Souder, Miller & Associates♦201 S. Halagueno St.♦Carlsbad, NM 88220
(575) 689-8801

October 11, 2017

#5E25852-BG3

NMOCD District II
Mike Bratcher
811 S. First St.
Artesia, NM 88210

SUBJECT: SOIL REMEDIATION WORK PLAN FOR THE INCIDENT AT THE Brushy Creek Gathering Station RELEASE, EDDY COUNTY, NEW MEXICO

Dear Mr. Bratcher,

On behalf of WPX Energy, Souder, Miller & Associates (SMA) has prepared this WORK PLAN that describes the assessment, initial delineation and proposed remediation for releases associated with the Brushy Creek Gathering Station releases. The site is in UNIT M, SECTION 25, TOWNSHIP 26S, RANGE 29E, NMPM, Eddy County, New Mexico, on Bureau of Land Management land. Figure 1 illustrates the vicinity and location of the site.

Table 1, below, summarizes information regarding the release.

Table 1: Release information and Site Ranking	
Name	Brushy Creek Gathering Station
Company	WPX Energy
RP Number	2RP-3811, 2RP-2742, 2RP-2796,2RP-3195
API Number	30-015-24451
Location	32.005758° -103.944660°
Estimated Date of Release	Various
Date Reported to NMOCD	Various
Land Owner	Federal
Reported To	Mike Bratcher
Source of Release	See Attached C-141
Released Material	See Attached C-141
Released Volume	See Attached C-141
Recovered Volume	See Attached C-141
Net Release	See Attached C-141
Nearest Waterway	0.9 Miles from Red Bluff Lake
Depth to Groundwater	Estimated to be less than 100’
Nearest Domestic Water Source	Greater than 1,000 feet
NMOCD Ranking	10

1.0 Background

This location currently has four open Remediation Permits for the location including: 2RP-3811, 2RP-2742, 2RP-2796,2RP-3195. Equipment failures and human error have been the reasoning for the releases on the location. The impacted area is approximately 200 feet long by 100 feet wide. Release area is shown in Figure 2 and in Figure 3.

2.0 Site Ranking and Land Jurisdiction

The release site is located approximately 0.9 miles north of the Red Bluff Lake, with an elevation of approximately 2,882 feet above sea level. SMA searched the New Mexico State Engineer's Office (NMOSE) online water well database for water wells in the vicinity of the release. Three wells are located within a three-mile radius of the site. Using a boring 0.4 miles southeast of location, drilled by SMA on September 13, 2017 no water was found at 70' bgs. After evaluation of the site using aerial photography and topographic maps, depth to groundwater is estimated to be less than 100 feet below ground surface (bgs).

Recommended Remediation Action Levels (RRALs) are determined by the site ranking according to the NMOCD *Guidelines for Remediation of Leaks, Spills, and Releases* (1993). Below in Table 2 are the remediation standards and the site ranking for this location. Justification for this site ranking is found in Figure 1 and Appendix B.

Table 2.

Soil Remediation Standards	0 to 9	10 to 19	>19
Benzene	10 PPM	10 PPM	10 PPM
BTEX	50 PPM	50 PPM	50 PPM
TPH	5000 PPM	1000 PPM	100 PPM

Depth to Groundwater	NMOCD Numeric Rank
< 50 BGS = 20	
50' to 99' = 10	10
>100' = 0	
Distance to Nearest Surface Water	**NMOCD Numeric Rank**
< 200' = 20	
200' - 1000' = 10	
>1000' = 0	0
Well Head Protection	**NMOCD Numeric Rank**
<1000' (or <200' domestic) = 20	
> 1000' = 0	0
Total Site Ranking	**0**

3.0 Release Characterization

On September 4, November 14, 2016, January 24 and 26, 2017 WPX staff collected samples and Vertex conducted a Geophysical Survey of the Area refer to APPENDIX C for further information

concerning the release data. The surface impact is estimated to be 2,115 square yards. This area encompasses the Brushy Creek Gathering Station with associated tank battery, equipment and buried lines. In Appendix D a model was used to determine the risk to groundwater.

4.0 Soil Remediation Workplan

SMA will oversee licensed driller to conduct a soil boring to delineate affected soils. After approval from area utilities owners via 811 and NMOCD. SMA will continuously guide the boring activities with a by collecting composite soil samples and logging geology downhole for field screening with a mobile titration unit (EPA 4500). The samples will be sent under chain-of-custody protocols to Hall Environmental Analysis Laboratory for analyses including chlorides by Method 300.0, volatile organics (BTEX) by Method 8021B, and MRO, DRO, and GRO by EPA Method 8015D.

After delineation samples are submitted requested for deferment is being asked for this location. This area cannot be excavated due to the proximity of the operational equipment and un located buried pipelines.

5.0 Scope and Limitations

The scope of our services consisted of the performance of assessment sampling, verification of release stabilization, regulatory liaison, and preparation of this work plan. All work has been performed in accordance with generally accepted professional environmental consulting practices for oil and gas releases in the Permian Basin in New Mexico.

If there are any questions regarding this report, please contact either Austin Weyant at 575-689-8801 or Shawna Chubbuck at 505-325-7535.

Submitted by:
SOUDER, MILLER & ASSOCIATES

J. Austin Weyant

Austin Weyant
Project Scientist

Reviewed by:

Jennifer Knowlton

Jennifer Knowlton, PE
Senior Engineer II

ATTACHMENTS:

Figures:

Figure 1: Vicinity and Well Head Protection Map
Figure 2: Site and Sample Location Map

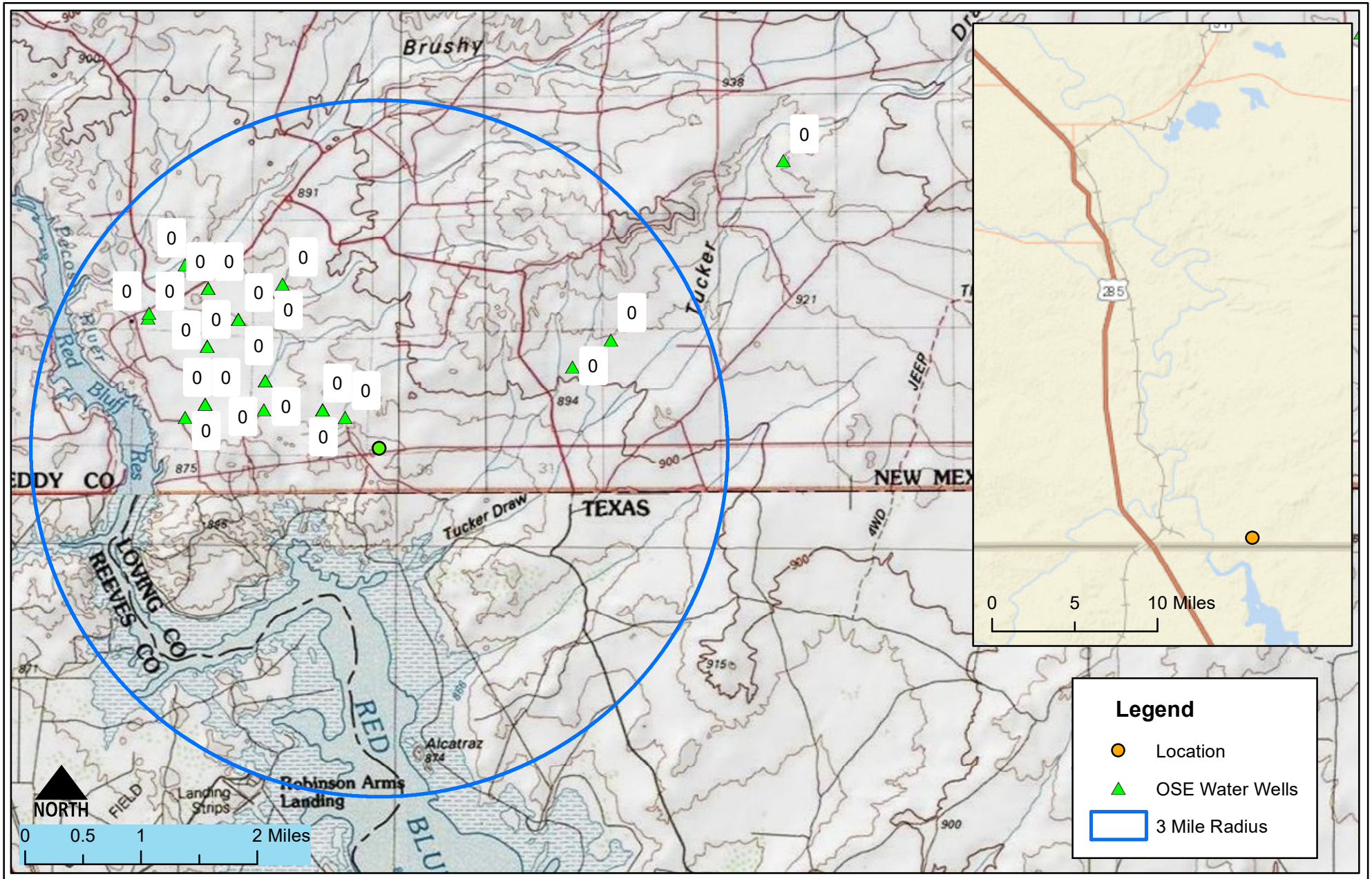
Tables:

Table 3: Summary of Sample Results

Appendices:

Appendix A: Form C141 Initial and Final
Appendix B: NMOSE Wells Report
Appendix C: Laboratory Analytical Reports
Appendix D: Groundwater Impact Risk Model

FIGURE 1
VICINITY AND NMOSE DATA MAP



Vicinity and Well Head Protection Map
Brushy Creek Gathering Station - RKI EXPLORATION & PRODUCTION, LLC
S:22 T26S R25E, New Mexico

Figure 1

Document: C:\Users\lcm.CBO\Documents\GIS DATA\MAPS\Brushy Booster Figure 1.mxd

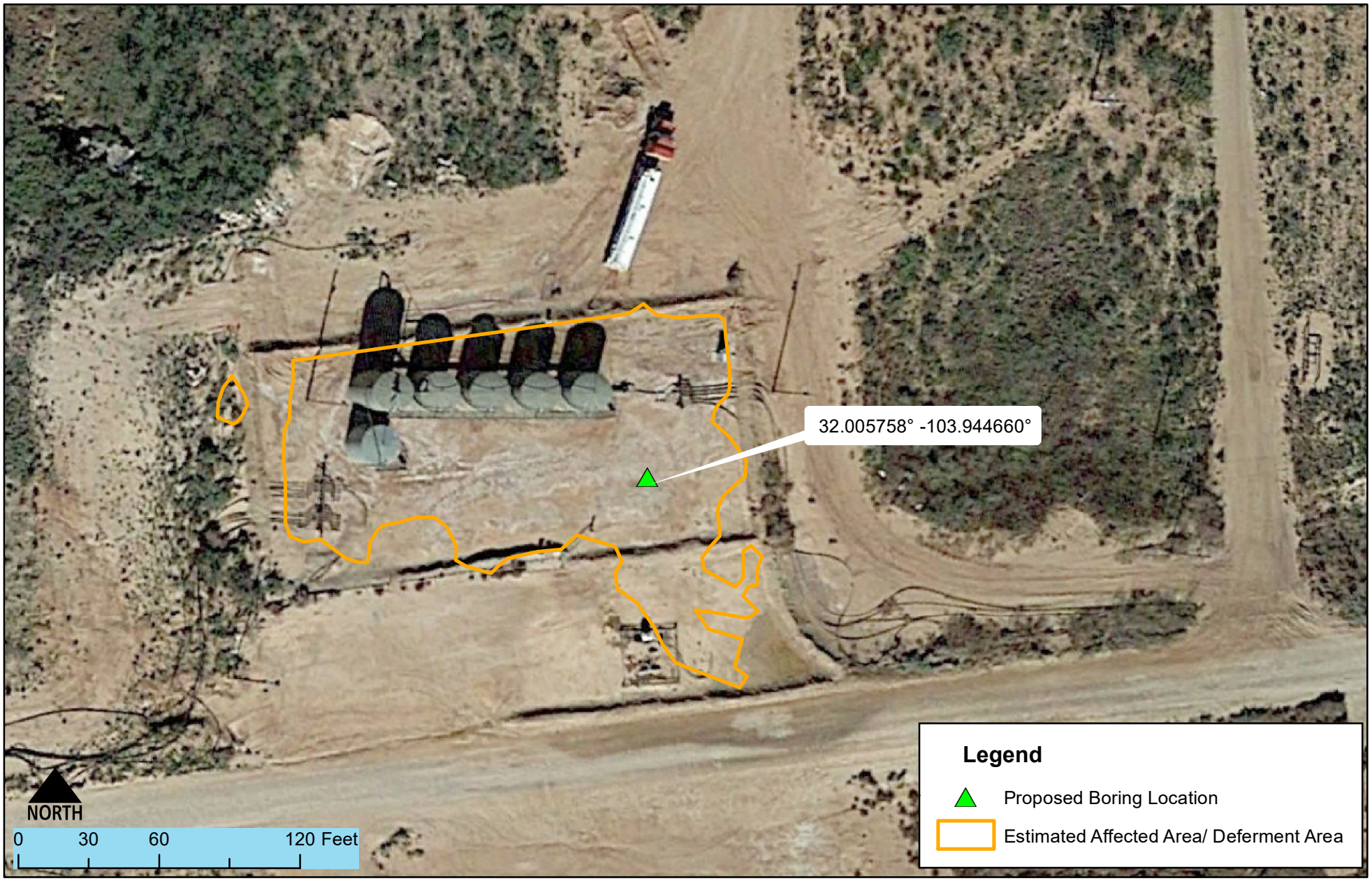
Date Saved: 10/3/2017

Revisions
By: Date: Descr:
By: Date: Descr:

Drawn Lucas Middleton
Checked
Approved

SMA
201 South Halaguena Street
Carlsbad, New Mexico 88221
(575) 689.7040
www.soudermiller.com
Serving the Southwest & Rocky Mountains

FIGURE 2
LOCATION MAP



LOCATION MAP
Brushy Creek Gathering Station
S:25 T26S R29E, New Mexico

Figure 2

Document: C:\Users\lcm.CBO\Documents\GIS DATA\MAPS\Brushy Booster Figure 2.mxd

Date Saved: 10/4/2017

Revisions
By: Date: Descr:
By: Date: Descr:

Drawn Lucas Middleton
Checked
Approved

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Carlsbad, New Mexico 88221
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Serving the Southwest & Rocky Mountains

APPENDIX A
FORM C141 INITIALS

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

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

NM OIL CONSERVATION
ARTESIA DISTRICT
JUL 28 2016
RECEIVED

Form C-141
Revised August 8, 2011
Submit 1 Copy to appropriate District Office in accordance with 19.15.29 NMAC.

Release Notification and Corrective Action

nAB1621453181

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company WPX Energy Inc/RKI 246289	Contact Karolina Blaney
Address 5315 Buena Vista Dr.	Telephone No. 970 589 0743
Facility Name: Brushy Draw Booster Station/Fed UCBHWW 1	Facility Type: Tank Farm

Surface Owner: Federal	Mineral Owner: Federal	API No. 30- 015-24034

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
M	25	26S	29E	660	FSL	660	FWL	Eddy

Latitude: 32.005742 N **Longitude**: -103.944433 W

NATURE OF RELEASE

Type of Release. Produced Water	Volume of Release: 380 Bbls	Volume Recovered: 340 Bbls
Source of Release Pipeline valve located in a valve can	Date and Hour of Occurrence 713/2016	Date and Hour of Discovery 7/13/2016 – 2345 hrs MT
Was Immediate Notice Given? ☐ Yes ☐ No ☒ Not Required	If YES, To Whom? NMOCD Heather Patterson & Michael Bratcher, BLM Shelly Tucker	
By Whom? Karolina Blaney	Date and Hour: 7/14/16– 1645 hrs MT	
Was a Watercourse Reached? ☐ Yes ☒ No	If YES, Volume Impacting the Watercourse. N/A	

If a Watercourse was Impacted, Describe Fully.* N/A

Describe Cause of Problem and Remedial Action Taken.*

The cause of the spill is equipment failure; a poly line running from the tank farm to an injection well ruptured. The compromised section of the line is located outside the SPCC containment but there was enough pressure in the line to spray it into the containment. The vast majority of spilled water was contained inside the dirt containment berm, approximately 5 bbls of produced water was sprayed outside the containment on the access road.

Describe Area Affected and Cleanup Action Taken.*

The impacted area of the access road was scraped and impacted dirt was hauled off to a disposal facility. The access road will be sampled for BTEX and TPH in accordance with NM OCD Guidelines for Remediation of Leaks, Spills, and Releases. The impacted area will also be sampled for chlorides as required by BLM. Further remediation will be based on these results. The total ranking score for this site is 0 and the site will be remediated to levels specified in 0-9 column of the Guidelines document. This spill did impact any undisturbed land/pastures.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD 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 NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD 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.

Signature: Karolina Blaney

Printed Name: Karolina Blaney

Title: Environmental Specialist

E-mail Address: Karolina.blaney@wpxenergy.com

Date: 7/28/2016 Phone: 970-589-0743

OIL CONSERVATION DIVISION

Signed By

Approved by Environmental Specialist:

Approval Date: 7/29/16 Expiration Date: N/A

Conditions of Approval: Attached ☐
Remediation per O.C.D. Rules & Guidelines
SUBMIT REMEDIATION PROPOSAL NO
LATER THAN: 9/29/16

2RP-3811

* Attach Additional Sheets If Necessary

Bratcher, Mike, EMNRD

From: Blaney, Karolina <Karolina.Blaney@wpxenergy.com>
Sent: Thursday, July 28, 2016 6:47 AM
To: Tucker, Shelly; Patterson, Heather, EMNRD; Bratcher, Mike, EMNRD
Subject: RE: WPX - Brushy Draw Tank Farm - C 141
Attachments: Brushy Draw Booster Station - Initial C-141.doc

Good morning,
Attached is the initial C-141 for the Brushy Draw Booster Station.
Please let me know if you have any comments or concerns.
Thank you and have a great day,

Karolina Blaney
Environmental Specialist
WPX Energy
Office: (575) 885-7514
Cell: (970) 589-0743
karolina.blaney@wpxenergy.com

From: Blaney, Karolina
Sent: Thursday, July 14, 2016 4:48 PM
To: 'Tucker, Shelly' <stucker@blm.gov>; 'heather.patterson@state.nm.us' <heather.patterson@state.nm.us>; 'mike.bratcher@state.nm.us' <mike.bratcher@state.nm.us>
Subject: WPX - Brushy Draw Tank Farm - spill notification

Good afternoon,
WPX had a produced water spill last night at the Brushy Draw Tank Farm. The Tank Farm is located south of the FED USBH 1 well, API # 30-015-24034. The legal description is S25, T26S, R29E. Coordinates: 32.0056803, -103.9439288.
The cause of the spill is equipment failure; a poly line running from the tank farm to an injection well ruptured. The compromised section of the line is located outside the SPCC containment but there was enough pressure in the line to spray it into the containment. The vast majority of spilled water was contained inside the dirt containment berm, approximately 5 bbls of produced water was sprayed outside the containment on the access road. The total volume spilled and recovered is unknown as we are adding up the hauling tickets but it is expected to be more than 100 bbls.
I will be submitting the C-141 and NTL-3A (if preferred) in the next 15 days. However, please don't hesitate to call if you have any questions, comments, or concerns.
Thank you and have a great afternoon,

Karolina Blaney
Environmental Specialist
WPX Energy
Office: (575) 885-7514
Cell: (970) 589-0743
karolina.blaney@wpxenergy.com

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

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

Form C-141
Revised August 8, 2011

Submit 1 Copy to appropriate District Office in accordance with 19.15.29 NMAC.

Release Notification and Corrective Action

nAB1504054780 240289

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company RKI E&P, LLC	Contact Taylor Jones
Address 210 Park Ave. – Ste. 900, OKC, OK 73102	Telephone No. 405-996-5782
Facility Name: Brushy Creek Gathering Station	Facility Type : Tank Battery

Surface Owner Federal	Mineral Owner NA	API No. 30-015-24451

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
A	25	26S	29E		660 FSL		1980FWL	Eddy

Latitude: 32.007240348386 **Longitude:** -103.940095327473

NATURE OF RELEASE

Type of Release. Produced Water/Oil	Volume of Release: 1oil/10water Bbls	Volume Recovered: 0oil/10water Bbls
Source of Release Tanks overran	Date and Hour of Occurrence 01/22/15 – prior to 0800hrs MT	Date and Hour of Discovery 01/22/15 – 0800hrs MT
Was Immediate Notice Given? ☐ Yes ☐ No ☒ Not Required	If YES, To Whom? N/A	
By Whom? N/A	Date and Hour N/A	
Was a Watercourse Reached? ☐ Yes ☒ No	If YES, Volume Impacting the Watercourse. N/A	

If a Watercourse was Impacted, Describe Fully.* N/A

NM OIL CONSERVATION
ARTESIA DISTRICT
FEB 05 2015
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Describe Cause of Problem and Remedial Action Taken.*

More water was put into system and trucking company failed to haul sufficient loads away.

Shut in wells and let station pump down. Had vac truck within 1 hour to suck up water out of containment.

Describe Area Affected and Cleanup Action Taken.*

All fluid remained in secondary containment berm, 10/11Bbls spilled were recovered.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD 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 NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD 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.

Signature: Taylor Jones

Printed Name: Taylor Jones

Title: EHS Systems Specialist

E-mail Address: TJones@rkixp.com

Date: 02/05/15 Phone: 405-996-5782

OIL CONSERVATION DIVISION

Approved by Environmental Specialist:

Approval Date: 2/9/15 Expiration Date:

Conditions of Approval: Attached ☐

Remediation per O.C.D. Rules & Guidelines
SUBMIT REMEDIATION PROPOSAL NO LATER THAN: 3/9/15

* Attach Additional Sheets If Necessary

2RP-2796

Patterson, Heather, EMNRD

From: Taylor Jones <TJones@rkixp.com>
Sent: Thursday, February 05, 2015 2:44 PM
To: 'Heather.Patterson@state.nm.us'
Cc: shughes@blm.gov; Zackary Laird
Subject: RKI E&P Spill Notification and C-141
Attachments: NM_BrushyCreekGatheringStation_InitialC141(020515)-signed.pdf

Heather,
Attached please find completed OCD form C-141 for a spill occurring at the RKI operated Brushy Creek Gathering Station in Eddy County, NM. Please feel free to contact myself or a local RKI representative with any questions.
Thank you,

Taylor Jones
RKI Exploration & Production, LLC
210 Park Avenue, Suite 900
Oklahoma City, OK 73102
405-996-5782 (o) | 405.326.0791 (m)
TJones@RKIXP.com

District I
1625 N. French Dr., Hobbs, NM 88240
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811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
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1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources

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

NM OIL CONSERVATION
ARTESIA DISTRICT
JAN 16 2015
RECEIVED

Form C-141
Revised August 8, 2011
Submit 1 Copy to appropriate District Office in accordance with 19.15.29 NMAC.

Release Notification and Corrective Action

nAB1501655607

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company RKI E&P, LLC 246289	Contact Zack Laird
Address 210 Park Ave. – Ste. 900, OKC, OK 73102	Telephone No. 405-742-2696
Facility Name: Brushy Creek Gathering Station	Facility Type : Tank Battery

Surface Owner Federal	Mineral Owner NA	API No. 30-015-24451 (UCBH WW Fed. #3)

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
A	25	26S	29E		660 FSL		1980FWL	Eddy

Latitude: 32.007240348386 **Longitude:** -103.940095327473

NATURE OF RELEASE

Type of Release. Produced Water/Oil	Volume of Release: 10oil/40water Bbls	Volume Recovered: 8oil/35water Bbls
Source of Release Tanks overran due to pump salt-off	Date and Hour of Occurrence 01/07/15 – prior to 0800hrs MT	Date and Hour of Discovery 01/07/15 – 0800hrs MT
Was Immediate Notice Given? ☐ Yes ☒ No ☐ Not Required	If YES, To Whom? N/A	
By Whom? N/A	Date and Hour N/A	
Was a Watercourse Reached? ☐ Yes ☒ No	If YES, Volume Impacting the Watercourse. N/A	

If a Watercourse was Impacted, Describe Fully.* N/A

Describe Cause of Problem and Remedial Action Taken.*

The transfer pump, which moves fluids from gathering battery to SWD well, salted off and tanks ran over. All fluids contained in secondary containment berm.

Wells producing to gathering battery were shut-in, vac trucks recovered free fluid and pump repairs were made. Plan to install high-level alarms/shutdowns on battery.

Describe Area Affected and Cleanup Action Taken.*

All fluid remained in secondary containment berm, 43/50Bbls spilled were recovered.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD 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 NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD 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.

Signature:

Printed Name: Zack Laird

Title: Sr. EHS Manager

E-mail Address: ZLaird@rkixp.com

Date: 01/15/15 Phone: 405-987-2213

OIL CONSERVATION DIVISION

Approved by Environmental Specialist:

Approval Date: 1/16/15 Expiration Date: NA

Conditions of Approval: Attached ☐

Remediation per O.C.D. Rules & Guidelines
SUBMIT REMEDIATION PROPOSAL NO LATER THAN: 2/16/15

2RP-2742

* Attach Additional Sheets If Necessary

Patterson, Heather, EMNRD

From: Zackary Laird <ZLaird@rkixp.com>
Sent: Friday, January 16, 2015 9:05 AM
To: Patterson, Heather, EMNRD
Cc: Hughes, Solomon
Subject: RKI E&P Spill Notification and C-141
Attachments: NM_BrushyCreekGatheringStation_InitialC141(011515).pdf

Heather,
Attached please find completed OCD form C-141 for a spill occurring at the RKI operated Brushy Creek Gathering Station in Eddy County, NM. I used the legals for the RKI operated UCBH WW Federal 003 (API # 30-015-24451) as it is on the same pad as the gathering battery. I apologize for the delayed report.
Please feel free to contact myself or a local RKI representative with any questions.
Kind Regards,

Zack Laird | Sr. EHS Manager
RKI Exploration & Production, LLC
210 Park Avenue, Suite 900 | Oklahoma City, OK 73102
405.987.2213 (o) | 405.742.2696 (m) | ZLaird@rkixp.com

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
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1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources

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

Form C-141
Revised August 8, 2011

Submit 1 Copy to appropriate District Office in accordance with 19.15.29 NMAC.

Release Notification and Corrective Action

nAB1522341042

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company RKI E&P, LLC 246289	Contact Zack Laird
Address 210 Park Ave. – Ste. 900, OKC, OK 73102	Telephone No. 405-987-2213
Facility Name: Brushy Creek Gathering Station	Facility Type : Tank Battery

Surface Owner Federal	Mineral Owner NA	API No. 30-015-24451

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
M	25	26S	29E		660 FSL		660FWL	Eddy

Latitude: 32.0070152 **Longitude:** -103.9444

NATURE OF RELEASE

Type of Release. Produced Water	Volume of Release: 200 Bbls	Volume Recovered: 185 Bbls
Source of Release Tanks overran	Date and Hour of Occurrence 08/10/15 – prior to 0800hrs MT	Date and Hour of Discovery 08/10/15 – 0800hrs MT
Was Immediate Notice Given? ☒ Yes ☐ No ☐ Not Required	If YES, To Whom? Heather Patterson and Shelly Tucker (BLM)	
By Whom? Zack Laird	Date and Hour 08/10/15 – 12p CT	
Was a Watercourse Reached? ☐ Yes ☒ No	If YES, Volume Impacting the Watercourse. N/A	

If a Watercourse was Impacted, Describe Fully.* N/A

Describe Cause of Problem and Remedial Action Taken.*

Water pump tripped and tanks ran over. Alarm was not sent due to faulty modem.

Pump reset and vac trucks dispatched to recover free fluids.

NM OIL CONSERVATION
ARTESIA DISTRICT
AUG 10 2015
RECEIVED

Describe Area Affected and Cleanup Action Taken.*

All fluid remained in secondary containment, 185/200Bbls recovered

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD 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 NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD 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.

Signature:

Printed Name: Zack Laird

Title: Sr. EHS Manager

E-mail Address: Zlaird@rkixp.com

Date: 08/10/15 Phone: 405-987-2213

OIL CONSERVATION DIVISION

Approved by Environmental Specialist:

Approval Date: 8/10/15 Expiration Date: N/A

Conditions of Approval: Attached ☐

Remediation per O.C.D. Rules & Guidelines
SUBMIT REMEDIATION PROPOSAL NO LATER THAN: 9/11/16

2RP-3195

* Attach Additional Sheets If Necessary

Patterson, Heather, EMNRD

From: Zackary Laird <ZLaird@rkixp.com>
Sent: Monday, August 10, 2015 11:07 AM
To: Patterson, Heather, EMNRD
Cc: stucker@blm.gov
Subject: RKI E&P Spill Notification and C-141
Attachments: RKI_BrushyCreekGatheringStation_InitialC141(081015).pdf

Heather,

Per our discussion, please see attached OCD form C-141 for a spill occurring at the RKI operated Brushy Creek Gathering Station in Eddy County, NM (API # 30-015-24451).

Please let me know if you have any questions

Regards,

Zack Laird | Sr. EHS Manager
RKI Exploration & Production, LLC
210 Park Avenue, Suite 900 | Oklahoma City, OK 73102
405.987.2213 (o) | 405.742.2696 (m) | ZLaird@rkixp.com

APPENDIX B
NMOSE WELLS REPORT

New Mexico Office of the State Engineer
Water Column/Average Depth to Water

(A CLW##### in the POD suffix indicates the POD has been replaced & no longer serves a water right file.)

(R=POD has been replaced, O=orphaned, C=the file is closed)

(quarters are 1=NW 2=NE 3=SW 4=SE)
(quarters are smallest to largest) (NAD83 UTM in meters) (In feet)

POD Number	POD Sub-basin Code	County	Q 64	Q 16	Q 4	Sec	Tws	Rng	X	Y	Distance	Depth Well	Depth Water	Water Column
C 02038	C	ED	3	2	4	26	26S	29E	599204	3541992*	642	200		
C 01354 X-3	C	ED	2	1	3	23	26S	29E	598323	3543837	2649	170		
C 03605 POD1	CUB	ED	4	2	3	27	26S	29E	596990	3541983	2724	45	0	45

Average Depth to Water: **0 feet**

Minimum Depth: **0 feet**

Maximum Depth: **0 feet**

Record Count: 3

UTMNAD83 Radius Search (in meters):

Easting (X): 599681.3 **Northing (Y):** 3541562.19 **Radius:** 5000

***UTM location was derived from PLSS - see Help**

APPENDIX C

REPORTS GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION FOR BRUSHY BOOSTER STATION

March 3, 2017

WPX Energy
5315 Buena Vista Drive
Carlsbad, New Mexico 88220

Attention: Karolina Blaney

Re: Geophysical Survey Results and Interpretation for Brushy Booster Station

Ms. Blaney,

WPX Energy (WPX) retained Vertex Resource Services Inc. (Vertex) to conduct electromagnetic (EM) and electrical resistivity tomography (ERT) surveys over a produced water release at the Brushy Booster Station (hereafter referred to as "site"). The site is located along State Line Road near Brushy Draw in New Mexico. Vertex personnel conducted the EM and ERT surveys on January 24 and 26, 2017. This letter reviews the results of the geophysical surveys at the site and discusses the possible origins of any anomalous subsurface electrical conductivity (EC) as it relates to chloride concentrations.

The origin of any geophysical anomaly is usually a combination of several factors. A discussion of factors affecting subsurface EC, such as soil saturation, salinity, soil type, etc., is included in Attachment 1. In an arid environment with alluvium cover, soil saturation and salinity will likely determine EC. A produced water spill will elevate both soil saturation and salinity above background conditions and ultimately increase subsurface EC above background as well. EM and ERT surveys measure subsurface EC and will be used to delineate the aerial and depth extent of elevated subsurface EC. Furthermore, the chloride concentrations from several soil samples were obtained to link chloride concentration to EC measured during the geophysical surveys.

Background

Based on observations made while performing the EM survey, the site is set between two small washes. Surface water flows to the south, and there is an exposed bedrock outcrop northwest of the site. The rock has large fractures that appear to have been opened up by erosion and dissolution. The soil and subsoil is alluvium which, at this site, is composed mostly of sand with small amounts of silt and clay. Salt residue is visible on-site and across State Line Road. The origin of the salt crystals further south is less understood because the area was not identified during the initial spill response and assessment (see the release area in Figure 1 of Attachment 2).

WPX mentioned that caliche (a hardened soil layer cemented together with carbonates) maybe present and is thought to act as an impervious layer that will impede vertical seepage of chlorides. While caliche was not observed outcropping on-site nor was it present in the soil samples acquired on-site, caliche was found in several soil borings 1 mi. southeast of the site in Texas (Texas Water Development Board, 2014). The ERT cross section can be interpreted to show whether the caliche layer prevents migration of produced water impacts at depth.

Electromagnetic Survey

The subsurface conductivity measured with the EM31 instrument is presented on Figure 1 (Attachment 2). In general, EC is elevated throughout the release area; one area of elevated EC (orange/red area) was identified:

1. Anomaly 1 – Main area of elevated EC correlates with the location of the surface within the bermed area. Elevated EC is contained onsite north of State Line Road. Less elevated EC is observed to extend south of State Line Road following the natural drainage direction. The depth of the measured EC within the anomaly ranges from 4 to 10 feet below ground surface (ft. bgs)

Electrical Resistivity Tomography Survey

An ERT survey was proposed to determine the depth to which produced water has impacted the subsurface. The subsurface conductivity measured with the ERT system is presented as a cross section. Cross section A-A' is presented on Figure 2 (Attachment 2). The horizontal axis is the linear distance along the cross section line from A to A' measured in linear feet along line (ft. al). The vertical axis is relative elevation in ft. and is exaggerated by a factor of three over the horizontal axis to clearly show subsurface variations in EC.

1. Cross section A-A' – The first layer of elevated EC is discontinuous and extends from 98 to 220 ft. al (light blue, yellow to red shaded area). This layer is approximately 6 ft. bgs. There is a deeper zone of elevated EC that extends from 75 to 220 ft. al and from -10 ft. to -35 ft. in elevation. This layer correlates laterally with the EM anomaly observed (transition from red to orange shading). The deeper layer is thinner on the edges than in the middle and has a similar shape to the cross section of a creek channel. Elevated EC is not observed below 35 ft. bgs, suggesting that there is an impervious layer such as bedrock that the higher conductivity sediments are resting on top of. Three areas with extremely elevated EC, at 39, 56 and 172 ft. al, are likely due to a grounded metal object and/or subsurface utilities nearby. Metal interferes with the electrical current flow and can cause false anomalies to occur.

Soil Sample Analysis

Two testholes were advanced with a hand auger and soil samples from 6 ft. bgs were submitted to Cardinal Laboratories in Hobbs, New Mexico. The soil samples were analyzed for texture, EC and chloride concentration. The soil samples were ordered to show a correlation between the geophysical results (EC) and chloride concentration, which is diagnostic of impacts from a produced water release. The soil sample analysis is presented in Attachment 3 and laboratory results are presented Attachment 4 (TH17-01 is Brushy Booster North and TH17-02 is Brushy Booster South). The table and graphs in Attachment 3 show that there is a positive correlation between EC measured by laboratory, EC from EM and ERT surveys, and chloride concentration.

Correlation between Electrical Conductivity and Chloride Concentration

Previous soil sampling completed by WPX shows a correlation between EC and chloride concentration. The correlation is not linear in nature. Elevated chloride concentration increases the EC measured by the EM and ERT surveys from background to elevated levels over short distances. Two examples of this non-linear relationship are shown in the sharp boundaries between background and elevated EC in the ERT cross section (Figure 2) and the

quick transition from background to elevated EC in the EM survey (Figure 1) at the margins of Anomaly 1. To quantify the relationship, Attachment 3 presents a table with chloride concentration and EC for all soil samples on-site. Attachment 3 also presents two graphs detailing the non-linear relationship between chloride concentration and the EC measured in both the ERT and EM surveys. Since there were three measurements for each WPX sample location, the average and maximum chloride concentrations were compared to estimate the EC at different chloride concentrations. Both graphs show that EC at low chloride concentration is at or near background levels, and then with increasing chloride concentration, EC rises quickly to the maximum level and remains at this level with ever increasing chloride concentration.

At this site, The New Mexico Oil Conservation Division (NMOCD) has set the preferred cleanup concentration for chlorides to be 1,000 mg/kg (personal communication, Karolina Blaney, 2016), corresponding to EC values of 106 mS/m (transition from light green to yellow shading in Figure 1) for the EM Survey and 208 mS/m for the ERT survey (transition from dark blue to light blue shading in Figure 2). There is some discrepancy between the length of the elevated EC along A-A' and where the 106 mS/m contour crosses the ERT line. To adjust for this discrepancy, a zone of elevated chloride concentration has been identified that includes sample locations north of State Line Road with a chloride concentration exceeding 1,000 mg/kg (Figure 3). A contour level of 190 mS/m crosses A-A' near the extents of elevated EC from the ERT cross section.

Additional Interpretation of Cross Section A-A'

The ERT cross section west of 98 ft. al does not correlate well with the soil samples if we simply conclude that elevated EC equates to elevated chloride concentration. Attachment 3 clearly shows that chloride concentration decreases with depth in the soil, yet the ERT cross section shows that on the western half of the survey EC is at or near background conditions until 11 ft. bgs. This discrepancy is explained by factoring in the extremely low soil moisture content that averages 15% for all soil samples. Subsurface electrical current flow is impeded in the near surface because there are no free disassociated ions to carry the current in the dry soils. The electrical current dives deeper and flows in the more conductive (saturated) layer at 11 ft. bgs. At this site, based on this analysis, there is a zone of highly saturated sediments sitting on top of an impervious layer which is likely the bedrock observed northwest of the site. Also, the bedrock does not appear to be saturated or fractured along A-A'.

Near-surface elevated EC east of 98 ft. al along A to A' is also due to increased soil saturation. The topography slopes to the south and east, and from the aerial photograph, it appears that surface water pools and flows to the southeast portion of the site. Based on this information, the soil is more saturated east of 98 ft. al along A-A' and will therefore have a greater EC compared to drier areas to the west.

The ERT cross section suggests that the near-surface zone of elevated chloride concentration is only 6 ft. thick, but there are soil samples at 7 ft. that exceed 1,000 mg/kg. Since chloride concentration decreases with depth, the depth at which the chloride concentration is below 1,000 mg/kg is calculated to be 10 ft. (Attachment 3).

Conclusions and Recommendations

The EM and ERT surveys identified and delineated a zone of elevated chloride concentration. This zone is contained on-site inside the soil berm. Based on the results of the ERT and EM surveys, the zone encompasses an area of 20,494 ft^2. The volume of soil impacted by the release is estimated to be approximately 7,591 yd^3 at 10 ft. thick.

Additionally, there are areas of visible salt impacts, elevated EC and chloride concentrations that exceed 1,000 mg/kg south of State Line Road around TH17-02. The origin of the off-site salt and elevated chlorides could be from surface water run-off or another unrelated produced water release. An additional ERT cross section in this area would not yield definitive results because there are two or three large metal pipelines buried in this area that would significantly interfere with electric current flow and produce spurious results. To investigate this area further, additional soil sampling is recommended.

Sincerely,

Michael Wallace, PGp
MANAGER OF GEOPHYSICS – ENVIRONMENT

Attachments

Attachment 1. Additional Information
Attachment 2. Figures
Attachment 3. Soil Sample Analysis
Attachment 4. Soil Sample Laboratory Report

References

Texas Water Development Board. (2014). *State of Texas Well Report for Tracking #381144.* Austin, Texas: Texas Water Development Board. http://www2.twdb.texas.gov.

ATTACHMENT 1

ADDITIONAL INFORMATION ON EC, EM and ERT

Factors Affecting Subsurface Electrical Conductivity

Subsurface electrical conductivity (EC) may increase due to a few factors, some natural and others man-made. Subsurface EC will naturally increase where there is increased water saturation, increased clay content, a combination of both, or saturated soils with a higher salt content. Man-made causes of increased EC usually involve the discharge of chemicals or water (salty or brackish water) that will increase saturation and/or the total dissolved solids in the subsurface. Buried metal objects also have high electrical conductivities and will produce anomalies. Some of the anomalies from metal objects are bipolar or tripolar because the magnetic fields generated from a buried metal object can be opposing (cancelling) the primary field from the instrument or enhancing it (adding).

Description of Electromagnetic Instrument and Measurements

An electromagnetic (EM) conductivity survey utilizes Faraday's law of induction to measure soil and subsoil conductivity. A magnetic field is generated at a source coil which induces eddy currents in the earth. These eddy currents will flow through the subsurface and generate their own magnetic fields by Ampere's law. These secondary magnetic fields are measured at another coil separated some distance away from the transmitter. The ratio of the secondary magnetic field received to primary magnetic field is proportional to the subsurface conductivity. Depth of investigation for an EM survey is based on the separation between coils. Typical depths of investigation are 6 to 20 ft. for the EM31 instrument. The following website provides a description of the EM31 and how subsurface electrical conductivity is measured:

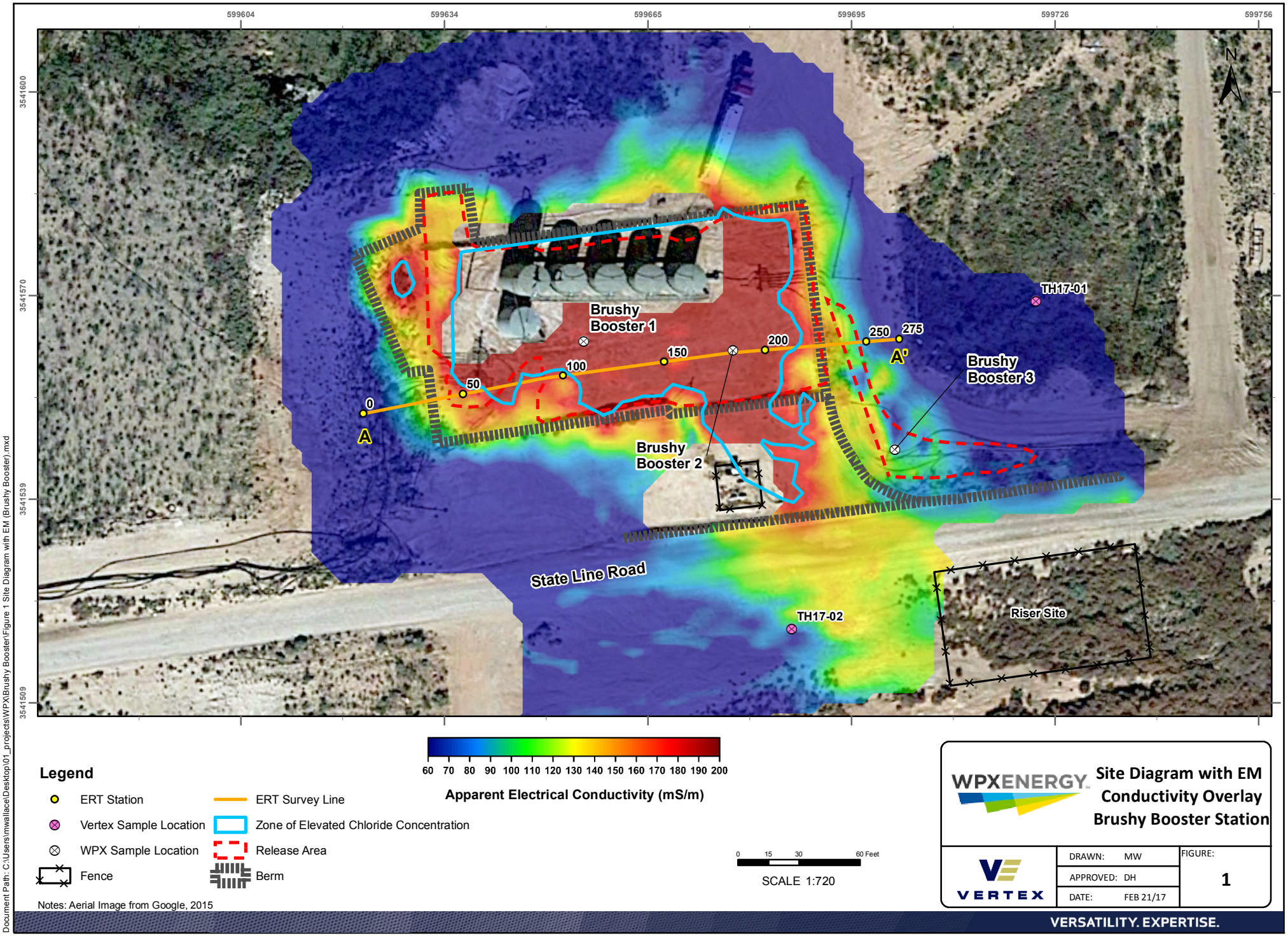
http://www.eos.ubc.ca/ubcgif/iag/foundations/method-summ_files/em31-notes.htm

Description of Electrical Resistivity Tomography

Electrical resistivity tomography (ERT) is a subsurface imaging technique that utilizes direct current and Ohm's Law to measure EC along a 2D plane (cross section) or within a 3D volume. Direct current is injected into the subsurface through two electrodes called the current dipole. Voltage is measured somewhere else on the earth with another dipole. Ohm's Law and the electrode positions are used to calculate the apparent EC. The apparent EC refers to what the EC would be under homogeneous conditions and not accounting for surrounding variation in EC that affects electrical current flow. Typically, a survey is setup along a surveyed line with electrodes (metal stakes pounded into the ground), cables, car battery, and control/measurement unit. The control unit is preprogrammed to energize two electrodes (current dipole) and measure the voltage between another two electrodes (voltage dipole). By switching the electrodes used, the EC is measured along the line at different depths. Typically, hundreds or even thousands of measurements are made to sample EC in the subsurface at high density. After measurements are collected, a modelling methodology called inversion is used to refine the estimate of depth and EC by using the physical equations that describe electrical current flow. After inversion modelling, ERT data is typically presented as a contoured cross section or set of cross sections. Visit the website below for more detail about ERT:

https://archiv.ub.uniheidelberg.de/propylaeumdok/488/1/02_05_ullrich_et_al_resistivity.pdf.

ATTACHMENT 2



WPXENERGY

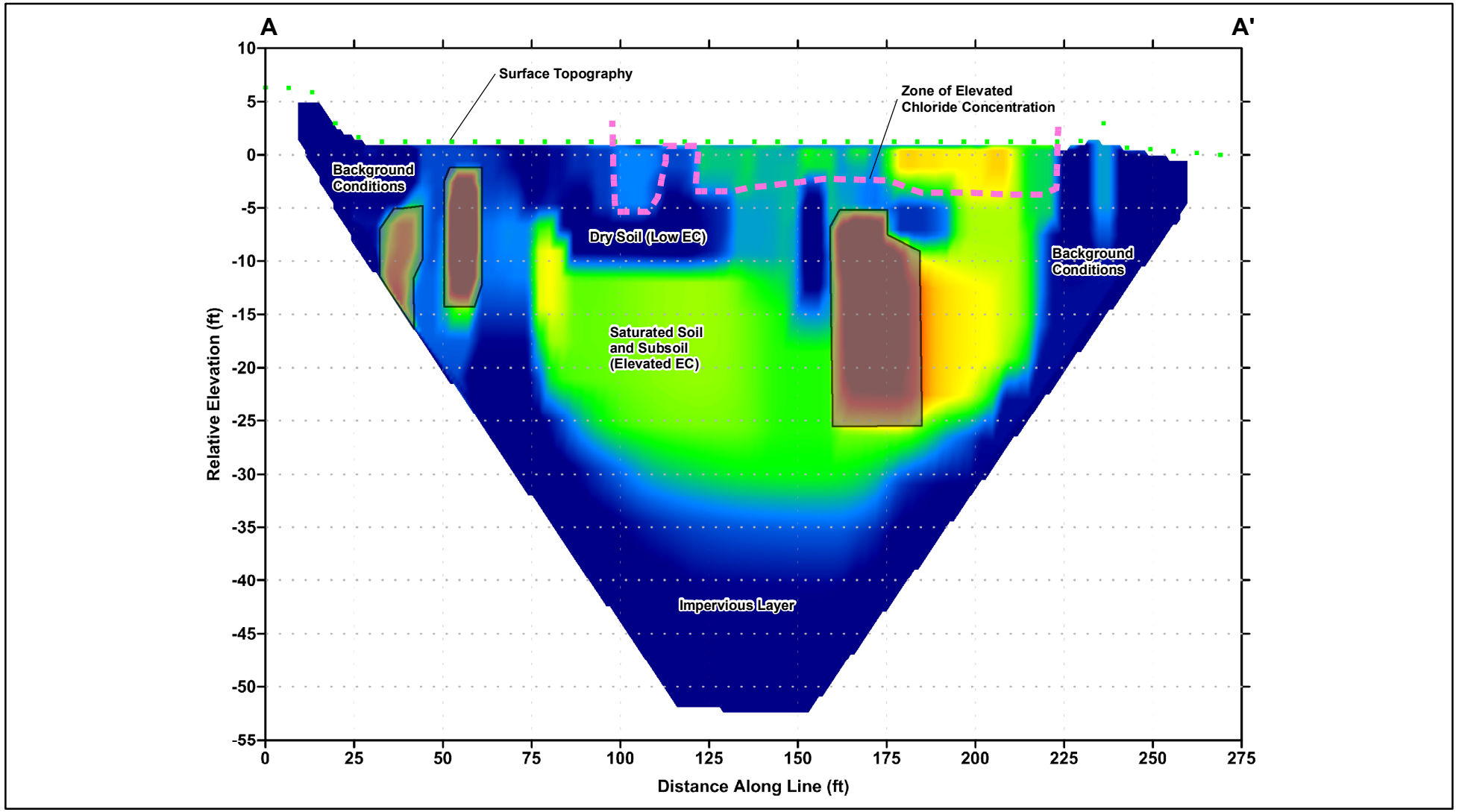
Site Diagram with EM Conductivity Overlay Brushy Booster Station

VERTEX

DRAWN:	MW
APPROVED:	DH
DATE:	FEB 21/17

FIGURE: 1

VERSATILITY. EXPERTISE.



Legend

Interference From Metal

100 200 300 400 500 600 700 800 900 1000

Apparent Electrical Conductivity (mS/m)

Notes: Vertical Exaggeration = 3

WPXENERGY

EC Cross Section A-A'
Brushy Booster Station

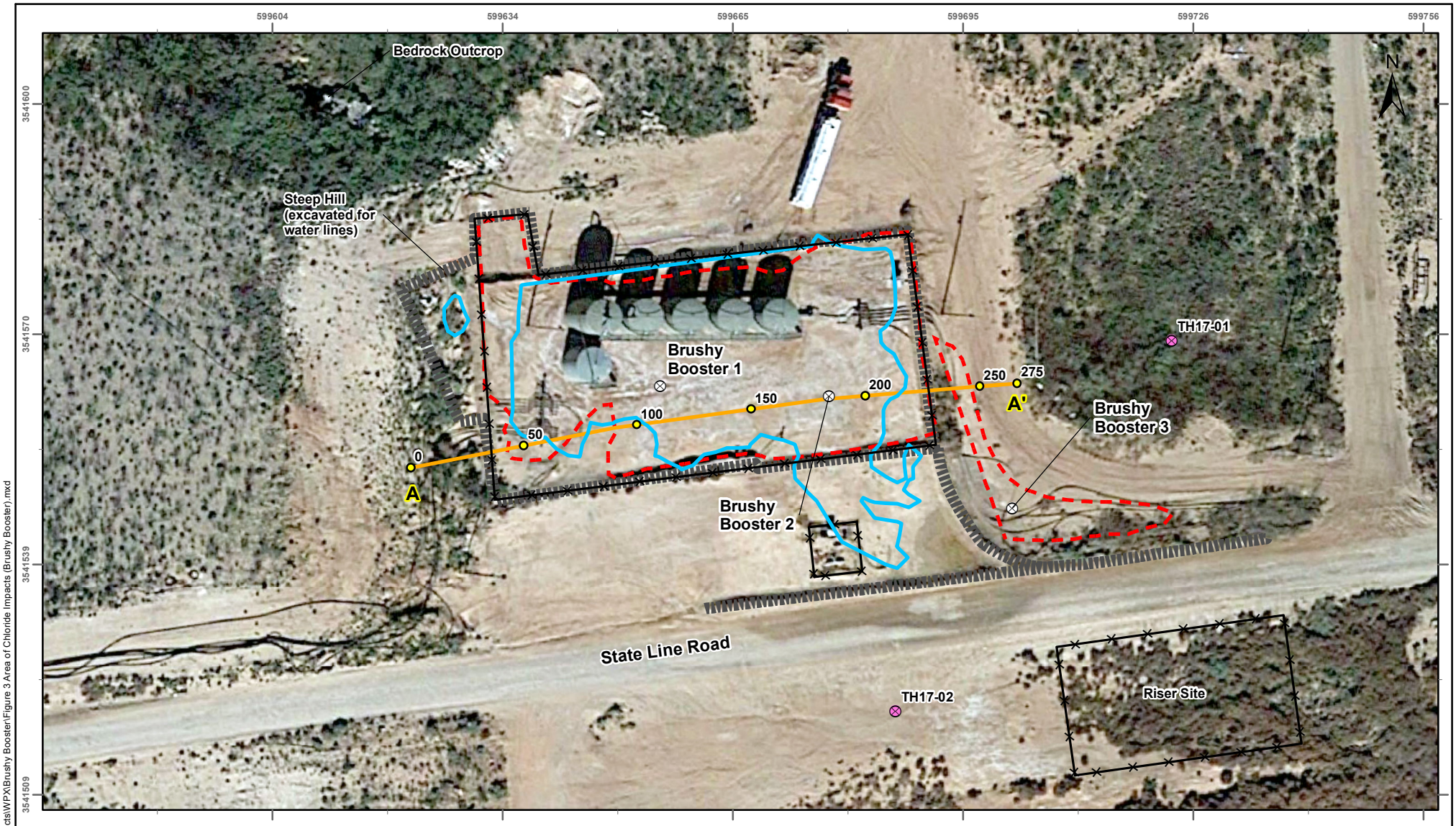
VERTEX

DRAWN:	MW
APPROVED:	DH
DATE:	FEB 21/17

FIGURE: 2

VERSATILITY. EXPERTISE.

Document Path: C:\Users\mwallace\Desktop\01_projects\WPX\Brushy Booster\Figure 2 Cross Section A-A' (Brushy Booster Station).mxd



Legend

- ERT Station
- Vertex Sample Location
- WPX Sample Location
- Fence
- ERT Survey Line
- Zone of Elevated Chloride Concentration
- Release Area
- Berm

0 15 30 60 Feet

SCALE 1:720

Notes:
1. Zone of Elevated Chloride Concentration encompasses an area of 20,494 ft^2
2. Aerial Image from Google, 2015

WPXENERGY

Area of Chloride Impacts Brushy Booster Station

VERTEX

DRAWN:	MW
APPROVED:	DH
DATE:	FEB 21/17

FIGURE: 3

VERSATILITY. EXPERTISE.

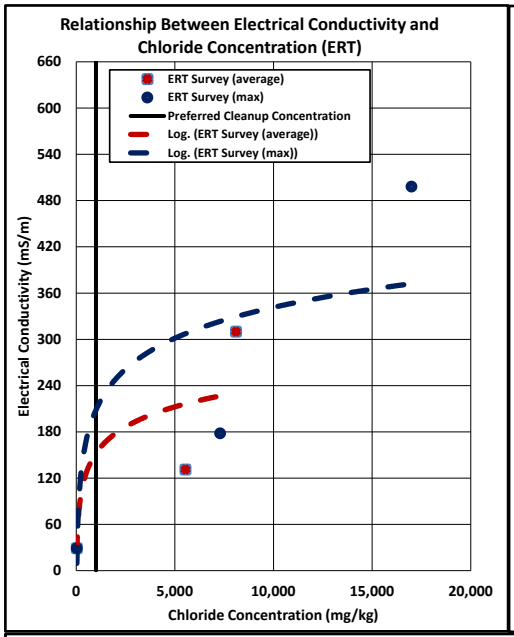
Document Path: C:\Users\mwallace\Desktop\01_projects\WPX\Brushy Booster\Figure 3 Area of Chloride Impacts (Brushy Booster).mxd

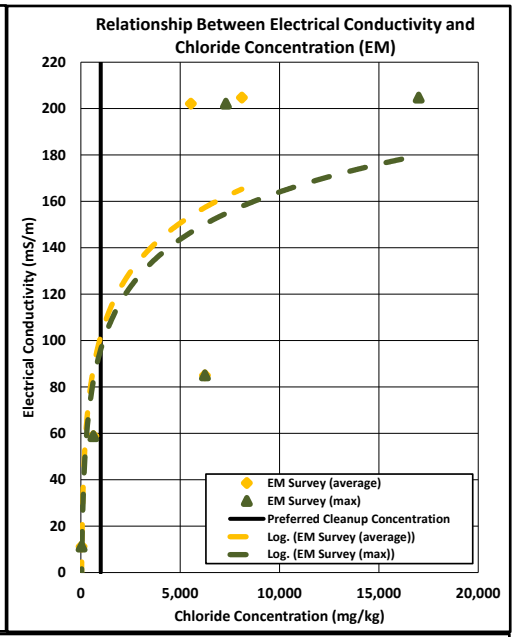
ATTACHMENT 3

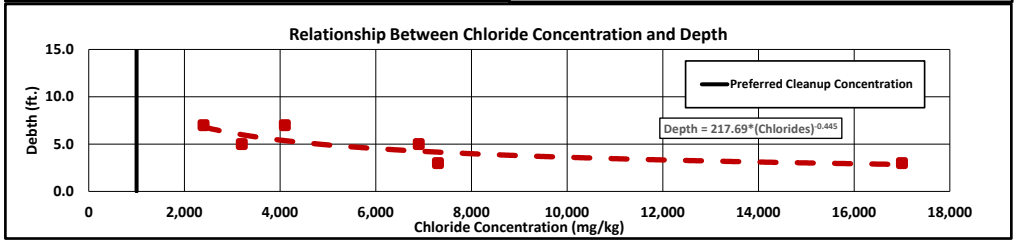
Soil Sample Analysis to Correlate Electrical Conductivity and Chloride Concentration
WPX Energy
Brushy Booster Station
Project #: 17E-00097

Sample Description			Salinity		Soil Properties			Geophysical	
Location	Depth (ft)	Date	Chloride	Electrical Conductivity	Soil Moisture Content	Percent Sand Content	Percent Silt and Clay Content	Electrical Conductivity from Electromagnetic Survey	Electrical Conductivity from Electrical Resistivity Tomography Survey
			(mg/kg)	(mS/m)	(%)	(%)	(%)	(ms/m)	(mS/m)
NMOCD Preferred Cleanup Concentration			1,000	-	-	-	-	-	-
Background									
TH17-01	6.0	January 26, 2017	32	273	-	88.8	11.2	11.573	29
WPX Samples									
Brushy Booster 1	3.0	September 4, 2016	7,300	-	12	-	-	202	178
	5.0	September 4, 2016	6,900	-	12	-	-	202	141
	7.0	November 14, 2016	2,400	-	24	-	-	202	74
Brushy Booster 2	3.0	September 4, 2016	17,000	-	11	-	-	205	498
	5.0	September 4, 2016	3,200	-	9.6	-	-	205	273
	7.0	November 14, 2016	4,100	-	20	-	-	205	159
Brushy Booster 3	0.5	September 4, 2016	630	-	19	-	-	85	-
Vertex Samples									
TH17-02	6.0	January 26, 2017	6,240	22,400	-	41.2	58.8	80	-

NMOCD Preferred Cleanup Concentration - Personal communication, Karolina Blaney, 2016
" - " - No standard/not analyzed
Shading indicates values (excluding those in background samples) exceeding comparative guidelines
Average refers to the average chloride concentration at a location
Max refers to the maximum recorded chloride concentration at a location







VERTEX

ATTACHMENT 4

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

February 08, 2017

NATHAN CHANCLER

VERTEX RESOURCE GROUP

420 SOUTH MAIN, SUITE 202

TULSA, OK 74103

RE: SOIL SAMPLES

Enclosed are the results of analyses for samples received by the laboratory on 01/27/17 5:56.

Cardinal Laboratories is accredited through Texas NELAP under certificate number T104704398-16-8. Accreditation applies to drinking water, non-potable water and solid and chemical materials. All accredited analytes are denoted by an asterisk (*). For a complete list of accredited analytes and matrices visit the TCEQ website at www.tceq.texas.gov/field/qa/lab_accred_certif.html.

Cardinal Laboratories is accreditated through the State of Colorado Department of Public Health and Environment for:

Method EPA 552.2	Total Haloacetic Acids (HAA-5)
Method EPA 524.2	Total Trihalomethanes (TTHM)
Method EPA 524.4	Regulated VOCs (V1, V2, V3)

Cardinal Laboratories is accredited through the State of New Mexico Environment Department for:

Method SM 9223-B	Total Coliform and E. coli (Colilert MMO-MUG)
Method EPA 524.2	Regulated VOCs and Total Trihalomethanes (TTHM)
Method EPA 552.2	Total Haloacetic Acids (HAA-5)

Accreditation applies to public drinking water matrices for State of Colorado and New Mexico.

This report meets NELAP requirements and is made up of a cover page, analytical results, and a copy of the original chain-of-custody. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Celey D. Keene

Celey D. Keene

Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Analytical Results For:

VERTEX RESOURCE GROUP 420 SOUTH MAIN, SUITE 202 TULSA OK, 74103	Project: SOIL SAMPLES Project Number: NONE GIVEN Project Manager: NATHAN CHANCLER Fax To: NA	Reported: 08-Feb-17 13:54

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BRUSHY PIPELINE - SOUTH	H700206-01	Soil	25-Jan-17 13:00	27-Jan-17 05:56
BRUSHY PIPELINE - NORTH	H700206-02	Soil	25-Jan-17 13:30	27-Jan-17 05:56
BRUSHY BOOSTER - SOUTH	H700206-03	Soil	26-Jan-17 09:30	27-Jan-17 05:56
BRUSHY BOOSTER - NW	H700206-04	Soil	26-Jan-17 10:00	27-Jan-17 05:56

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Analytical Results For:

VERTEX RESOURCE GROUP 420 SOUTH MAIN, SUITE 202 TULSA OK, 74103	Project: SOIL SAMPLES Project Number: NONE GIVEN Project Manager: NATHAN CHANCLER Fax To: NA	Reported: 08-Feb-17 13:54

BRUSHY PIPELINE - SOUTH

H700206-01 (Soil)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
Cardinal Laboratories										
Inorganic Compounds										
Chloride	<16.0		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	**2300**		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	
Green Analytical Laboratories										
Texture Classification 6Hr										
Textural Class	L			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	**43.8**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	**12.5**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	**43.8**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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Analytical Results For:

VERTEX RESOURCE GROUP 420 SOUTH MAIN, SUITE 202 TULSA OK, 74103	Project: SOIL SAMPLES Project Number: NONE GIVEN Project Manager: NATHAN CHANCLER Fax To: NA	Reported: 08-Feb-17 13:54

BRUSHY PIPELINE - NORTH

H700206-02 (Soil)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
Cardinal Laboratories										
Inorganic Compounds										
Chloride	<16.0		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	**2370**		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	
Green Analytical Laboratories										
Texture Classification 6Hr										
Textural Class	L			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	**48.8**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	**8.80**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	**42.5**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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Analytical Results For:

VERTEX RESOURCE GROUP 420 SOUTH MAIN, SUITE 202 TULSA OK, 74103	Project: SOIL SAMPLES Project Number: NONE GIVEN Project Manager: NATHAN CHANCLER Fax To: NA	Reported: 08-Feb-17 13:54

BRUSHY BOOSTER - SOUTH

H700206-03 (Soil)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
Cardinal Laboratories										
Inorganic Compounds										
Chloride	**6240**		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	**22400**		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	
Green Analytical Laboratories										
Texture Classification 6Hr										
Textural Class	L			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	**41.3**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	**18.8**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	**40.0**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

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Analytical Results For:

VERTEX RESOURCE GROUP 420 SOUTH MAIN, SUITE 202 TULSA OK, 74103	Project: SOIL SAMPLES Project Number: NONE GIVEN Project Manager: NATHAN CHANCLER Fax To: NA	Reported: 08-Feb-17 13:54

BRUSHY BOOSTER - NW

H700206-04 (Soil)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Notes
Cardinal Laboratories										
Inorganic Compounds										
Chloride	**32.0**		16.0	mg/kg	4	7013110	HM	01-Feb-17	4500-Cl-B	
Conductivity*	**273**		1.00	uS/cm	1	7013102	AC	31-Jan-17	120.1	
Green Analytical Laboratories										
Texture Classification 6Hr										
Textural Class	LS			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Sand, Percent	**88.8**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Clay, Percent	**10.0**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	
Silt, Percent	**1.30**			%	1	B702044	BDV	07-Feb-17	Hydrometer, Modified Bouyoucos	

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Analytical Results For:

VERTEX RESOURCE GROUP 420 SOUTH MAIN, SUITE 202 TULSA OK, 74103	Project: SOIL SAMPLES Project Number: NONE GIVEN Project Manager: NATHAN CHANCLER Fax To: NA	Reported: 08-Feb-17 13:54

Inorganic Compounds - Quality Control

Cardinal Laboratories

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 7013102 - General Prep - Wet Chem										
LCS (7013102-BS1)				Prepared & Analyzed: 31-Jan-17						
Conductivity	488		uS/cm	500		97.6	80-120			
Duplicate (7013102-DUP1)	**Source: H700206-01**			Prepared & Analyzed: 31-Jan-17						
Conductivity	2270	1.00	uS/cm		2300			0.963	20	
Batch 7013110 - 1:4 DI Water										
Blank (7013110-BLK1)				Prepared: 31-Jan-17 Analyzed: 01-Feb-17						
Chloride	ND	16.0	mg/kg							
LCS (7013110-BS1)				Prepared: 31-Jan-17 Analyzed: 01-Feb-17						
Chloride	432	16.0	mg/kg	400		108	80-120			
LCS Dup (7013110-BSD1)				Prepared: 31-Jan-17 Analyzed: 01-Feb-17						
Chloride	432	16.0	mg/kg	400		108	80-120	0.00	20	

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

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VERTEX RESOURCE GROUP 420 SOUTH MAIN, SUITE 202 TULSA OK, 74103	Project: SOIL SAMPLES Project Number: NONE GIVEN Project Manager: NATHAN CHANCLER Fax To: NA	Reported: 08-Feb-17 13:54

Texture Classification 6Hr - Quality Control

Green Analytical Laboratories

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B702044 - General Prep - Wet Chem										
Duplicate (B702044-DUP1)		**Source: H700206-02**		Prepared & Analyzed: 07-Feb-17						
Sand, Percent	48.8		%		48.8			0.00	20	
Clay, Percent	8.80		%		8.80			0.00	20	
Silt, Percent	42.5		%		42.5			0.00	20	

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Notes and Definitions

Texta	LS
Text	L
ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference
**	Samples not received at proper temperature of 6°C or below.
***	Insufficient time to reach temperature.
-	Chloride by SM4500Cl-B does not require samples be received at or below 6°C
	Samples reported on an as received basis (wet) unless otherwise noted on report

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

101 East Marland, Hobbs, NM 88240
(575) 393-2326 FAX (575) 393-2476

Company Name:	Vortex Resource Services	**BILL TO** P.O. #:	
Project Manager:	Nathan Chandler	Company:	
Address:		Attn:	
City:	State: Zip:	Address:	
Phone #:	Fax #:	City:	
Project #:	Project Owner:	State: Zip:	
Project Name:		Phone #:	
Project Location:		Fax #:	
Sampler Name:			

ANALYSIS REQUEST

FOR LAB USE ONLY Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP.	# CONTAINERS	MATRIX: GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER :	PRESERV.: ACID/BASE:	ICE / COOL	OTHER :	SAMPLING: DATE	TIME	BTEX	Chloride	Texture
H700206																	
1	Brushy Pipeline-S	G	1			1							1/25	1300	X	X	X
2	Brushy Pipeline-N	G	1			1							1/25	1330	X	X	X
3	Brushy Booster-S	G	1			1							1/26	0930	X	X	X
4	Brushy Booster-NW	G	1			1							1/26	1000	X	X	X

Relinquished By:	Date: 1/27/17	Received By:	
	Time: 5:56		
Relinquished By:	Date:	Received By:	
	Time:		

Delivered By: (Circle One)
Sampler - UPS - Bus - Other: 1.1°C

Sample Condition: Cool: ☑ Yes ☐ No; Intact: ☑ Yes ☐ No

CHECKED BY: (Initials) CH #75

Phone Result:	☐ Yes	☐ No	Add'l Phone #:
Fax Result:	☐ Yes	☐ No	Add'l Fax #:
REMARKS:			

† Cardinal cannot accept verbal changes. Please fax written changes to (575) 393-2326

APPENDIX D

GROUNDWATER IMPACT RISK MODEL

AMIGO

New File | Choose File | No file chosen | Save | Quick Start | Manual | AMIGO

Units

Metric (m) / English (inches)

Climate

Arid Hot (NM/W.Texas, Hobbs)

Input for a Distant Well

Distance to Well	1000	[ft]
Source Width	10	[ft]
Longitudinal Dispersivity	10	[-]
Transverse Dispersivity	1	[-]

Groundwater Characterictics

Background Cl Concentration in Aquifer	cGW =	447	[mg/L]
Aquifer porosity	n =	0.3	[-]
Groundwater Table Depth	D =	100	[ft]
Aquifer Thickness	H =	20	[ft]
Slope of Water Table	i =	0.02	[-]
Hydraulic Conductivity	Ks =	3.28	[ft/d]
Groundwater Flux	Q =	1.31	[ft2/d]

Source Characteristics

Chloride Load: M = 9.59 [kg/m2]

Max. length of the spill in direction of GW flow: L = 180 [ft]

Plant Uptake Trigger

1% Input Concentration

10% Input Concentration

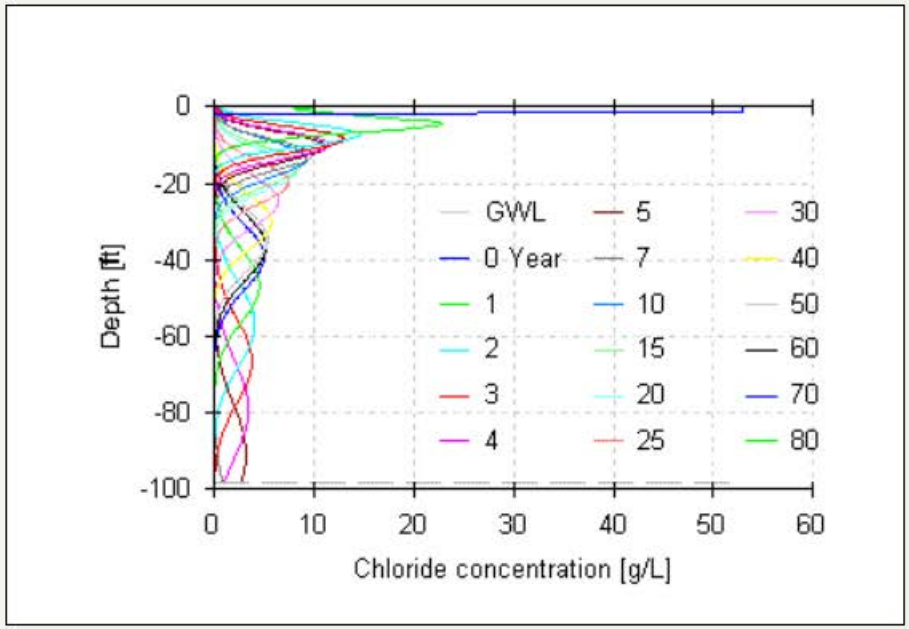
Soil Profiles

Surface Layer: Medium Sand

Soil Profile: P9 - Sandy Clay (30)

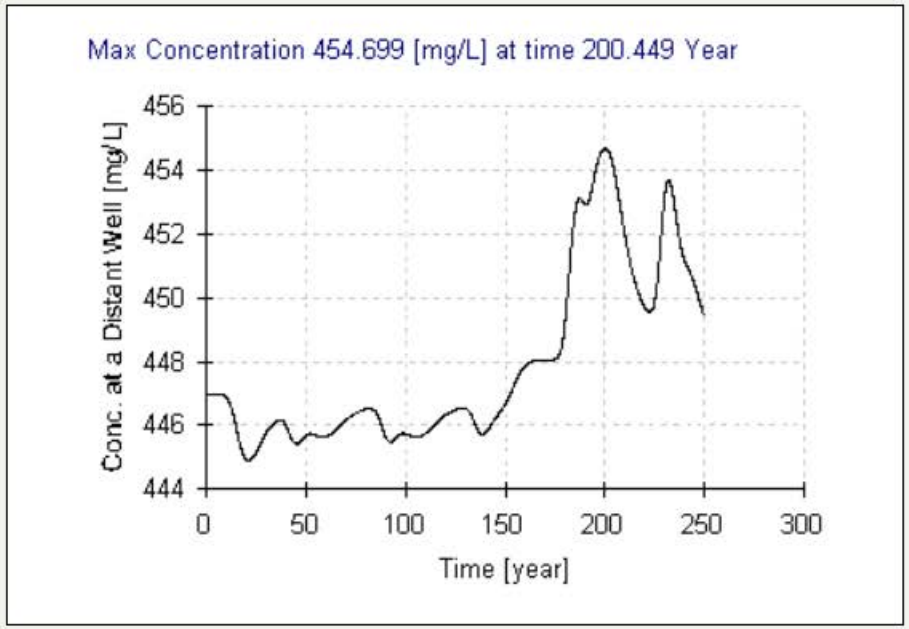
Output Charts

Quantity 1: Chloride concentration [g/L]



Reduce | Display All | Legend | Export | Export All

Quantity 2: Conc. at a Distant Well [mg/L]



Refresh | Auto-Refresh | Export | Export All