3 waters are defined in Appendix F of the proposed permit.

c. Operators who intend to obtain authorization under this permit for new and existing storm water discharges from construction sites must satisfy the following condition: The SWPPP must include site-specific interim and permanent stabilization, managerial, and structural solids, erosion and sediment control best management practices (BMPs) and/or other controls that are designed to prevent to the maximum extent practicable an increase in the sediment yield and flow velocity from pre-construction, pre-development conditions to assure that applicable standards in 20.6.4.NMAC, including the antidegradation policy, or TMDL waste load allocations (WLAs) are met. This requirement applies to discharges both during construction and after construction operations have been completed. The SWPPP must identify and document the rationale for selecting these BMPs and/or other controls. The SWPPP must also describe design specifications, construction specifications, maintenance schedules (including a long term maintenance plan), criteria for inspections, and expected performance and longevity of these BMPs. For sites greater than 5 acres in size, BMP selection must be made based on the use of appropriate soil loss prediction models (i.e. SEDCAD, RUSLE, SEDIMOT, MULTISED, etc.) OR equivalent generally accepted (by professional erosion control specialists) soil loss prediction tools.

  i. For all sites, the operator(s) must demonstrate, and include documentation in the SWPPP, that implementation of the site-specific practices will assure that the applicable standards or TMDL WLAs are met, and will result in sediment yields and flow velocities that, to the maximum extent practicable, will not be greater than the sediment yield levels and flow velocities from preconstruction, pre-development conditions.

  ii. All SWPPPs must be prepared in accordance with good engineering practices by qualified (e.g. CPESC certified, engineers with appropriate training) erosion control specialists familiar with the use of soil loss prediction models and design of erosion and sediment control systems based on these models (or equivalent soil loss prediction tools). Qualifications of the preparer (e.g., professional certifications, description of appropriate training) must be documented in the SWPPP. The operator(s) must design, implement, and maintain BMPs in the manner specified in the SWPPP.

d. State regulations at 20.6.2.1203 NMAC state: *With respect to any discharge from any facility of oil or other water contaminant, in such quantity as may with reasonable probability injure or be detrimental to human health, animal or plant life, or property, or unreasonably interfere with the public welfare or the use of property, the following notifications and corrective actions are required*:

  i. As soon as possible after learning of such a discharge, but in no event more than twenty-four (24) hours thereafter, any person in charge of the facility shall orally notify the Chief of the Ground Water Quality Bureau of the department, or his counterpart in any constituent agency delegated responsibility for enforcement of these rules as ta any facility subject to such delegation.

  Permittees can call 505-827-9329 for emergencies at any time and 505-476-6000 for non-emergencies during business hours from 5am-5pm, Monday through Friday.

e. NMED does not allow permittees to use the Equivalent Analysis Waiver.

9.4.2 NMR10I000 Indian country within the State of New Mexico, except Navajo Reservation Lands that are covered under Arizona permit AZR10000I and Ute Mountain Reservation Lands that are covered under Colorado permit COR10000I.

9.4.2.1 Pueblo of Isleta. The following conditions apply only to discharges on the Pueblo of Isleta Reservation:

a. CGP at 1.3 Prohibited discharges: Stormwater discharges associated with construction activity that EPA or the Pueblo of Isleta, prior to authorization under this perm it, determines will cause, have the reasonable potential to cause, or may reasonably be expected to contribute to a violation or excursion of any applicable water quality standard, including the antidegradation policy, or the impairment of a designated use of receiving waters are not authorized by this permit.

b. CGP at 1.4.1 How to Submit Your NOI: The operator shall provide a copy of the Notice of Intent ("NOI") to the Pueblo of Isleta at the same time it is submitted to the U.S. Environmental Protection Agency, for projects occurring within the exterior boundaries of the Pueblo of Isleta. The operator shall also notify the Pueblo of Isleta when it has submitted the Notice of Termination ("NOT"). The NOI and NOT shall be sent to the Pueblo of Isleta at the following address:

Water Quality Control Officer
Pueblo of Isleta
Environment Division
PO Box 1270
Isleta, NM 87022
(505) 869-7565
E-mail: POI36871@isletapueblo.com

Overnight/Express Mail Delivery
Pueblo of Isleta
Environment Division
6 Sagebrush St.
Albuquerque, NM 87105

c. CGP at 1.5 Requirement to post a notice of your permit coverage: Amend to read: "You must post a sign or other notice of your permit coverage at a safe, publicly accessible location in close proximity to the construction site. The notice must be located so that it is visible from the public road or tribal road that is nearest to the active part of the construction site..."

d. CGP at 7.2.6 Description of stormwater controls: The SWPPP will be considered to be incomplete if the operator has not coordinated requirements under this Part with the Pueblo of Isleta Public Services Department.

e. CGP I.12.6.1 at pg.I-6 of 8. The Pueblo of Isleta requests notification within 10 hours (rather than 24 hrs.) if health or the environment become endangered.

f. CGP at I.12.2 Anticipated noncompliance: Amend to read: "You must give advance notice to EPA and the Pueblo of Isleta at the address indicated in 1.4.1(a) of any planned changes in the permitted facility or activity which may results in noncompliance with permit requirements."

g. CGP at I.12.6.1: Any noncompliance for projects within the exterior boundaries of the Pueblo of Isleta which may endanger health or the environment shall be reported directly to the EPA Regional Office [(see contacts at https://www.epa.gov/npdes/contact-us-stormwater#regional) I and to the Pueblo of Isleta Water Quality Control Officer. Any information must be provided orally with n 12 hours of the time you become aware of the circumstances. Other requirements of this Part for a written submission apply. Electronic communication (E-mail) shall be provided as soon as practical. Verbal notice shall be provided to:

Water Quality Control Officer
Pueblo of Isleta
E-mail: POI36871@isletapueblo.com
(505) 869-7565
(505) 263-5425 cellular
(505) 869-3030 Police Dispatch

h. CGP at 2.2 Erosion and sediment control requirements: Erosion and sediment controls shall be designed to retain sediment on-site.

i. CGP at 2.2 Under Sediment control requirements, Standard Permit Condition Duty to Mitigate Volumes of sediment at or over (five) 5 cubic yards must be removed and placed for disposal within a tribally approved sediment Disposal Site, located on Pueblo of Isleta lands. CGP 2.2 at pg. 8.

j. Under Minimize erosion, a permittee must secure permission from the Pueblo or affected Pueblo of Isleta land assignment owner if a dissipation device needs to be placed up- or down- elevation of a given construction site. CGP 2.2.11 at pg. 11.

k. CGP at 2.3.6 Emergency spill notification requirements: You must notify the Pueblo of Isleta Water Quality Control Officer and National Response Center (NRC) [at (800) 424-8802 or, in the Washington, DC metropolitan area, call (202) 267-2675 in accordance with the requirements of 40 CFR 110, 40 CFR 117, and 40 CFR 302] as soon as you have knowledge of the release. Verbal and electronic notice shall be provided as specified in I.12.6.1

l. CGP at C.3 Equivalent analysis waiver: Parties wishing to apply for an Equivalent Analysis Waiver (see Appendix D, Section C) must provide a copy of the waiver analysis to the Pueblo of Isleta Water Quality Control Officer at the address indicated in 1.4.1 (a).

9.4.2.2 Pueblo of Sandia. The following conditions apply only to discharges on the Pueblo of Sandia Reservation:

a. Only those activities specifically authorized by the CGP are authorized by the Pueblo of Sandia's Water Quality certification. The Pueblo of Sandia's Water Quality Certification does not authorize impact to cultural properties, historical sites or properties that may be eligible as such.

b. Copies of all Notices of Intent (NOI) submitted to the EPA must also be sent concurrently to the Pueblo of Sandia at the following address. Discharges are not authorized by this permit unless an accurate and complete NOI has been submitted to the Pueblo of Sandia, either by mail or electronically.

Regular U.S. Delivery Mail:
Pueblo of Sandia Environment Department
Attention: Scott Bulgrin, Water Quality Manager
481 Sandia Loop
Bernalillo, New Mexico 87004

Electronically:
sbulgrin@sandiapueblo.nsn.us

c. Any correspondences between the applicant and EPA related to analytical data, written reports, corrective action, enforcement, monitoring, or an adverse incident written reports should likewise be routed to the Pueblo of Sandia at the above address.

d. The Stormwater Pollution Prevention Plan (SWPPP) must be available to the Pueblo of Sandia Environment Department either electronically or hard copy upon request for review. The SWPPP must be made available at least fourteen (14) days before construction begins. The fourteen (14) day period will give Pueblo staff time to become familiar with the project site, prepare for construction site inspections, and determine compliance with the Pueblo of Sandia Water Quality Standards. Failure to provide a SWPPP to the Pueblo of Sandia may result in the delay or denial of the construction project.

e. If requested by the Pueblo of Sandia Environment Department, the permittee must provide additional information necessary for a case-by-case eligibility determination to assure compliance with the Pueblo of Sandia Water Quality Standards and/or applicable Federal Standards not authorized by this certification.

f. An "Authorization to Proceed Letter" with site specific mitigation requirements may be sent out to the permittee when a review of the NOI and SWPPP, on a case- by-case basis is completed by the Pueblo of Sandia Environment Department. This approval will allow the application to proceed if all mitigation requirements are met.

g. The Pueblo of Sandia will not allow Small construction Waivers (Appendix C) or the Rainfall Erosivity Waiver (Appendix C.1) to be granted for any small construction activities.

h. Before submitting a Notice of Termination (NOT) to the EPA, permittees must clearly demonstrate to the Pueblo of Sandia Environment Department through a site visit or documentation that requirements for site stabilization have been met and any temporary erosion control structures have been removed. A short letter stating the NOT is acceptable and all requirements have been met will be sent to the permittee to add to the permittee's NOT submission to EPA.

i. Copies of all NOT submitted to the EPA must also be sent concurrently to the Pueblo of Sandia through the mail or electronically.

Regular U.S. Delivery Mail:
Pueblo of Sandia Environment Department
Attention: Scott Bulgrin, Water Quality Manager 481 Sandia Loop
Bernalillo, New Mexico 87004

Electronically:
sbulgrin@sandiapueblo.nsn.us

j. The Pueblo of Sandia may require the permittee to perform water quality monitoring for pH, turbidity, and total suspended solids (TSS) during the permit term if the discharge is to a surface water leading to the Rio Grande for the protection of public health and the environment.

9.4.2.3 Pueblo of Santa Ana. The following conditions apply only to discharges on the Pueblo of Santa Ana Reservation:

a. The operator shall provide a copy of the Notice of Intent (NOI) to the Pueblo of Santa Ana (the Pueblo), at the same time it is submitted to the U.S. Environmental Protection Agency (EPA), for projects with discharges onto the lands of the Pueblo as defined in the Pueblo of Santa Ana Water Quality Standards.

b. The operator shall provide a copy of the Stormwater Pollution Prevention Plan (SWPPP), at the same time that an NOI is submitted to the EPA, to the Pueblo for projects with discharges onto the lands of the Pueblo as defined in the Pueblo of Santa Ana Water Quality Standards.

c. The operator shall provide a copy of the SWPPP, copies of inspections reports, and copies of corrective action reports to the Pueblo at the address below for review, upon request.

d. The NOI, SWPPP and Notice of Termination (NOT) shall be sent to the Pueblo at the following address:

Pueblo of Santa Ana Department of Natural Resources,
Attention: Water Quality Program Specialist
2 Dove Road
Santa Ana Pueblo, NM, 87004

e. Discharges are not authorized by this permit unless an accurate and complete NOI and SWPPP have been submitted to the Pueblo. Failure to provide an accurate and complete NOI and SWPPP may result in a denial of the discharge permit or groundbreaking or construction delay.

f. The operator will not proceed with site work until authorized by the Pueblo. The Pueblo requires review of the complete and final SWPPP by the Pueblo before authorization to proceed. The Pueblo will provide an "authorization to proceed" notice after review and approval of the SWPPP.

g. Before submitting a NOT, permittees must certify to the Pueblo's Department of Natural Resources in writing that requirements for site stabilization have been met, and any temporary erosion control structures have been removed. Documentation of the Pueblo's review that such requirements have been reviewed and met will be provided for the permittee to add to the permittee's NOT submission to EPA. Copies of all NOT submitted to the EPA must also be sent to the Pueblo at the address provided above.

9.4.2.4 Pueblo of Santa Clara. The following conditions apply only to discharges on the Pueblo of Santa Clara Reservation:

a. The operator must provide a copy of the Notice of Intent (NOI) and Notice of Termination (NOT) to the Santa Clara Pueblo Governor's Office at the same time it is provided to the US Environmental Protection Agency.

b. A copy of the Storm water Pollution Prevention Plan shall be made available to the Pueblo of Santa Clara staff upon request.

9.4.2.5 Pueblo of Tesuque. The following conditions apply only to discharges on the Pueblo of Tesuque Reservation:

a. The operator shall provide a copy of the Notice of Intent (NOI) to the Pueblo of Tesuque Governor’s Office and Environment Department at same time it is submitted to the Environmental Protection Agency, for projects occurring within the exterior boundaries of our tribal lands. The operator shall also notify the Pueblo of Tesuque Governor's Office and Environment Department when it submitted the Notice of Termination. The NOI and NOT shall be sent to the Pueblo of Tesuque Governor's Office and Environment Department at the following address:

Pueblo of Tesuque
Office of the Governor
Route 42 Box 360-T
Santa Fe, NM 87506 or
email: governor@pueblooftesuque.org

b. The operator shall also provide a copy of the Stormwater Pollution Prevention Plan, copies of inspections reports, and copies of corrective action reports to staff in the Pueblo of Tesuque Environment Department.

9.4.2.6 Taos Pueblo. The following conditions apply only to discharges on the Taos Pueblo Reservation:

a. The operator shall provide a copy of the Notice of Intent (NOI) to the Taos Pueblo Governor's Office, War Chief's Office and Environmental Office, at the same time it is submitted to the U.S. Environmental Protection Agency, for projects occurring within the exterior boundaries of Taos Pueblo. The operator shall also notify Taos Pueblo when it has submitted the Notice of Termination (NOT). The NOI and NOT shall be sent to the Taos Pueblo at the following addresses:

   i. Taos Pueblo Governor's Office
   P.O. Box 1846
   Taos NM 87571

   ii. Taos Pueblo War Chief's Office
   P.O. Box 2596
   Taos NM 87571

   iii. Environmental Office
   Attn: Program Manger
   P.O. Box 1846
   Taos NM 87571

b. Taos Pueblo requests that in the event Indian artifacts or human remains are inadvertently discovered on projects occurring near or on Taos Pueblo lands that consultation with the tribal Governor's Office occur at the earliest possible time.

c. The operator shall provide a copy of the Stormwater Pollution Prevention Plan, copies of inspections reports, and copies of corrective action reports to staff in the Taos Pueblo Environmental Office for review and copy, upon request.

9.4.2.7 Ohkay Owingeh. The following conditions apply only to discharges on the Ohkay Owingeh Reservation:

a. Prior to commencement of any construction activity on Ohkay Owingeh Lands requiring permit coverage under EPA's Construction General Permit, the operator(s) shall submit to Ohkay Owingeh Office of Environmental Affairs, a copy of the electronic "Notice of Intent," submitted to the Environmental Protection Agency, immediately following EPA's electronic notification that the NOI has been received. A copy of the Stormwater Pollution Prevention Plan(s) must be made available to the Ohkay Owingeh Office of Environmental Affairs upon the tribe's request either electronically or hard copy. Operator(s) shall also submit to Ohkay Owingeh Office of Environmental Affairs a copy of the electronic Notice of Termination (NOT) submitted to the Environmental Protection Agency. Documents shall be submitted to Ohkay Owingeh at the following address:

Ohkay Owingeh Office of Environment Affairs
Attention: Environmental Programs Manager
P.O. Box 717
Ohkay Owingeh, New Mexico 87566
Office # 505.852.4212
Fax # 505.852.1432
Electronic mail: naomi.archuleta@ohkay.org

b. Ohkay Owingeh will not allow the Rainfall Erosivity Waivers (see Appendix C) to be granted for any small construction activities.

c. All vegetation used to prevent soil loss, seeding or planting of the disturbed area(s) to meet the vegetative stabilization requirements must utilize native seeds/vegetation commonly known to the area. All temporary erosion control structures, such as silt fences must be removed as soon as stabilization requirements are met.

9.4.3 OKR10I000 Indian country within the State of Oklahoma

9.4.3.1 Pawnee Nation. The following conditions apply only to discharges within Pawnee Indian country:

a. Copies of the Notice of Intent (NOI) and Notice of Termination (NOT) must be provided to the Pawnee Nation at the same time it is submitted to the Environmental Protection Agency to the following address:

Pawnee Nation Department of Environmental Conservation and Safety
P.O. Box 470
Pawnee, OK 74058
Or email to mmatlock@pawneenation.org

b. The Storm Water Pollution Prevention Plan must be available to Departmental inspectors upon request.

c. The Department must be notified at 918.762.3655 immediately upon discovery of any noncompliance with any provision of the permit conditions.

9.4.4 OKR10F000 Discharges in the State of Oklahoma that are not under the authority of the Oklahoma Department of Environmental Quality, including activities associated with oil and gas exploration, drilling, operations, and pipelines (includes SIC Groups 13 and 46, and SIC codes 492 and 5171), and point source discharges associated with agricultural production, services, and silviculture (includes SIC Groups 01, 02, 07, 08, 09).

a. For activities located within the watershed of any Oklahoma Scenic River, including the Illinois River, Flint Creek, Barren Fork Creek, Upper Mountain Fork, Little Lee Creek, and Lee Creek or any water or watershed designated "ORW" in Oklahoma's Water Quality Standards, this permit may only be used to authorize discharges from temporary construction activities. Certification is denied for any on-going activities such as sand and gravel mining or any other mineral mining.

b. For activities located within the watershed of any Oklahoma Scenic River, including the Illinois River, Flint Creek, Barren Fork Creek, Upper Mountain Fork, Little Lee Creek, and Lee Creek or any water or watershed designated "ORW" in Oklahoma's Water Quality Standards, certification is denied for any discharges originating from support activities, including concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, or borrow areas.

c. In order to company with Oklahoma's Water Quality Standards, these conditions and restrictions also apply to any construction projects located wholly or partially on Indian Country lands within the State of Oklahoma.

9.5 EPA REGION 8

9.5.1 MTR10I000 Indian country within the State of Montana

9.5.1.1 The Confederated Salish and Kootenai Tribes of the Flathead Nation. The following conditions apply only to discharges on the Confederated Salish and Kootenai Tribes of the Flathead Nation Reservation:

a. Permittees must submit the Stormwater Pollution Prevention Plan (SWPPP) to the Confederated Salish and Kootenai Tribes at least 30 days before construction starts.

b. Before submitting the Notice of Termination (NOT), permittees must clearly demonstrate to an appointed Tribal staff person during an onsite inspection that requirements for site stabilization have been met.

c. The permittee must send a copy of the Notice of Intent (NOI) and the NOT to CSKT.

d. Permittees may submit their SWPPPs, NOIs and NOTs electronically to: clintf@cskt.org.

e. Written SWPPPs, NOIs and NOTs may be mailed to:

Clint Folden, Water Quality Regulatory Specialist
Confederated Salish and Kootenai Tribes
Natural Resources Department
P.O. Box 278
Pablo, MT 59855

9.6 EPA REGION 9

9.6.1 CAR10I000 Indian country within the State of California

9.6.1.1 Twenty-Nine Palms Band of Mission Indians. The following conditions apply only to discharges on the Twenty-Nine Palms Band of Mission Indians Reservation:

a. At the time the applicant submits its Notice of Intent (NOI) to the EPA, the applicant must concurrently submit written notification of the NOI and a copy of the Stormwater Pollution Prevention Plan (SWPPP) to the Twenty-Nine Palms Band of Mission Indians at the address below:

Tribal Environmental Coordinator
Twenty-Nine Palms Band of Mission Indians
46-200 Harrison Place
Coachella, CA 92236

b. The applicant must also concurrently submit to the Tribal Environmental Coordinator written notification of any other forms or information submitted to the EPA, including waivers, reporting, and Notice of Termination (NOT).

c. Permitted entities under the CGP must keep the Tribal EPA informed of authorized discharges under the CGP by submitting written information about the type, quantity, frequency and location, intended purpose, and potential human health and/or environmental effects of their activities. These requirements are pursuant to Section 4 of the Twenty-Nine Palms Band of Mission Indians Water Pollution Control Ordinance (022405A). This information may be submitted to Tribal EPA in the form of Stormwater Pollution Prevention Plans (SWPPPs), monitoring reports, or other reports as required under the CGP. Spills, leaks, or unpermitted discharges must be reported in writing to Tribal EPA within 24 hours of the incident.

9.6.2 GUR100000 Island of Guam. The following conditions apply only to discharges on the Island of Guam:

a. Any earth-moving operations which require a permit must be obtained from the Department of Public Works (DPW) with clearance approval from various Government of Guam Agencies including Guam EPA prior to the start of any earth-moving activity.

b. In the event that the construction sites are within the Guam Sole Source Aquifer, the construction site owner and operator must consider opportunities to facilitate groundwater recharge for construction and post-construction implementing infiltration Best Management Practices. Stormwater disposal systems shall be designed and operated within the boundaries of the project. Stormwater systems shall not be permitted within any Wellhead Protection Zone unless the discharge meets the Guam Water Quality Standards within the zone. Waters discharged within the identified category G-2 recharge zone shall receive treatment to the degree required to protect the drinking water quality prior to it entering the category G-1 resource zone.

c. All conditions and requirements set forth in the 22 Guam Administrative Rules and Regulations (GARR), Division II, Water Control, Chapter 10, Guam Soil Erosion and Sediment Control Regulations (GSESCR) that are more protective than the CGP regarding construction activities must be complied with.

d. All standards and requirements set forth in the 22 GARR, Division II, Water Control, Chapter 5, *Guam Water Quality Standards (GWQS) 2001 Revisions*, must be complied with to include reporting GWQS exceedance to Guam EPA.

e. All operators/owners of any property development or earth moving activities shall comply with the erosion control pre-construction and post-construction BMP design performance standards and criteria set forth in the 2006 CNMI and Guam Stormwater Management Manual.

f. All conditions and requirements regarding dewatering activities set forth in 22 Guam Administrative Rules and Regulations Chapter 7, Water Resources Development and Operating Regulations must be complied with to include securing permits with Guam EPA prior to the start of any dewatering activities.

g. If a project to be developed is covered under the Federal Stormwater Regulations (40 CFR Parts 122 & 123), a Notice of Intent (NOI) to discharge stormwater to the surface and marine waters of Guam must be submitted to the U.S. EPA and a copy furnished to Guam EPA, pursuant to Section 10, 104(B)(5)(d) 22GAR, Division II, Chapter 10.

h. Guam EPA shall apply the Buffer Requirements listed in Appendix G of the CGP NPDES Permit for construction activities as it pertains to Waters of the U.S. in Guam. Guam EPA shall also apply the same buffer requirements for sinkholes in Guam.

i. When Guam EPA, through its permit review process, identifies that the proposed construction activity is close proximity to marine waters, contractors and owners will be informed that any activity that may impair water quality are required to stop during peak coral spawning periods as per the Guam Coral Spawning Construction Moratoriums.

j. The Proposed Construction General Permit must set appropriate measures and conditions to protect Guam's Threatened and Endangered Species and Outstanding Resource Waters of exceptional recreational or ecological significance as determined by the Guam EPA Administrator as per *Guam Water Quality Standards 2001 Revisions,* §5102, Categories of Waters, D. Outstanding Resource Waters.

k. When Guam EPA through its permit review process identifies that proposed construction activity is in close proximity to any Section 303d impaired waters, which includes marine waters and surface waters, shall ensure that construction activity does not increase the impaired water's ambient parameters.

l. When Rainfall Erosivity and TMDL Waivers reflected in the CGP, Appendix C, are submitted to the U.S. EPA, Guam EPA will review waivers on a project by project basis.

m. Prior to submission of the Notice of Termination (NOT) to the U.S. EPA, permittees must clearly demonstration to Guam EPA that the project site has met all soil stabilization requirements and removal of any temporary erosion control as outlined in the GSESCR.

9.7 EPA REGION 10

9.7.1 IDR100000 State of Idaho, except Indian country

a. *Idaho's Antidegradation Policy*. The WQS contain an antidegradation policy providing three levels of protection to water bodies in Idaho (IDAPA 58.01.02.051).

   1. Tier I Protection. The first level of protection applies to all water bodies subject to Clean Water Act jurisdiction and ensures that existing uses of a water body and the level of water quality necessary to protect those existing uses will be maintained and protected (IDAPA 58.01.02.051.01; 58.01.02.052.01). Additionally, a Tier 1 review is performed for all new or reissued permits or licenses (IDAPA 58.01.02.052.05).
   2. Tier II Protection. The second level of protection applies to those water bodies considered high quality and ensures that no lowering of water quality will be allowed unless deemed necessary to accommodate important economic or social development (IDAPA 58.01.02.051.02; 58.01.02.052.08).
   3. Tier III Protection. The third level of protection applies to water bodies that have been designated outstanding resource waters and requires that activities not cause a lowering of water quality (IDAPA 58.01.02.051.03; 58.01.02.052.09).

   DEQ is employing a water body by water body approach to implementing Idaho's antidegradation policy. This approach means that any water body fully supporting its beneficial uses will be considered high quality (IDAPA 58.01.02.052.05.a). Any water body not fully supporting its beneficial uses will be provided Tier I protection for that use, unless specific circumstances warranting Tier II protection are met (IDAPA 58.01.02.052.05.c). The most recent federally approved Integrated Report and supporting data are used to determine support status and the tier of protection (IDAPA 58.01.02.052.05).

b. *Pollutants of Concern.* The primary pollutants of concern associated with stormwater discharges from construction activities are sediment, typically measured as total suspended solids and turbidity. Other potential pollutants include the following:

phosphorus, nitrogen, pesticides, organics, metals, PCBs, petroleum products, construction chemicals, and solid wastes.

c. *Receiving Water Body Level of Protection.* The CGP provides coverage to construction activities throughout the entire State of Idaho. Because of the statewide applicability, all of the jurisdictional waters within Idaho could potentially receive discharges either directly or indirectly from activities covered under the CGP. DEQ applies a water body by water body approach to determine the level of antidegradation a water body will receive.

All waters in Idaho that receive discharges from activities authorized under the CGP will receive, at minimum Tier I antidegradation protection because Idaho's antidegradation policy applies to all waters of the state. Water bodies that fully support their aquatic life or recreational uses are considered to be *high quality waters* and will receive Tier II antidegradation protection.

Although Idaho does not currently have any Tier III designated outstanding resource waters (ORWs) designated, it is possible for a water body to be designated as an ORW during the life of the CGP. Because of this potential, the antidegradation review also assesses whether the permit complies with the outstanding resource water requirements of Idaho's antidegradation policy.

To determine the support status of the receiving water body, persons filing a Notice of Intent (NOI) for coverage under this general permit must use the most recent EPA-approved Integrated Report, available on Idaho DEQ's website: http://www.deq.idaho.gov/water-quality/surface-water/monitoring-assessment/integrated-report/.

High quality waters are identified in Categories 1 and 2 of the Integrated Report. If a water body is in either Category 1 or 2, it is a Tier II water body.

Unassessed waters are identified as Category 3 of DEQ's Integrated Report. These waters require a case-by-case determination to be made by DEQ based on available information at the time of the application for permit coverage. If a water body is unassessed, the applicant is directed to contact DEQ for assistance in filing the NOI.

Impaired waters are identified in Categories 4 and 5 of the Integrated Report. Category 4(a) contains impaired waters for which a TMDL has been approved by EPA. Category 4(b) contains impaired waters for which controls other than a TMDL have been approved by EPA. Category 5 contains waters which have been identified as "impaired," for which a TMDL is needed. These waters are Tier I waters, for the use which is impaired. With the exception, if the aquatic life uses are impaired for any of these three pollutants—dissolved oxygen, pH, or temperature—and the biological or aquatic habitat parameters show a health, balanced biological community, then the water body shall receive Tier II protection, in addition to Tier I protection, for aquatic life uses (IDAPA 58.01.02.052.05.c.i.).

DEQ's webpage also has a link to the state's map-based Integrated Report which presents information from the Integrated Report in a searchable, map-based format: http://www.deq.idaho.gov/assistance-resources/maps-data/.

Water bodies can be in multiple categories for different causes. If assistance is needed in using these tools, or if additional information/clarification regarding the support status of the receiving water body is desired, the operator is directed to make contact with the appropriate DEQ regional office of the State office in the table below:

Regional and State Office	Address	Phone Number	Email
Boise	1445 N. Orchard Rd., Boise 83706	208-373-0550	Kati.carberry@deq.idaho.gov
Coeur d'Alene	2110 Ironwood Parkway, Coeur D'Alene 83814	208-769-1422	June.bergquist@deq.idaho.gov
Idaho Falls	900 N. Skyline, Suite B., Idaho Falls 83402	208-528-2650	Troy.saffle@deq.idaho.gov
Lewiston	1118 "F" St., Lewiston 83501	208-799-4370	Mark.sellet@deq.idaho.gov
Pocatello	444 Hospital way, #300 Pocatello 83201	208-236-6160	Lynn.vanevery@deq.idaho.gov
Twin Falls	650 Addison Ave., W., Suite 110, Twin Falls 83301	208-736-2190	Balthasar.buhidar@deq.idaho.gov
State Office	1410 N. Hilton Rd., Boise 83706	208-373-0502	Nicole.deinarowicz@deq.idaho.gov

d. *Turbidity Monitoring.* The permittee must conduct turbidity monitoring during construction activities and thereafter on days where there is a direct discharge of pollutants from an unstabilized portion of the site which is causing a visible plume to a water of the U.S.

A properly and regularly calibrated turbidimeter is required for measurements analyzed in the field (preferred method), but grab samples may be collected and taken to a laboratory for analysis. If the permittee can demonstrate that there will be no direct discharge from the construction site, then turbidity monitoring is not required. When monitoring is required, a sample must be taken at an undisturbed area immediately upstream of the project area to establish background turbidity levels for the monitoring event. Background turbidity, location, date and time must be recorded prior to monitoring downstream of the project area. A sample must also be taken immediately downstream from any point of discharge and *within* any visible plume. The turbidity, location, date and time must be recorded. The downstream sample must be taken immediately following the upstream sample in order to obtain meaningful and representative results.

Results from the compliance point sampling or observation[78] must be compared to the background levels to determine whether project activities are causing an exceedance of state WQS. If the downstream turbidity is 50 NTUs or more than the upstream turbidity, then the project is causing an exceedance of WQS. *Any exceedance of the turbidity standard must be reporting to the appropriate DEQ regional office within 24 hours. The following six (6) steps should be followed to ensure compliance with the turbidity standard:*

1. If a visible plume is observed, quantify the plume by collecting turbidity measurements from within the plume and compare the results to Idaho's instantaneous numeric turbidity criterion (50 NTU over the background).
2. If turbidity is less than 50 NTU instantaneously over the background turbidity; continue monitoring as long as the plume is visible. If turbidity exceeds background turbidity by more than 50 NTU instantaneously then stop all earth disturbing construction activities and proceed to step 3.
3. Take immediate action to address the cause of the exceedance. That may include inspection the condition of project BMPs. If the BMPs are functioning to their fullest capability, then the permittee must modify project activities and/or BMPs to correct the exceedance.
4. Notify the appropriate DEQ regional office within 24 hours.
5. Possibly increase monitoring frequency until state water quality standards are met.
6. Continue earth disturbing construction activities once turbidity readings return to within 50 NTU instantaneously <u>and</u> 25 NTU for more than ten consecutive days over the background turbidity.

Copies of daily logs for turbidity monitoring must be available to DEQ upon request. The report must describe all exceedances and subsequent actions taken, including the effectiveness of the action.

e. *<u>Reporting of Discharges Containing Hazardous Materials or Petroleum Products.</u>* All spills of hazardous material, deleterious material or petroleum products which may impact waters (ground and surface) of the state shall be immediately reported. Call 911 if immediate assistance is required to control, contain or clean up the spill. If no assistance is needed in cleaning up the spill, contact the appropriate DEQ regional office in the table below during normal working hours or Idaho State Communications Center after normal working hours. If the spilled volume is above federal reportable quantities, contact the National Repose Center.

<u>For immediate assistance</u>: Call 911

<u>National Response Center</u>: (800) 424-8802

<u>Idaho State Communications Center</u>: (800) 632-8000

[78] A visual observation is only acceptable to determine whether BMPs are functioning properly. If a plume is observed, the project may be causing an exceedance of WQS and the permittee must collect turbidity data and inspect the condition of the projects BMPs. If the BMPs appear to be functioning to their fullest capability and the turbidity is 50 NTUs or more than the upstream turbidity, then the permittee must modify the activity or implement additional BMPs (this may also include modifying existing BMPs).

Regional office	Toll Free Phone Number	Phone Number
Boise	888-800-3480	208-373-0550
Coeur d'Alene	877-370-0017	208-769-1422
Idaho Falls	800-232-4635	208-528-2650
Lewiston	977-547-3304	208-799-4370
Pocatello	888-655-6160	208-236-6160
Twin Falls	800-270-1663	208-736-2190

9.7.2 IDR10I000 Indian country within the State of Idaho, except Duck Valley Reservation lands (see Region 9)

9.7.2.1 Shoshone-Bannock Tribes. The following conditions apply only to discharges on the Shoshone-Bannock Reservation:

f. Each operator shall submit a signed hard copy of the Notice of Intent (NOI) to the Shoshone-Bannock Tribes Water Resources Department at the same time it is submitted electronically to the Environmental Protection Agency (EPA) and shall provide the Shoshone-Bannock Tribes Water Resources Department the acknowledgement of receipt of the NOI from the EPA within 7 calendar days of receipt from the EPA.

9.7.3 WAR10F000 Areas in the State of Washington, except those located on Indian country, subject to construction activity by a Federal Operator. The following conditions apply only to discharges on federal facilities in the State of Washington:

a. Discharges shall not cause or contribute to a violation of surface water quality standards (Chapter 173-201A WAC), groundwater quality standards (Chapter 173-200 WAC), sediment management standards (Chapter 173-204 WAC), and human health-based criteria in the National Toxics Rule (40 CFR Part 131.36). Discharges that are not in compliance with these standards are not authorized.

b. Prior to the discharge of stormwater and non-storm water to waters of the State, the Permittee must apply all known, available, and reasonable methods of prevention, control, and treatment (AKART). This includes the preparation and implementation of an adequate SWPPP, with all appropriate BMPs installed and maintained in accordance with the SWPPP and the terms and conditions of this permit.

c. Permittees who discharge to segments of waterbodies listed as impaired by the State of Washington under Section 303(d) of the Clean Water Act for turbidity, fine sediment, phosphorus, or pH must comply with the following numeric effluent limits:

Parameter Identified in 303{d) Listing	Parameter Sampled	Unit	Analytical Method	Numeric Effluent Limit
• Turbidity • Fine Sediment • Phosphorus	Turbidity	NTU	SM2130 or EPA 180.1	25 NTUs at the point where the stormwater is discharged from the site.
High pH	pH	Su	pH meter	In the range of 6.5 – 8.5

d. All references and requirements associated with Section 303(d) of the Clean Water Act mean the most current EPA approved listing of impaired waters that exists on February 16, 2017, or the date when the operator's complete permit application is received by EPA, whichever is later.

e. Discharges to waterbodies subject to an applicable Total Maximum Daily Load (TMDL) for turbidity, fine sediment, high pH, or phosphorus, shall be consistent with the assumptions and requirements of the TMDL.

   i. Where an applicable TMDL sets specific waste load allocations or requirements for discharges covered by this permit, discharges shall be consistent with any specific waste load allocations or requirements establish by the applicable TMDL.

   ii. Where an applicable TMDL has established a general waste load allocation for construction stormwater discharges, but no specific requirements have been identified, compliance with this permit will be assumed to be consistent with the approved TMDL.

   iii. Where an applicable TMDL has not specified a waste load allocation for construction stormwater discharges, but has not excluded these discharges, compliance with this permit will be assumed to be consistent with the approved TMDL.

   iv. Where an applicable TMDL specifically precludes or prohibits discharges from construction activity, the operator is not eligible for coverage under this permit.

   v. Applicable TMDL means a TMDL for turbidity, fine sediment, high pH, or phosphorus, which has been completed and approved by EPA prior to February 16, 2017, or prior to the date the operator's complete NOI is received by EPA, whichever is later.

9.7.4 WAR10I000 Indian country within the State of Washington

9.7.4.1 Confederated Tribes of the Colville Reservation. The following conditions apply only to discharges on the Colville Indian Reservation (CIR) and on other Tribal trust lands or allotments of the Confederated Tribes of the Colville Reservation:

a. A copy of the Stormwater Pollution Prevention Plan must be submitted to the following office at least thirty (30) days in advance of sending the Notice of Intent (NOI) to EPA:

   Environmental Trust Department
   Confederated Tribes of the Colville Reservation
   PO Box 150
   Nesepelem, WA 99155

b. Copies of the Notice of Intent (NOI) and Notice of Termination (NOT) must be sent to the ETD at the same time they are submitted to EPA.

c. Discharges to Omak Creek, the Okanogan River, and Columbia River downstream of Chief Joseph Dam may affect threatened or endangered species, and shall only be permitted in adherence with Appendix D of the CGP.

d. All work shall be carried out in such a manner as will prevent violations of water quality criteria as stated in Chapter 4-8 Water Quality Standards of the Colville Law and Order Code, as amended.

e. Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the CIR. All spills must be reported to the appropriate emergency management agency and the ETD, and measures shall be taken immediately to prevent the pollution of waters of the CIR, including groundwater.

f. Stormwater site inspections shall be conducted at least once every 7 calendar days, within 24-hours of the occurrence of a rain event of 0.25 inches or greater in a 24-hour period, and daily during periods of saturated ground surface or snowmelt with accompanying surface runoff.

g. Results of discharge sampling must be reported to the ETD within 7 days of sample collection. All sample reporting must include the date and time, location, and individual performing the sampling.

h. Any corrective action reports that are required under the CGP must be submitted to the ETD at the above address within one (1) working day of the report completion.

i. This certification does not authorize impacts to cultural, historical, or archeological features or sites, or proprieties that may be eligible for such listing.

9.7.4.2 Lummi Nation. The following conditions apply only to discharges on the Lummi Reservation:

a. The Lummi Nation reserves the right to modify this 401 certification if the final version of the NPDES General Permit for Storm Water Discharges Associated with Construction Activity (CGP) on tribal lands in the State of Washington (Permit No. WAR10I000) is substantively different than the draft version of the proposed permit that was made available for public comments during April 2016. The Lummi Nation will determine if the final version of the NPDES CGP is substantively different than the draft version following review of the final version once the EPA makes it available.

b. This certification does not exempt and is provisional upon compliance with other applicable statutes and codes administered by federal and Lummi tribal agencies. Pursuant to Lummi Code of Laws (LCL) 17.05.020(a), the operator must also obtain a land use permit from the Lummi Planning Department as provided in Title 15 of the Lummi Code of Laws and regulations adopted thereunder.

c. Pursuant to LCL 17.05.020(a), each operator shall develop and submit a Storm Water Pollution Prevention Plan to the Lummi Water Resources Division for review and approval by the Water Resources Manager prior to beginning any discharge activities.

d. Pursuant to LCL Title 17, each operator shall be responsible for achieving compliance with the Water Quality Standards for Surface Waters of the Lummi Indian Reservation (Lummi Administrative Regulations [LAR] 17 LAR 07.010 through 17 LAR 07.210 together with supplements and amendments thereto).

e. Each operator shall submit a signed hard copy of the Notice of Intent (NOI) to the Lummi Water Resources Division at the same time it is submitted electronically to the Environmental Protection Agency (EPA) and shall provide the Lummi Water Resources Division the acknowledgement of receipt of the NOI from the EPA and the associated NPDES tracking number provided by the EPA within 7 calendar days of receipt from the EPA.

f. Each operator shall submit a signed hard copy of the Notice of Termination (NOT) to the Lummi Water Resources Division at the same time it is submitted electronically to the EPA and shall provide the Lummi Water Resources Division the EPA acknowledgement of receipt of the NOT.

g. Storm Water Pollution Prevention Plans, Notice of Intent, Notice of Termination and associated correspondence with the EPA shall be submitted to:

Lummi Natural Resources Department
ATTN: Water Resources Manager
2665 Kwina Road
Bellingham, WA 98226-9298

9.7.4.3 Makah Tribe. The following conditions apply only to discharges on the Makah Reservation:

a. The operator shall be responsible for achieving compliance with the Makah Tribe's Water Quality Standards.

b. The operator shall submit a Storm Water Pollution Prevention Plan to the Makah Tribe Water Quality Program and Makah Fisheries Habitat Division for review and approval at least thirty (30) days prior to beginning any discharge activities.

c. The operator shall submit a copy of the Notice of Intent to the Makah Tribe Water Quality Program and Makah Fisheries Habitat Division at the same time it is submitted to EPA.

d. Storm Water Pollution Prevention Plans and Notices of Intent shall be submitted to:

Aaron Parker
Makah Fisheries Management Water Quality Specialist
(360) 645-3162
Cell 206-356-0319
Aaron.parker@makah.com
PO Box 115
Neah Bay WA 98357

9.7.4.4 Puyallup Tribe of Indians. The following conditions apply only to discharges on the Puyallup Tribe of Indians Reservation:

a. Each permittee shall be responsible for achieving compliance with the Puyallup Tribe's Water Quality Standards, including antidegradation provisions. The Puyallup Natural Resources Department will conduct an antidegradation review for permitted activities that have the potential to lower water quality. The antidegradation review will be consistent with the Tribe's Antidegradation Implementation Procedures. The Tribe may also impose additional controls on a site-specific basis, or request EPA to require the operator obtain coverage under an individual permit, if information in the NOI or from other sources indicates that the operator's discharges are not controlled as necessary to meet applicable water quality standards.

b. The permittee shall be responsible for meeting any additional permit requirements imposed by EPA necessary to comply with the Puyallup Tribe's antidegradation policies if the discharge point is located within 1 linear mile upstream of waters designated by the Tribe.

c. Each permittee shall submit a copy of the Notice of Intent (NOI) to be covered by the general permit to Char Naylor (char.naylor@puyalluptribe.com) and Russ Ladley (russ.ladley@puyalluptribe.com) by email or at the address listed below at the same time it is submitted to EPA.

Puyallup Tribe of Indians
3009 E. Portland Avenue
Tacoma, WA 98404
ATTN: Russ Ladley and Char Naylor

d. All supporting documentation and certifications in the NOI related to coverage under the general permit for Endangered Species Act purposes shall be submitted to the Tribe's Resource Protection Manager (russ.ladley@puyalluptribe.com) and Char Naylor (char.naylor@puyalluptribe.com) for review.

e. If EPA requires coverage under an individual or alternative permit, the permittee shall submit a copy of the permit to Russ Ladley and Char Naylor at the address listed above.

f. The permittee shall submit all stormwater pollution prevention plans to Char Naylor for review and approval prior to beginning any activities resulting in a discharge to tribal waters.

g. The permittee shall conduct benchmark monitoring for turbidity (or transparency) and, in the event of significant concrete work or engineered soils, pH monitoring as well. Monitoring, benchmarks, and reporting requirements contained in Condition S.4. (pp.13-20) of the Washington State Construction Stormwater General Permit, effective January 1, 2016, shall apply, as applicable.

h. The permittee shall notify Char Naylor (253-680-5520) and Russ Ladley (253-680-5560) prior to conducting inspections at construction sites generating storm water discharged to tribal waters.

i. Treat dewatering discharges with controls necessary to minimize discharges of pollutants in order to minimize the discharge of pollutants to groundwater or surface waters from stormwater that is removed from excavations, trenches, foundations, vaults, or other storage areas. Examples of appropriate controls include sediment basins or sediment traps, sediment socks, dewatering tanks, tube settlers, weir tanks, and filtration systems (e.g., bag or sand filters) that are designed to remove sediment.

   To the extent feasible, utilize vegetated, upland areas of the site to infiltrate dewatering water before discharge. At all points where dewatering water is discharged, comply with the velocity dissipation requirements of Part 2.2.11 of EPA's 2016 General Construction Stormwater Permit. Examples of velocity dissipation devices include check dams, sediment traps, riprap, and grouted riprap at outlets.

j. The permittee shall provide and maintain natural buffers to the maximum extent possible (and/or equivalent erosion and sediment controls) when tribal waters are located within 100 feet of the site's earth disturbances. If infeasible to provide and maintain an undisturbed 100 foot natural buffer, erosion and sediment controls to achieve the sediment load reduction equivalent to a 100-foot undisturbed natural buffer shall be required.

9.7.4.5 Spokane Tribe of Indians. The following conditions apply only to discharges on the Spokane Tribe Reservation:

a. Pursuant to Tribal Law and Order Code (TLOC) Chapter 30 each operator shall be responsible for achieving compliance with the Surface Water Quality Standards of the Spokane Tribe. The operator shall notify the Spokane Tribe, Water Control Board (WCB) of any spills of hazardous material and;
b. Each operator shall submit a signed hard copy of the Notice of Intent (NOI) to the WCB at the same time it is submitted to EPA.
c. The permittee shall allow the Tribal Water Control Board or its designee to inspect and sample at the construction site as needed.
d. Each operator shall submit a signed copy of the Notice of Termination (NOT) to the WCB at the same time it is submitted to EPA.

The correspondence address for the Spokane Tribe Water Control Board is:

Water Control Board
c/o. Brian Crossley
P0 Box 480
Wellpinit WA 99040
(509)626-4409
crossley@spokanetribe.com

9.7.4.6 Swinomish Indian Tribal Community. The following conditions apply only to discharges on the Swinomish Reservation:

a. Owners and operators seeking coverage under this permit who intend to discharge to Regulated Surface Waters must submit a copy of the Notice of Intent (NOI) to the DEP at the same time the NOI is submitted to EPA.
b. Owners and operators seeking coverage under this permit must also submit a Stormwater Pollution Prevention Plan to the DEP for review and approval by DEP prior to beginning any discharge activities.
c. Owners and operators must also submit to the DEP Changes in NOI and/or Notices of Termination at the same time they are submitted to EPA.

9.7.4.7 Tulalip Tribes. The following conditions apply only to discharges on the Tulalip Reservation:

a. This certification does not exempt and is provisional upon compliance with other applicable statues and codes administered by federal and Tulalip tribal agencies. Pursuant to Tulalip Tribes code of law, the operator must also obtain a land use permit from the Tulalip Tribes Planning Department as provided in Title 7 of the Tulalip Tribal Code (http://www.codepublishing.com/WA/Tulalip/?Tulalip02/Tulalip0205.html).
b. Each CGP operator shall be responsible for achieving compliance with Tulalip Tribes Water Quality Standards.
c. Each CGP operator shall submit their Stormwater Pollution Prevention Plan (SWPPP) to the:

Tulalip Natural & Cultural Resources Department
Tulalip Tribes
6406 Marine Drive
Tulalip, WA 98271

Appendix C
Notice of Intent (NOI)

NPDES FORM 3510-9	EPA	UNITED STATES ENVIRONMENTAL PROTECTION AGENCY WASHINGTON, DC 20460 NOTICE OF INTENT (NOI) FOR THE 2017 NPDES CONSTRUCTION PERMIT	FORM Approved OMB No. 2040-0004

Submission of this Notice of Intent (NOI) constitutes notice that the operator identified in Section III of this form requests authorization to discharge pursuant to the NPDES Construction General Permit (CGP) permit number identified in Section II of this form. Submission of this NOI also constitutes notice that the operator identified in Section III of this form meets the eligibility requirements of Part 1.1 CGP for the project identified in Section IV of this form. Permit coverage is required prior to commencement of construction activity until you are eligible to terminate coverage as detailed in Part 8 of the CGP. To obtain authorization, you must submit a complete and accurate NOI form. Discharges are not authorized if your NOI is incomplete or inaccurate or if you were never eligible for permit coverage. Refer to the instructions at the end of this form.

Permit Information

NPDES ID: NMR10022R

State where your construction site is located: NM

Is your construction site located on Indian Country Lands? ☐ YES ☑ NO

Are you requesting coverage under this NOI as a *"Federal Operator"* as defined in Appendix A (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_a_-_definitions_508.pdf)?
☐ YES ☑ NO

Have stormwater discharges from your current construction site been covered previously under an NPDES permit? ☐ YES ☑ NO

Will you use polymers, flocculants, or other treatment chemicals at your construction site? ☐ YES ☑ NO

Has a Stormwater Pollution Prevention Plan (SWPPP) been prepared in advance of filling this NOI, as required? ☑ YES ☐ NO

Are you able to demonstrate that you meet one of the criteria listed in Appendix D (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_d_-_endangered_species_reqs_508.pdf) with respect to protection of threatened or endangered species listed under the Endangered Species Act (ESA) and federally designated critical habitat?
☑ YES ☐ NO

Have you completed the screening process in Appendix E (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_e_-_historic_properties_reqs_508.pdf) relating to the protection of historic properties?
☑ YES ☐ NO

Indicating "Yes" below, I confirm that I understand that CGP only authorized the allowable stormwater discharges in Part 1.2.1 and the allowable non-stormwater discharges listed in Part 1.2.2. Any discharges not expressly authorized in this permit cannot become authorized or shielded from liability under CWA section 402(k) by disclosure to EPA, state or local authorities after issuance of this permit via any means, Including the Notice of Intent (NOI) to be covered by the permit, the Stormwater Pollution Prevention Plan (SWPPP), during an Inspection, etc. If any discharges requiring NPDES permit coverage other than the allowable stormwater and non-stormwater discharges listed in Parts 1.2.1 and 1.2.2 will be discharged, they must be covered under another NPDES permit.
☑ YES ☐ NO

Operator Information

Operator Information

Operator Name: NGL Waste Services, LLC

Mailing Address:

Street/Location: 3773 Cherry Creek North Drive, Suite 1000

City: Denver **State:** CO **Zip Code:** 80209

County or Similar Government Subdivision: DENVER

Operator Point of Contact Information

First Name, Middle Initial, LastName: Garrett Clemons

Title: Vice President, EHS

Phone: 303-370-7106 **Ext.**

Email: garrett.clemons@nglep.com

Project/Site Information

Project/Site Name: North Ranch Surface Waste Management Facility

Project/Site Address

Street/Location: Battle Axe Road

City: Jal **State:** NM **Zip Code:** 88252

County or Similar Government Subdivision: LEA

Latitude/Longitude: 32.1449°N, 103.4624°W

Latitude/Longitude Data Source: Map **Horizontal Reference Datum:** NAD 83

Project Start Date: 2019-05-15 **Project End Date:** 2029-06-15 **Estimated Area to be Disturbed:** 270.25

Types of Construction Sites:

- Industrial

Will there be demolition of any structure built or renovated before January 1, 1980? ☐ YES ☑ NO

Was the pre-development land use used for agriculture? ☑ YES ☐ NO

Have earth-disturbing activities commenced on your project/site? ☐ YES ☑ NO

Is your project located on a property of religious or cultural significance to an Indian tribe? ☐ YES ☑ NO

Discharge Information

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)? ☐ YES ☑ NO

Are there any waters of the U.S. within 50 feet of your project's earth disturbances? ☐ YES ☑ NO

Are any of the waters of the U.S. to which you discharge designated by the state or tribal authority under its antidegradation policy as a Tier 2 (or Tier 2.5) water (water quality exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water) or as a Tier 3 water (Outstanding National Resource Water)? See Appendix F (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_f_-_tier_3_tier_2_and_tier_2.5_waters_508.pdf)

☐ YES ☑ NO

001: Unnamed Surrounding property is at a higher elevation (on all sides) than the subject property

Latitude/Longitude: 32.1396°N, 103.4654°W

Tier Designation: N/A

Is this receiving water impaired (on the CWA 303(d) list)? ☐ YES ☑ NO

Has a TMDL been completed for this receiving waterbody? ☐ YES ☑ NO

002: Unnamed Surrounding property is at a higher elevation (on all sides) than the subject property

Latitude/Longitude: 32.1367°N, 103.4592°W

Tier Designation: N/A

Is this receiving water impaired (on the CWA 303(d) list)? ☐ YES ☑ NO

Has a TMDL been completed for this receiving waterbody? ☐ YES ☑ NO

Stormwater Pollution Prevention Plan (SWPPP)

First Name, Middle Initial, LastName: LaVern D Choquette

Title: Principal Consultant

Phone: 405-531-0600 **Ext.**

Email: vchoquette@bearcreekconsultants.com

Endangered Species Protection

Using the Instructions in Appendix D of the CGP, under which criterion listed in Appendix D are you eligible for coverage under this permit? Criterion A

Provide a brief summary of the basis for criterion selection listed above (the necessary content for a supportive basis statement is provided under the criterion you selected.):

According to the USFWS Information for Planning and Conservation (IPaC) Environmental Conservation Online System, only one federally protected species is located in the area: Northern Aplomado Falcon (Falco femoralis septentrionalis). There is no critical habitat located in the project area.

Historic Preservation

Are you installing any stormwater controls as described in Appendix E (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_e_-_historic_properties_reqs_508.pdf) that require subsurface earth disturbances? (Appendix E (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_e_-_historic_properties_reqs_508.pdf), Step 1)

☑ YES ☐ NO

Have prior surveys or evaluations conducted on the site already determined historic properties do not exist, or that prior disturbances have precluded the existence of historic properties? (Appendix (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_e_-_historic_properties_reqs_508.pdf), Step 2):

☐ YES ☑ NO

Have you determined that your installation of subsurface earth-disturbing stormwater controls will have no effect on historic properties? (Appendix E (https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_e_-_historic_properties_reqs_508.pdf), Step 3)

☑ YES ☐ NO

Certification Information

Certified By: Garrett Clemons (GCLEMONS)

Certified On: 04/15/2019 4:33 PM

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. Signing an electronic document on behalf of another person is subject to criminal, civil, administrative, or other lawful action.

Appendix D
SWP3 Forms

General Information (see reverse for instructions)					
Name of Project		**NPDES ID No.**		**Inspection Date**	
Weather conditions during inspection		**Inspection start time**		**Inspection end time**	
Inspector Name, Title & Contact Information					
Present Phase of Construction					
Inspection Location (if multiple inspections are required, specify location where this inspection is being conducted)					

Inspection Frequency *(Note: you may be subject to different inspection frequencies in different areas of the site. Check all that apply)*

Standard Frequency:
- ☐ Every 7 days
- ☐ Every 14 days and within 24 hours of a 0.25" rain or the occurrence of runoff from snowmelt sufficient to cause a discharge

Increased Frequency:
- ☐ Every 7 days and within 24 hours of a 0.25" rain (for areas of sites discharging to sediment or nutrient-impaired waters or to waters designated as Tier 2, Tier 2.5, or Tier 3)

Reduced Frequency:
- ☐ Twice during first month, no more than 14 calendar days apart; then once per month after first month; (for stabilized areas)
- ☐ Twice during first month, no more than 14 calendar days apart; then once more within 24 hours of a 0.25" rain (for stabilized areas on "linear construction sites")
- ☐ Once per month and within 24 hours of a 0.25" rain (for arid, semi-arid, or drought-stricken areas during seasonally dry periods or during drought)
- ☐ Once per month (for frozen conditions where earth-disturbing activities are being conducted)

Was this inspection triggered by a 0.25" storm event? ☐ Yes ☐ No

If yes, how did you determined whether a 0.25" storm event has occurred?

☐ Rain gauge on site ☐ Weather station representative of site. Specify weather station source:

Total rainfall amount that triggered the inspection (in inches)**:**

Was this inspection triggered by the occurrence of runoff from snowmelt sufficient to cause a discharge? ☐ Yes ☐ No

Unsafe Conditions for Inspection

Did you determine that any portion of your site was unsafe for inspection per CGP Part 4.5? ☐ Yes ☐ No

If "yes", complete the following:

- Describe the conditions that prevented you from conducting the inspection in this location:

- Location(s) where conditions were found:

Instructions for Filling Out "General Information" Section

Name of Project
Enter the name for the project.

NPDES ID No.
Enter the NPDES ID number that was assigned to your NOI for permit coverage.

Inspection Date
Enter the date you conducted the inspection.

Weather Conditions During Inspection
Enter the weather conditions occurring during the inspection, e.g., sunny, overcast, light rain, heavy rain, snowing, icy, windy.

Inspection start and end times
Enter the time you started and ended the inspection.

Inspector Name, Title & Contact Information
Provide the name of the person(s) (either a member of your company's staff or a contractor or subcontractor) that conducted this inspection. Provide the inspector's name, title, and contact information as directed in the form.

Present Phase of Construction
If this project is being completed in more than one phase, indicate which phase it is currently in.

Inspection Location
If your project has multiple locations where you conduct separate inspections, specify the location where this inspection is being conducted. If only one inspection is conducted for your entire project, enter "Entire Site." If necessary, complete additional inspection report forms for each separate inspection location.

Inspection Frequency
Check the box that describes the inspection frequency that applies to you. Note that you may be subject to different inspection frequencies in different areas of your site. If your project does not discharge to a "sensitive water" (i.e., a water impaired for sediment or nutrients, or listed as Tier 2, 2.5, or 3 by your state or tribe) and you are not affected by any of the circumstances described in CGP Part 4.4, then you can choose your frequency based on CGP Part 4.2 – either every 7 calendar days, or every 14 calendar days <u>and</u> within 24 hours of a 0.25-inch storm event. For any portion of your site that discharges to a sensitive water, your inspection frequency for that area is fixed under CGP Part 4.3 at every 7calendar days <u>and</u> within 24 hours of a 0.25-inch storm event. If portions of your site are stabilized, are located in arid, semi-arid, or drought-stricken areas, or are subject to frozen conditions, consult CGP Part 4.4 for the applicable inspection frequency. Check all the inspection frequencies that apply to your project.

Was This Inspection Triggered by a 0.25 Inch Storm Event or the occurrence of runoff from snowmelt sufficient to cause a discharge?
If you were required to conduct this inspection because of a 0.25-inch (or greater) rain event, indicate whether you relied on an on-site rain gauge or a nearby weather station (and where the weather station is located). Also, specify the total amount of rainfall for this specific storm event. If you were required to conduct this inspection because of the occurrence of runoff from snowmelt, then check the appropriate box.

Unsafe Conditions for Inspection
Inspections are not required where a portion of the site or the entire site is subject to unsafe conditions. See CGP Part 4.5. These conditions should not regularly occur, and should not be consistently present on a site. Generally, unsafe conditions are those that render the site (or a portion of it) inaccessible or that would pose a significant probability of injury to applicable personnel. Examples could include severe storm or flood conditions, high winds, and downed electrical wires.

If your site, or a portion of it, is affected by unsafe conditions during the time of your inspection, provide a description of the conditions that prevented you from conducting the inspection and what parts of the site were affected. If the entire site was considered unsafe, specify the location as "Entire site"

Condition and Effectiveness of Erosion and Sediment (E&S) Controls (CGP Part 2.2) (see reverse for instructions)				
Type/Location of E&S Control [Add an additional sheet if necessary]	**Maintenance Needed?***	**Corrective Action Required?***	**Date on Which Maintenance or Corrective Action First Identified?**	**Notes**
1.	☐Yes ☐No	☐Yes ☐No		
2.	☐Yes ☐No	☐Yes ☐No		
3.	☐Yes ☐No	☐Yes ☐No		
4.	☐Yes ☐No	☐Yes ☐No		
5.	☐Yes ☐No	☐Yes ☐No		
6.	☐Yes ☐No	☐Yes ☐No		
7.	☐Yes ☐No	☐Yes ☐No		
8.	☐Yes ☐No	☐Yes ☐No		
9.	☐Yes ☐No	☐Yes ☐No		
10.	☐Yes ☐No	☐Yes ☐No		

*** Note:** The permit differentiates between conditions requiring routine maintenance, and those requiring corrective action. The permit requires maintenance in order to keep controls in effective operating condition. Corrective actions are triggered only for specific conditions, which include: 1) A stormwater control needs repair or replacement (beyond routine maintenance) if it is not operating as intended; 2) A stormwater control necessary to comply with the permit was never installed or was installed incorrectly; 3) You become aware that the stormwater controls you have installed and are maintaining are not effective enough for the discharge to meet applicable water quality standards or applicable requirements in Part 3.1; 4) One of the prohibited discharges in Part 1.3 is occurring or has occurred; or 5) EPA requires corrective actions as a result of a permit violation found during an inspection carried out under Part 4.8. If a condition on your site requires a corrective action, you must also fill out a corrective action form found at https://www.epa.gov/npdes/stormwater-discharges-construction-activities#resources. See Part 5 of the permit for more information.

Instructions for Filling Out the "Erosion and Sediment Control" Table

Type and Location of E&S Controls
Provide a list of all erosion and sediment (E&S) controls that your SWPPP indicates will be installed and implemented at your site. This list must include at a minimum all E&S controls required by CGP Part 2.2. Include also any natural buffers established under CGP Part 2.2.1. Buffer requirements apply if your project's earth-disturbing activities will occur within 50 feet of a water of the U.S. You may group your E&S controls on your form if you have several of the same type of controls (e.g., you may group "Inlet Protection Measures", "Perimeter Controls", and "Stockpile Controls" together on one line), but if there are any problems with a specific control, you must separately identify the location of the control, whether maintenance or corrective action is necessary, and in the notes section you must describe the specifics about the problem you observed.

Maintenance Needed?
Answer "yes" if the E&S control requires maintenance due to normal wear and tear in order for the control to continue operating effectively. At a minimum, maintenance is required in the following specific instances: (1) for perimeter controls, whenever sediment has accumulated to half or more the above-ground height of the control (CGP Part 2.2.3.a); (2) where sediment has been tracked-out onto the surface of off-site streets or other paved areas (CGP Part 2.2.4); (3) for inlet protection measures, when sediment accumulates, the filter becomes clogged, and/or performance is compromised (CGP Part 2.2.10); and (4) for sediment basins, as necessary to maintain at least half of the design capacity of the basin (CGP Part 2.2.12.f). Note: In many cases, "yes" answers are expected and indicate a project with an active operation and maintenance program. You should also answer "yes" if work to fix the problem is still ongoing from the previous inspection.

Corrective Action Needed?
Answer "yes" if during your inspection you found any of the following conditions to be present (CGP, Part 5.1): (1) a required E&S control needs repair or replacement (beyond routine maintenance required under Part 2.1.4); (2) a require E&S control was never installed or was installed incorrectly; (3) you become aware that the inadequacy of the E&S control has led to an exceedance of an applicable water quality standard; (4) one of the prohibited discharges in Part 1.3 is occurring or has occurred; or (5) EPA requires corrective action for an E&S control as a result of a permit violation found during an inspection carried out under Part 4.8. If you answer "yes", you must take corrective action and complete a corrective action report, found at https://www.epa.gov/npdes/stormwater-discharges-construction-activities#resources.. Note: You should answer "yes" if work to fix the problem from a previous inspection is still ongoing.

Date on Which Maintenance or Corrective Action First Identified?
Provide the date on which the condition that triggered the need for maintenance or corrective action was first identified. If the condition was just discovered during this inspection, enter the inspection date. If the condition is a carryover from a previous inspection, enter the original date of the condition's discovery.

Notes
For each E&S control and the area immediately surrounding it, note whether the control is properly installed and whether it appears to be working to minimize sediment discharge. Describe any problem conditions you observed such as the following, and why you think they occurred as well as actions (e.g., maintenance or corrective action) you will take or have taken to fix the problem:

1. Failure to install or to properly install a required E&S control
2. Damage or destruction to an E&S control caused by vehicles, equipment, or personnel, a storm event, or other event
3. Mud or sediment deposits found downslope from E&S controls
4. Sediment tracked out onto paved areas by vehicles leaving construction site
5. Noticeable erosion at discharge outlets or at adjacent streambanks or channels
6. Erosion of the site's sloped areas (e.g., formation of rills or gullies)
7. E&S control is no longer working due to lack of maintenance

For buffer areas, make note of whether they are marked off as required, whether there are signs of construction disturbance within the buffer, which is prohibited under the CGP, and whether there are visible signs of erosion resulting from discharges through the area.

If maintenance or corrective action is required, briefly note the reason. If maintenance or corrective action have been completed, make a note of the date it was completed and what was done. *If corrective action is required, note that you will need to complete a separate corrective action report describing the condition and your work to fix the problem*.

Condition and Effectiveness of Pollution Prevention (P2) Practices (CGP Part 2.3) (see reverse for instructions)				
Type/Location of P2 Practices [Add an additional sheet if necessary]	**Maintenance Needed?***	**Corrective Action Required?***	**Date on Which Maintenance or Corrective Action First Identified?**	**Notes**
1.	☐Yes ☐No	☐Yes ☐No		
2.	☐Yes ☐No	☐Yes ☐No		
3.	☐Yes ☐No	☐Yes ☐No		
4.	☐Yes ☐No	☐Yes ☐No		
5.	☐Yes ☐No	☐Yes ☐No		
6.	☐Yes ☐No	☐Yes ☐No		
7.	☐Yes ☐No	☐Yes ☐No		
8.	☐Yes ☐No	☐Yes ☐No		
9.	☐Yes ☐No	☐Yes ☐No		
10.	☐Yes ☐No	☐Yes ☐No		

*** Note:** The permit differentiates between conditions requiring routine maintenance, and those requiring corrective action. The permit requires maintenance in order to keep controls in effective operating condition. Corrective actions are triggered only for specific conditions, which include: 1) A stormwater control needs repair or replacement (beyond routine maintenance) if it is not operating as intended; 2) A stormwater control necessary to comply with the permit was never installed or was installed incorrectly; 3) You become aware that the stormwater controls you have installed and are maintaining are not effective enough for the discharge to meet applicable water quality standards or applicable requirements in Part 3.1; 4) One of the prohibited discharges in Part 1.3 is occurring or has occurred; or 5) EPA requires corrective actions as a result of a permit violation found during an inspection carried out under Part 4.8. If a condition on your site requires a corrective action, you must also fill out a corrective action form found at https://www.epa.gov/npdes/stormwater-discharges-construction-activities#resources. See Part 5 of the permit for more information.

Instructions for Filling Out the "Pollution Prevention (P2) Practice" Table

Type and Location of P2 Controls
Provide a list of all pollution prevention (P2) practices that are implemented at your site. This list must include all P2 practices required by Part 2.3, and those that are described in your SWPPP.

Maintenance Needed?
Answer "yes" if the P2 practice requires maintenance due to normal wear and tear in order for the control to continue operating effectively. Note: In many cases, "yes" answers are expected and indicate a project with an active operation and maintenance program.

Corrective Action Needed?
Answer "yes" if during your inspection you found any of the following conditions to be present (CGP, Part 5.1): (1) a required P2 practice needs repair or replacement (beyond routine maintenance required under Part 2.1.4); (2) a require P2 practice was never installed or was installed incorrectly; (3) you become aware that the inadequacy of the P2 practice has led to an exceedance of an applicable water quality standard; (4) one of the "prohibited discharges" listed in CGP Part 1.3 is occurring or has occurred, or (5) EPA requires corrective action for a P2 practice as a result of a permit violation found during an inspection carried out under Part 4.8. If you answer "yes", you must take corrective action and complete a corrective action report (see https://www.epa.gov/npdes/stormwater-discharges-construction-activities#resources). Note: You should answer "yes" if work to fix the problem from a previous inspection is still ongoing.

Date on Which Maintenance or Corrective Action First Identified?
Provide the date on which the condition that triggered the need for maintenance or corrective action was first identified. If the condition was just discovered during this inspection, enter the inspection date. If the condition is a carryover from a previous inspection, enter the original date of the condition's discovery.

Notes
For each P2 control and the area immediately surrounding it, note whether the control is properly installed, whether it appears to be working to minimize or eliminate pollutant discharges, and whether maintenance or corrective action is required. Describe problem conditions you observed such as the following, and why you think they occurred, as well as actions you will take or have taken to fix the problem:

1. Failure to install or to properly install a required P2 control
2. Damage or destruction to a P2 control caused by vehicles, equipment, or personnel, or a storm event
3. Evidence of a spill, leak, or other type of pollutant discharge, or failure to have properly cleaned up a previous spill, leak, or other type of pollutant discharge
4. Spill response supplies are absent, insufficient, or not where they are supposed to be located
5. Improper storage, handling, or disposal of chemicals, building materials or products, fuels, or wastes
6. P2 practice is no longer working due to lack of maintenance

If maintenance or corrective action is required, briefly note the reason. If maintenance or corrective action have been completed, make a note of the date it was completed and what was done. *If corrective action is required, note that you will need to complete a separate corrective action report describing the condition and your work to fix the problem.*

Stabilization of Exposed Soil (CGP Part 2.2.14) (see reverse for instructions)			
Stabilization Area **[Add an additional sheet if necessary]**	**Stabilization Method**	**Have You Initiated Stabilization?**	**Notes**
1.		☐ YES ☐ NO If yes, provide date:	
2.		☐ YES ☐ NO If yes, provide date:	
3.		☐ YES ☐ NO If yes, provide date:	
4.		☐ YES ☐ NO If yes, provide date:	
5.		☐ YES ☐ NO If yes, provide date:	

Description of Discharges (CGP Part 4.6.6) (see reverse for instructions)	
Was a stormwater discharge or other discharge occurring from any part of your site at the time of the inspection? ☐ Yes ☐ No **If "yes", provide the following information for each point of discharge:**	
Discharge Location **[Add an additional sheet if necessary]**	**Observations**
1.	Describe the discharge: At points of discharge and the channels and banks of waters of the U.S. in the immediate vicinity, are there any visible signs of erosion and/or sediment accumulation that can be attributed to your discharge? ☐ Yes ☐ No If yes, describe what you see, specify the location(s) where these conditions were found, and indicate whether modification, maintenance, or corrective action is needed to resolve the issue:
2.	Describe the discharge: At points of discharge and the channels and banks of waters of the U.S. in the immediate vicinity, are there any visible signs of erosion and/or sediment accumulation that can be attributed to your discharge? ☐ Yes ☐ No If yes, describe what you see, specify the location(s) where these conditions were found, and indicate whether modification, maintenance, or corrective action is needed to resolve the issue:

Instructions for Filling Out the "Stabilization of Exposed Soil" Table

Stabilization Area
List all areas where soil stabilization is required to begin because construction work in that area has permanently stopped or temporarily stopped (i.e., work will stop for 14 or more days), and all areas where stabilization has been implemented.

Stabilization Method
For each area, specify the method of stabilization (e.g., hydroseed, sod, planted vegetation, erosion control blanket, mulch, rock).

Have You Initiated Stabilization
For each area, indicate whether stabilization has been initiated.

Notes
For each area where stabilization has been initiated, describe the progress that has been made, and what additional actions are necessary to complete stabilization. Note the effectiveness of stabilization in preventing erosion. If stabilization has been initiated but not completed, make a note of the date it is to be completed. If stabilization has been completed, make a note of the date it was completed. If stabilization has not yet been initiated, make a note of the date it is to be initiated, and the date it is to be completed.

Instructions for Filling Out the "Description of Discharges" Table

You are only required to complete this section if a discharge is occurring at the time of the inspection.

Was a Stormwater Discharge Occurring From Any Part of Your Site At The Time of the Inspection?
During your inspection, examine all points of discharge from your site, and determine whether a discharge is occurring. If there is a discharge, answer "yes" and complete the questions below regarding the specific discharge. If there is not a discharge, answer "no" and skip to the next page.

Discharge Location (repeat as necessary if there are multiple points of discharge)
Location of discharge. Specify the location on your site where the discharge is occurring. The location may be an outlet from a stormwater control or constructed stormwater channel, a discharge into a storm sewer inlet, or a specific point on the site. Be as specific as possible; it is recommended that you refer to a precise point on your site map.

Describe the discharge. Include a specific description of any noteworthy characteristics of the discharge such as color; odor; floating, settled, or suspended solids; foam; oil sheen; and other obvious pollution indicators.

Are there visible signs of erosion or sediment accumulation? At each point of discharge and the channel and streambank in the immediate vicinity, visually assess whether there are any obvious signs of erosion and/or sediment accumulation that can be attributed to your discharge. If you answer "yes", include a description in the space provided of the erosion and sediment deposition that you have found, specify where on the site or in the water of the U.S. it is found, and indicate whether modification, maintenance, or corrective action is needed to resolve the issue.

Contractor or Subcontractor Signature and Certification (see reverse for instructions)
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."
Signature of Contractor or Subcontractor: ____ **Date:**
Printed Name and Affiliation: ____

Operator Signature and Certification (see reverse for instructions)
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."
Signature of Operator or "Duly Authorized Representative": ____ **Date:**
Printed Name and Affiliation: ____

Instructions for Signature / Certification

Each inspection report must be signed and certified to be considered complete.

Contractor or Subcontractor Signature and Certification
Where you rely on a contractor or subcontractor to carry out the inspection and complete the inspection report, you should require the inspector to sign and certify each report. Note that this does not relieve you, the permitted operator, of the requirement to sign and certify the inspection report as well.

Operator Signature and Certification
At a minimum, the inspection report must be signed by either (1) the person who signed the NOI, or (2) a duly authorized representative of that person. The following requirements apply to scenarios (1) and (2):

If the signatory will be the person who signed the NOI for permit coverage, as a reminder, that person must be one of the following types of individuals:

- *For a corporation*: A responsible corporate officer. For the purpose of this subsection, a responsible corporate officer means: (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
- *For a partnership or sole proprietorship*: A general partner or the proprietor, respectively.
- *For a municipality, state, federal, or other public agency*: Either a principal executive officer or ranking elected official. For purposes of this subsection, a principal executive officer of a federal agency includes (i) the chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator of EPA).

If the signatory will be a duly authorized representative, the following requirements must be met:

- The authorization is made in writing by the person who signed the NOI (see above);
- The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and
- The signed and dated written authorization is included in the SWPPP. A copy must be submitted to EPA, if requested.

Section A – Initial Report (CGP Part 5.4.1) (Complete this section within 24 hours of identifying the condition that triggered corrective action)					
Name of Project		NPDES ID No.		Today's Date	
Date Problem First Discovered		Time Problem First Discovered			
Name and Contact Information of Individual Completing this Form					

What site conditions triggered the requirement to conduct corrective action *(check the box that applies)*:

- ☐ A stormwater control needs repair or replacement (beyond routine maintenance required under Part 2.1.4)
- ☐ A stormwater control necessary to comply with the requirements of this permit was never installed, or was installed incorrectly
- ☐ A discharge is causing an exceedance of applicable water quality standards
- ☐ A Part 1.3 prohibited discharge has occurred
- ☐ EPA requires corrective action as a result of permit violations found during an EPA inspection carried out under Part 4.8

Provide a description of the problem:

Deadline for completing corrective action *(check the box that applies)*:

- ☐ Immediately take all reasonable steps to address the condition, including cleaning up any contaminated surfaces so the material will not discharge in subsequent storm events
- ☐ Complete by close of the next business day when problem does not require a new or replacement control or significant repair
- ☐ No later than 7 calendar days from the time of discovery for problems that require a new or replacement control or significant repair
- ☐ Infeasible to complete the installation or repair within 7 calendar days. Explain why it is infeasible and document schedule for installing control:

Enter date of corrective action completion: ____________________

Section B – Corrective Action Completion (CGP Part 5.4.2) (Complete this section no later than 24 hours after completing the corrective action)	
Section B.1 – Why the Problem Occurred	
Cause(s) of Problem (Add an additional sheet if necessary)	How You Determined the Cause and the Date You Determined the Cause
1. 2.	1. 2.

Section B.2 – Stormwater Control Modifications Implemented to Correct the Problem			
List of Stormwater Control Modification(s) **Needed to Correct Problem** (Add an additional sheet if necessary)	**Date of Completion**	**SWPPP Update Necessary?**	**Notes**
1.		☐Yes ☐No If yes, provide date SWPPP modified:	
2.		☐Yes ☐No If yes, provide date SWPPP modified:	

Instructions for Filling Out the Initial Report (Section A)

You must complete Section A of the report form within 24 hours of discovering the condition that triggered corrective action

Name of Project
Enter the name for the project.

NPDES ID No.
Enter the NPDES ID number that was assigned to your NOI for permit coverage.

Today's Date
Enter the date you completed this form.

Date/Time Problem First Discovered
Specify the date on which the triggering condition was first discovered. Also specify the time of the discovery.

Name/Contact Information
Provide the individual's name, title, and contact information as directed in the form.

Site Condition That Triggered Corrective Action
Under the CGP, corrective action is required when one of 4 triggering conditions occurs at your site or when EPA requires a corrective action as a result of a permit violation found during an EPA inspection. See CGP Parts 5.1 and 5.3. Check the box that corresponds to the condition that triggered this corrective action.

Description of the Site Condition
Provide a summary description of the condition you found that triggered corrective action under CGP Part 5.1 and the specific location where it was found. Be as specific as possible about the location; it is recommended that you refer to a precise point on your site map. If you have already provided this explanation in an inspection report, you can refer to that report.

Deadline for Completing Corrective Action
This deadline is fixed in CGP Part 5.2. For all projects, the deadlines are: (1) immediately take all reasonable steps; (2) by the close of the next business day when the problem does not require significant repair or replacement; (3) no more than 7 calendar days after the date you discovered the problem when the problem does require significant repair or replacement, or (4) if it is infeasible to complete work within the first 7 days, as soon as practicable following the 7th day. If your estimated date of completion falls after the 7-day deadline consistent with (3), above, explain (a) why you believe it is infeasible to complete work within 7 days, and (b) why the date you have established for making the new or modified stormwater control operational is the soonest practicable timeframe.

Instructions for Filling Out the Corrective Action Completion Table (Section B)

You must complete Section B of the report form no later than 24 hours after completing the correction action.

Section B.1 – Why the Problem Occurred
After you have had the opportunity to examine the problem more closely, provide details as to what you believe to be the cause of the problem, and specify the follow-up actions you took (along with the dates of such actions) to diagnose the problem. This is consistent with CGP Part 5.4.2.

Section B.2 – Stormwater Control Modifications Implemented
Provide a list of modifications you made to your stormwater controls to correct the problem and the date you completed such work. Keep in mind that your work must be completed within the timeline specified in Section A for the completion of corrective action work.

Also, if a SWPPP modification is necessary consistent with Part 7.4.1.a in order to reflect changes implemented at your site, indicate the date you modified your SWPPP. Keep in mind that SWPPP changes must be made within 7 days of discovering the problem that triggered this corrective action.

Space is provided for you to include additional notes or observations regarding the change that you implemented at your site to correct the problem.

Section C –Signature and Certification (CGP Part 5.4.3)

Section C.1 – Contractor or Subcontractor Signature and Certification

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature of Contractor or Subcontractor: ____

Date:

Printed Name and Affiliation: ____

Section C.2 – Operator Signature and Certification

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature of Operator or "Duly Authorized Representative": ____

Date:

Printed Name and Affiliation: ____

Instructions for Signature and Certification (Section C)

Each corrective action report must be signed and certified to be considered complete.

Section C.1 – Contractor or Subcontractor Signature and Certification
Where you rely on a contractor or subcontractor to complete this report and the associated corrective action, you should require the individual(s) to sign and certify each report. Note that this does not relieve you, the permitted operator, of the requirement to sign and certify the report as well.

Section C.2 – Operator Signature and Certification
At a minimum, the corrective action report form must be signed by either (1) the person who signed the NOI, or (2) a duly authorized representative of that person. The following requirements apply to scenarios (1) and (2):

If the signatory will be the person who signed the NOI for permit coverage, as a reminder, that person must be one of the following types of individuals:

- *For a corporation*: A responsible corporate officer. For the purpose of this subsection, a responsible corporate officer means: (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
- *For a partnership or sole proprietorship*: A general partner or the proprietor, respectively.
- *For a municipality, state, federal, or other public agency*: Either a principal executive officer or ranking elected official. For purposes of this subsection, a principal executive officer of a federal agency includes (i) the chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator of EPA).

If the signatory will be a duly authorized representative, the following requirements must be met:

- The authorization is made in writing by the person who signed the NOI (see above);
- The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and
- The signed and dated written authorization is included in the SWPPP. A copy must be submitted to EPA, if requested.

SWPPP Amendment Log

Instructions (see CGP Part 7.4):

- Create a log here of changes and updates to the SWPPP. You may use the table below to track these modifications.
- SWPPP modifications are required pursuant to CGP Part 7.4.1 in the following circumstances:
  - ✓ Whenever new operators become active in construction activities on your site, or you make changes to your construction plans, stormwater controls, or other activities at your site that are no longer accurately reflected in your SWPPP;
  - ✓ To reflect areas on your site map where operational control has been transferred (and the date of transfer) since initiating permit coverage;
  - ✓ If inspections or investigations determine that SWPPP modifications are necessary for compliance with this permit;
  - ✓ Where EPA determines it is necessary to install and/or implement additional controls at your site in order to meet requirements of the permit; and
- To reflect any revisions to applicable federal, state, tribal, or local requirements that affect the stormwater control measures implemented at the site.
- If applicable, if a change in chemical treatment systems or chemically-enhanced stormwater control is made, including use of a different treatment chemical, different dosage rate, or different area of application.

No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: ____

Project Title: ____

Operator(s): ____

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company: ____

Address: ____

Telephone Number: ______________________

Type of construction service to be provided: ______________________

____

____

Signature: ______________________

Title: ______________________

Date: ______________________

Grading and Stabilization Activities Log

Date Grading Activity Initiated	Description of Grading Activity	Description of Stabilization Measure and Location	Date Grading Activity Ceased (Indicate Temporary or Permanent)	Date When Stabilization Measures Initiated
			☐ Temporary ☐ Permanent	
			☐ Temporary ☐ Permanent	
			☐ Temporary ☐ Permanent	
			☐ Temporary ☐ Permanent	
			☐ Temporary ☐ Permanent	
			☐ Temporary ☐ Permanent	
			☐ Temporary ☐ Permanent	
			☐ Temporary ☐ Permanent	

Stormwater Pollution Prevention Training Log

Project Name:

Project Location:

Instructor's Name(s):

Instructor's Title(s):

Course Location: ______________________________ Date: ________________

Course Length (hours): __________________________

Stormwater Training Topic: *(check as appropriate)*

☐ **Sediment and Erosion Controls**
☐ **Stabilization Controls**
☐ **Pollution Prevention Measures**
☐ **Emergency Procedures**
☐ **Inspections/Corrective Actions**

Specific Training Objective:____

____

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		

Appendix E
Delegation of Authority

Delegation of Authority

I, ________________________ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit (CGP), at the ______________________________________ construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans and all other documents required by the permit.

____ (name of person or position)
____ (company)
____ (address)
____ (city, state, zip)
____ (phone)

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Appendix I of EPA's CGP, and that the designee above meets the definition of a "duly authorized representative" as set forth in Appendix I.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: ____

Company: ____

Title: ____

Signature: ____

Date: ____

District I
1625 N. French Dr., Hobbs, NM 88240
Phone:(575) 393-6161 Fax:(575) 393-0720
District II
811 S. First St., Artesia, NM 88210
Phone:(575) 748-1283 Fax:(575) 748-9720
District III
1000 Rio Brazos Rd., Aztec, NM 87410
Phone:(505) 334-6178 Fax:(505) 334-6170
District IV
1220 S. St Francis Dr., Santa Fe, NM 87505
Phone:(505) 476-3470 Fax:(505) 476-3462

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 374012

CONDITIONS

Operator:	
NGL Waste Services, LLC 1008 Southview Circle Center, TX 75935	OGRID: 329268
	Action Number: 374012
	Action Type: [C-137] SWMF Minor Modification (C-137A)

CONDITIONS

Created By	Condition	Condition Date
lbarr	See approval letter with conditions.	9/20/2024