NM1-63

Permit Application Vol 3

Part 3 of 8

10/12/16

APPLICATION FOR PERMIT
OWL LANDFILL SERVICES, LLC

VOLUME III: ENGINEERING DESIGN AND CALCULATIONS
SECTION 1: ENGINEERING DESIGN

ATTACHMENT III.1.J

COMPUTER AIDED EARTHMOVING SYSTEM

Computer Aided Earthmoving System

CAES for Landfills

Landfill Compactors
Track-Type Tractors
Wheel Tractor Scrapers
Motor Graders

System Components	
Communications Radio	TC900B
GPS Antenna	L1/L2
GPS Receiver	MS840
In-Cab Display	CAES Touch Screen Display
CAESoffice™/METSmanager	

Computer Aided Earthmoving System for Landfills

Advanced GPS technologies for earthmoving equipment improve machine efficiency, maximize air space utilization, and extend landfill life.

Caterpillar is helping customers revolutionize the way they compact trash, grade slopes and manage their operation with new technology solutions for landfills. Solutions that provide greater accuracy, higher productivity, lower operating costs, more profitability and longer landfill life.

The Computer Aided Earthmoving System (CAES) is a high technology earthmoving tool that allows machine operators to achieve maximum landfill compaction, desired grade/slope, and conserve and ensure even distribution of valuable cover soil with increased accuracy without the use of traditional survey stakes and crews. Using global positioning system (GPS) technology, machine-mounted components, a radio network, and office management software, this state-of-the-art machine control system delivers real-time elevation, compaction and grade control information to machine operators on an in-cab display. By monitoring grade and compaction progress, operators have the information they need to maximize the efficiency of the machine, resulting in proper drainage and optimum airspace utilization.

This advanced technology tool also aids in the identification of site-specific storage areas for hazardous, medical, industrial, and organic waste requiring special handling and placement records.

Applications

CAES is an ideal tool for landfill planning, engineering, surveying, grade control, and production monitoring applications in dump areas. CAES is specifically designed for use on landfill compactors, track-type tractors, wheel tractor scrapers, and motor graders.

On-Board Components

- CAES Touch Screen Display
- GPS Receiver
- GPS Antenna (L1/L2)
- Communications Radio

Off-Board Components

- GPS Reference Station
- Radio Network
- CAESoffice/METSmanager

Operation

CAES uses GPS technology, a wireless radio communications network, and office software to map landfills, create site plans, locate a machine's position, and track compaction and earthmoving progress with complete accuracy.

The receiver uses signals from GPS satellites to determine precise machine positioning. Two receivers are used to capture and collect satellite data – one located at a stationary spot on the landfill site, and another located on the machine. Signals from the ground-based reference station and on-board computer are used to remove errors in satellite measurements for centimeter accuracy.

The CAES-enabled machine is driven over the site to create a digital terrain design file. Using the radio network and office software, landfill terrain data is transmitted from the machine to the landfill office. Landfill managers can then send the work plan from the office to the in-cab display to show operators the work to be done.

The in-cab display provides the operator with an overhead and cross-sectional three-dimensional surface view of the color-coded work plan and precise machine location. The software continuously updates terrain and machine position information as the machine traverses the site.

CAES gives the operator the ability to control grade by monitoring progress on the in-cab display, which shows a graphical representation of lift thickness and compaction density. Cut/fill numbers are displayed in real-time as the machine moves across the site, which allows the operator to know precise elevation, material spread, compaction passes, and required cut or fill at any point on the job.

The *compactor* display shows colored grids representing the number of compaction passes the machine has made across each area. As the compactor wheel travels over an area, the screen changes color to acknowledge the pass. Green areas indicate when optimum compaction has been reached. The system also monitors thick lift information and visually displays when a lift exceeds maximum site parameters.

In *tractor, scraper and motor grader* applications, the color display graphically shows the operator cut, fill, and grade work to be done according to plan. As the machine works, the screen changes color. Green indicates when the operator has achieved plan grade.

By providing immediate feedback on the accuracy of each pass, CAES operators have the information and confidence they need to work more efficiently, productively and profitably.

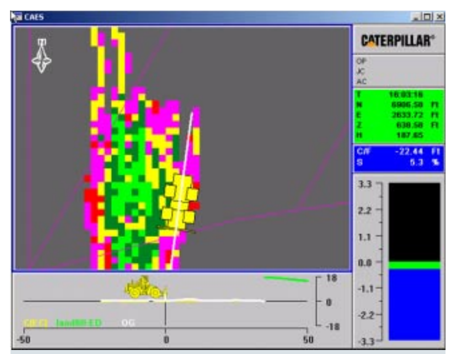
On-Board Components

Communications Radio. The rugged radio, mounted on the roof of the machine, is used for transmitting, repeating and receiving real-time data from GPS receivers. The radio broadcasts real-time, high-precision data for GPS applications. Under normal conditions, the 900 MHz radio broadcasts data up to 10 km (6.2 miles) line-of-sight. Coverage can be enhanced with a network of repeaters, which allows coverage over a broader area. Optimized for GPS with increased sensitivity and jamming immunity, the radio features error correction and high-speed data transfer, ensuring optimum performance. A 450 MHz radio solution is also available.

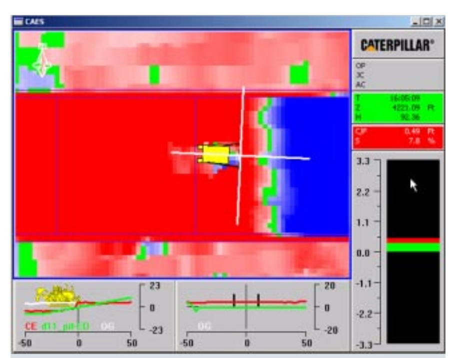
GPS Antenna (L1/L2). The dual frequency external antenna, mounted on the roof of the machine and reference station, is used to pick up the signals from the GPS satellites to determine the machine's position for high precision, real-time machine guidance and control. A low-noise amplifier provides sensitive performance in demanding applications. The compact, low profile design and sealed housing ensure reliable performance in harsh weather conditions.

GPS Receiver. The dual frequency real-time kinematic (RTK) GPS receiver is used to send and receive data simultaneously across the radio network. The system computes differential corrections for real-time positioning with centimeter accuracies, to ensure precise machine guidance and control.

CAES Touch Screen Display. The in-cab graphical display provides real-time operating information to the operator. Designed for simple operation, the 264 mm (10.4 in) custom configurable, integrated touch screen display allows operators to easily interface with the CAES system. The display utilizes the latest infrared touch and transflective backlight technology for superior viewing in bright light conditions and a broad-range dimmable backlight for viewing in low light conditions. Designed for reliable performance in extreme operating conditions, the unit is guarded against shock and sealed to keep out dust and moisture.



Compactor Screen



Dozer Screen

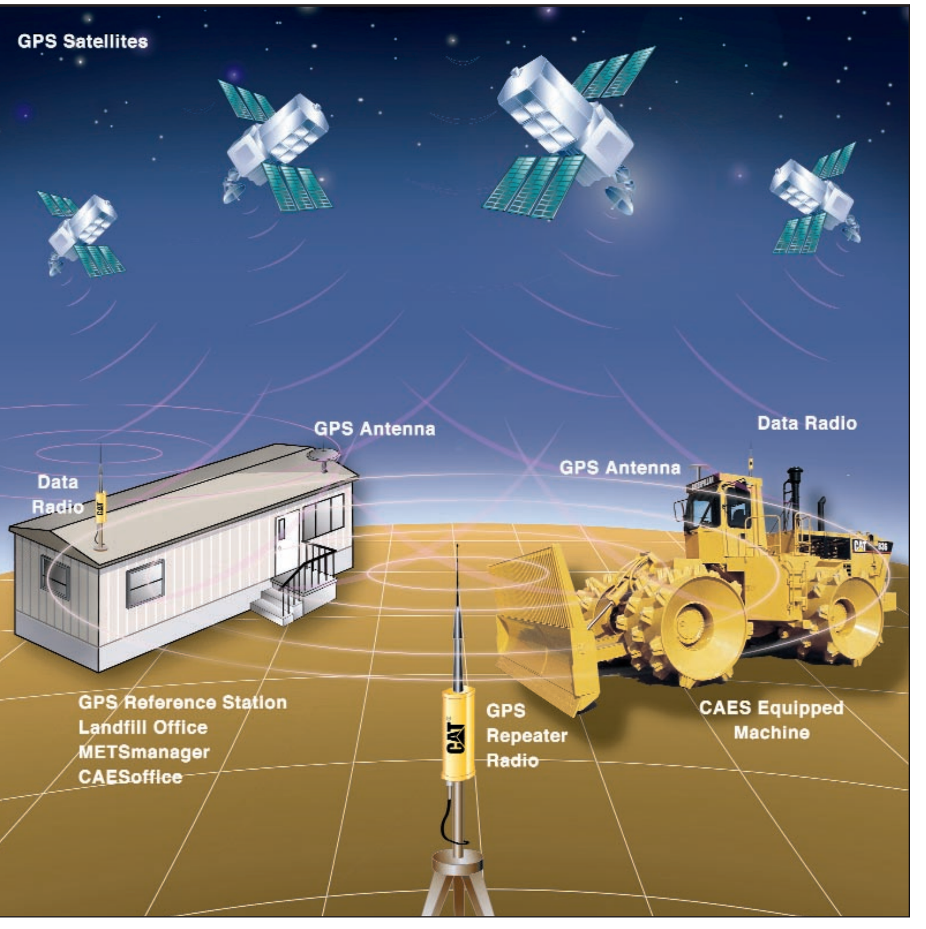
Off-Board Components

GPS Technology. Global Positioning System (GPS) technology uses 24+ satellites that orbit above the earth and constantly transmit their positions, identities and times of signal broadcasts to earth-based satellite sensors. The GPS receiver is an electronic box, which measures the distance to each visible satellite from an antenna on the ground. Through trilateralization, the receiver determines where the satellite is in respect to the center of the earth. The GPS receiver uses its own position and GPS satellite positions to calculate errors and corrections for computing exact location and precise positioning with centimeter accuracy.

GPS Reference Station. A GPS reference station is used to achieve the centimeter level accuracy needed in a landfill application. The reference station sends GPS information over a radio link to the GPS receiver on the CAES-enabled machine. The receiver combines the information with its own observations to compute precise positioning.

Radio Network. The radio network for CAES has two channels. GPS correction data is transmitted over one channel, while the other channel is used to send site planning and production data to the machine and from the machine back to the site office. By utilizing the same radio as a repeater the range can be extended to provide seamless coverage around local obstacles such as hills or large buildings. Up to four radio repeaters may be used to provide extended coverage.

Landfill Planning Software. Site planning and surveying begins with the landfill planning software. CAES is compatible with most third party CAD planning software packages. Data formats used between the CAES software and the planning software are industry standard .DXF and ASCII.



CAESoffice™. The powerful Caterpillar-designed CAESoffice software enables landfill management to monitor CAES-equipped machines and work progress throughout the site in near real-time. The data is stored in a database format for easy customized access, reporting and editing.

METSmanager. This software package allows for integration of the landfill planning system and the machine. It provides the user interface for CAES and controls all communications over the wireless radio network. METSmanager reads design files in standard .DXF formats, converts them to CAES format (.CAT), and sends the design files to the on-board display on the machine over the radio network. This program continually updates the site model by regularly requesting data transmissions from the machine to the office.

- **File Window.** Displays design files (.DXF) created using the site planning package, and holds application configuration files for GPS receivers and files converted from .DXF to the CAES on-board software format (.CAT).
- **Machines Window.** Shows icons of each machine equipped with CAES on-board software. Allows multiple machines to be monitored at the same time.
- **Messages Window.** Contains a list of recent error, warning, confirmation, or information messages generated by METSmanager.
- **Communications Queue Window.** Lists all file transmissions scheduled to occur over the radio network and displays transmission status for all files.

Specifications

TC900B Communications Radio
- Technology: Spread spectrum
- Modes: Base, repeater, rover
- Optimal Range: 10 km (6 miles), line-of-sight
- Typical Range: 3-5 km (2-3 miles) varies w/terrain and operating conditions. Repeaters may be used to extend range
- Frequency Range: 902-928 MHz
- Networks: Ten, user selectable
- Transmit Power: Meets FCC requirements, 1 watt max.
- License Free (U.S. and Canada)
- Wireless Data Rates: 128 Kbps[2]
- Operating Temperature: –40° C to 70° C (–40° F to 158° F)
- Storage Temperature: –40° C to 85° C (–40° F to 185° F)
- Humidity: 100%
- Sealing: Exceeds MIL-STD-810E, sealed to ±34.5 kPa (±5 psi), immersible to 1 m (39 in)
- Vibration: 8 gRMS, 20-2000 Hz
- Operational Shock: ±40 g, 10 msec
- Survival Shock: ±75 g, 6 msec
- Electrical Input: 10.5 to 20V DC
- Nominal Current: 250 mA (3 W)1
- Transmit Current: 1000 mA (12 W)1
- Protection: Reverse polarity
- Control Interface: SAE J1939 CAN
- Emissions and Susceptibility: CE compliant, exceeds ISO 13766
- Input Connector: 8-pin
- Network Connector: 8-pin
- Height: 250 mm (10 in)
- Width: 85 mm (3.4 in)
- Weight: 0.9 kg (2.0 lb)

Radios outside of U.S. and Canada operate on different frequencies. Please contact your Cat Dealer for specifics.

L1/L2 GPS Antenna
- Operating Temperature: –40° C to 70° C (–40° F to 158° F)
- Storage Temperature: –55° C to 85° C (–67° F to 185° F)
- Height: 151mm (6 in)
- Width: 330 mm (13 in)
- Depth: 72 mm (2.8 in)
- Weight: 1.695 kg (3.8 lb)

MS840 GPS Receiver
- Tracking: 9 channels L1 C/A code, L1/L2 full cycle carrier, fully operational during P-code encryption
- Signal Processing: Supertrak multibit technology, Everest multipath suppression
- Positioning Mode –
- Synchronized RTK: 1 cm + 2 ppm horizontal accuracy/2 cm + 2 ppm vertical accuracy, 300 ms latency, 5 Hz std. maximum rate
- Low Latency: 2 cm + 2 ppm horizontal accuracy/3 cm + 2 ppm vertical accuracy, <20 ms latency, 20 Hz maximum rate
- DPGS: <1m accuracy, <20 ms latency, 20 Hz maximum rate
- Range: Up to 20 km from base for RTK
- Communication: 3x RS-232 ports, baud rates up to 115,200
- Control Interface: SAE J1939 CAN
- Configuration: RS-232 Serial connection
- Operating Temperature: –20° C to 60° C (–4° F to 140° F)
- Storage Temperature: –30° C to 80° C (–22° F to 176° F)
- Humidity: 100%
- Operational Vibration: 3 gRMS
- Survival Vibration: 6.2 gRMS
- Operational Shock: ±40 g
- Survival Shock: ±75 g
- Electrical Input: 12/24V DC, 9 watts
- Height: 5.1 cm (2.0 in)
- Width: 14.5 cm (5.7 in)
- Depth: 23.9 cm (9.4 in)
- Weight: 1.0 kg (2.25 lb)

CAES Touch Screen Display
- LCD Display: 264 mm (10.4 in) 640 × 480 transflective color VGA
- Buttons: touch screen
- Touch Screen: 3.17 mm (0.125 in) resolution infrared high light rejection
- Back Light: 200 cd/m2, 200:1 dimming ratio
- Processor: Intel Pentium CPU
- Memory: 64 MB Ram
- Solid State Disk: Internal 128 MB, external compact flash
- Operating Environment: Embedded WinNT
- Operating Temperature: –20° C to 70° C (–4° F to 158° F)
- Storage Temperature: –50° C to 85° C (–58° F to 185° F)
- Sealing: IP68 sealed to ±5 psi
- Humidity: 100%
- Electrical Input: 9-32V DC
- Power Supply: 5 amp @ 40W load dump, reverse voltage, ESD, over voltage protection
- Connector: 70-pin
- Discrete I/O: 8 digital ports; 5 PMW inputs
- Mounting: bracket or panel
- Height: 261 mm (10.28 in)
- Width: 315 mm (12.4 in)
- Depth: 93 mm (3.66 in)
- Weight: 3.17 kg (8.5 lb)

CAESoffice/METSmanager PC Requirements
- Pentium II/III processor w/ 128 MB memory
- 21 in. monitor (SVGA color 1024 × 768 resolution) with 2MB video memory
- Windows NT 4.0 or higher with latest service pack
- Modem- internal or external (required for remote support)
- Required ports: serial (suggest 2 serial, 1 parallel)
- CD ROM drive
- 3.5 in disk drive
- Mouse or suitable pointing device
- Hard Drive Space: 200 MB min.

Customer Support. For over 25 years, Caterpillar has been providing electronic and electrical components and systems for the earthmoving industry – real world technology solutions that enhance the value of Cat products and make customers more productive and profitable. Your Cat Dealer is ready to assist you with matching machine systems to the application or obtaining responsible, knowledgeable support. For additional information, please contact us at LANDFILLGPS@CAT.com

Computer Aided Earthmoving System for Landfills

Landfill Compactors
Track-Type Tractors
Wheel Tractor Scrapers
Motor Graders

AEHQ5549 (9-03)

CATERPILLAR®

APPLICATION FOR PERMIT
OWL LANDFILL SERVICES, LLC

VOLUME III: ENGINEERING DESIGN AND CALCULATIONS
SECTION 2: VOLUMETRIC CALCULATIONS

TABLE OF CONTENTS

LIST OF TABLES

APPLICATION FOR PERMIT
OWL LANDFILL SERVICES, LLC

VOLUME III: LANDFILL ENGINEERING CALCULATIONS
SECTION 2: VOLUMETRIC CALCULATIONS

1.0 INTRODUCTION

OWL Landfill Services, LLC (OWL) is proposing to permit, construct, and operate a "Surface Waste Management Facility" for oil field waste processing and disposal services. The proposed OWL Facility is subject to regulation under the New Mexico (NM) Oil and Gas Rules, specifically 19.15.36 NMAC, administered by the Oil Conservation Division (OCD). The Facility has been designed in compliance with the requirements of 19.15.36 NMAC, and will be constructed, operated, and closed in compliance with a Surface Waste Management Facility Permit issued by the OCD.

The OWL Facility is one of the first designed to the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that OWL will provide fill a necessary void in the market for technologies that exceed current OCD requirements.

1.1 Site Location

The OWL site is located approximately 22 miles northwest of Jal, adjacent to the south of NM 128 in Lea County, NM. The OWL site is comprised of a 560-acre ± tract of land located within a portion of Section 23, Township 24 South, Range 33 East, Lea County, NM (**Figure IV.1.1**). Site access will be provided on the south side of NM 128. The coordinates for the approximate center of the OWL site are Latitude 32.203105577 and Longitude -103.543122319 (surface coordinates).

1.2 Description

The OWL Surface Waste Management Facility will comprise approximately 500 acres of the 560-acre site, and will include two main components: an oil field waste Processing Area and an oil field waste Landfill Disposal Area, as well as related infrastructure. Oil field wastes are anticipated to be delivered to the OWL Facility from oil and gas exploration and production operations in southeastern NM and west Texas. The Permit Plans (**Attachment III.1.A**) identify the locations of the Processing Area and Landfill Disposal Area.

2.0 LANDFILL VOLUMETRIC CALCULATIONS

Landfill volumetric calculations were completed for the OWL Landfill corresponding to the design shown on the **Permit Plans** (**Volume III.1**). Landfill volumetric calculations include waste capacity analysis and the soil material balance. The capacity analysis for the OWL Landfill is presented in **Table III.2.1**. The gross airspace computed for Cells 1 - 7 is approximately 44,770,270 cubic yards (yd^3); with approximately 38,339,141 yd^3 (38,339,141 tons assuming a waste density of 2,000 lbs/yd^3) of net airspace (i.e., waste capacity). The projected longevity is approximately 105 years assuming 1,000 tons per day (tpd) incoming waste volume; and 42 years assuming 2,500 tpd incoming waste volume. A materials balance was also completed for the Landfill and is presented in **Table III.2.2**. OWL has more than sufficient soils from on-site excavations for the protective soil layer, daily and intermediate cover soils, final cover for Cells 1-7, and screening berms.

Unit 1 volumetric calculations were also completed for the OWL Landfill corresponding to the design shown on the **Permit Plans** (**Volume III.1**). Unit 1 volumetric calculations include waste capacity analysis and the soil materials balance. The capacity analysis for the OWL Unit 1 is presented in **Table III.2.1**. The gross airspace computed for Unit 1 is approximately 2,383,135 cubic yards (yd^3); with approximately 1,698,500 yd^3 (1,698,500 tons assuming a waste density of 2,000 lbs/yd^3) of net airspace (i.e., waste capacity). The projected longevity is approximately 5 years assuming 1,000 tons per day (tpd) incoming waste volume; and 2 years assuming 2,500 tpd incoming waste volume. A materials balance was also completed for the Landfill and is presented in **Table III.2.2.** OWL has more than sufficient soils from on-site excavations for the protective soil layer, daily and intermediate cover soils, final cover for Unit 1, and screening berms.

APPLICATION FOR PERMIT
OWL LANDFILL SERVICES, LLC

VOLUME III: ENGINEERING DESIGN AND CALCULATIONS
SECTION 2: VOLUMETRICS CALCULATIONS

TABLE III.2.1
Capacity Analysis
OWL Landfill Services, LLC

Description	Fill Area (± acres)	Gross Airspace (yd^3)	Cover[2] (yd^3)	Waste Capacity[3,4] Airspace (yd^3)	Waste Capacity Airspace (tons)[4]	Longevity Estimate (years)[5,6] @ 500 tpd	Longevity Estimate (years)[5,6] @ 1,000 tpd	Longevity Estimate (years)[5,6] @ 2,500 tpd
Cell 1	37.4	3,814,605	707,289	3,107,316	3,107,316	17.0	8.5	3.4
Cell 2	29.9	5,830,323	843,521	4,986,802	4,986,802	27.3	13.7	5.5
Cell 3	29.9	8,242,989	1,084,788	7,158,201	7,158,201	39.2	19.6	7.8
Cell 4	29.9	8,994,437	1,159,933	7,834,505	7,834,505	42.9	21.5	8.6
Cell 5	29.9	8,242,989	1,084,788	7,158,201	7,158,201	39.2	19.6	7.8
Cell 6	29.9	5,830,323	843,521	4,986,802	4,986,802	27.3	13.7	5.5
Cell 7	37.4	3,814,605	707,289	3,107,316	3,107,316	17.0	8.5	3.4
Landfill Total	**224.3**	**44,770,270**	**6,431,129**	**38,339,141**	**38,339,141**	**210.1**	**105.0**	**42.0**
Unit 1	34.8	2,383,134	684,638	1,698,496	1,698,496	9.3	4.7	1.9

Notes:

1. The calculations presented in this table provide the proposed capacity and longevity for the site. Estimated waste rates include stabilized and solidified materials from the Processing Area, and are subject to change.

*2. yd^3 = cubic yards. Cover includes protective soil cover, daily, and intermediate cover; and final cover (collectively called total cover soil) [see **Table III.1.2**].*

*3. Waste capacity airspace = (gross airspace - cover soils); see **Table III.1.2** .*

4. In-place waste density: Oil Field Waste = 2,000 lbs/yd^3; [tons = ((waste capacity airspace (yd^3) x in-place waste density)/2,000 lbs/ton)]. 1 yd^3 = 1 ton.

5. Longevity = [waste capacity airspace (tons)/daily incoming waste rate (tons/day)] / (365 operating days/year).

6. Tons per day = tpd.

TABLE III.2.2
Materials Balance (yd^3)
OWL Landfill Services, LLC

Description	Fill Area (± acres)	Protective Soil/Drainage Layer[1]	Cover Soil[2] (Daily & Intermediate	Final Cover[3]	Total Soil Cover Required[4]	Excavation Volume	Soil Surplus
Landfill							
Cell 1	37.4	120,677	345,257	241,355	707,289	588,381	**-118,909**
Cell 2	29.9	96,477	554,089	192,955	843,521	899,294	**-63,136**
Cell 3	29.9	96,477	795,356	192,955	1,084,788	1,271,433	**123,510**
Cell 4	29.9	96,477	870,501	192,955	1,159,933	1,387,340	**350,917**
Cell 5	29.9	96,477	795,356	192,955	1,084,788	1,271,433	**537,563**
Cell 6	29.9	96,477	554,089	192,955	843,521	899,294	**593,335**
Cell 7	37.4	120,677	345,257	241,355	707,289	588,381	**474,427**
Landfill Total	**224.3**	**723,741**	**4,259,905**	**1,447,483**	**6,431,129**	**6,905,556**	**474,427**
Unit 1	34.8	112,288	347,774	224,576	684,638	739,593	**54,955**

Notes:

1. Volume of protective soil layer assumes 2-foot depth over liner area.

2. Cover Soil for Landfill assumes approximately 10% of effective airspace (gross airspace - protective soil/drainage layer - final cover).

3. Volume of final cover conservatively assumes 4-foot depth over lined area (12 inch erosion layer, 12 inch protective layer, 12 inch drainage layer and 12 inch foundation layer).

4. Includes protective cover/drainage layer soil, cover soil, and final cover.

5. Drainage excavation volume includes drainageways and basins.

6. There is additional soil available from the Waste Processing Area.

APPLICATION FOR PERMIT
OWL LANDFILL SERVICES, LLC

VOLUME III: LANDFILL ENGINEERING CALCULATIONS
SECTION 3: DRAINAGE CALCULATIONS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPLICATION FOR PERMIT
OWL LANDFILL SERVICES, LLC

VOLUME III: LANDFILL ENGINEERING CALCULATIONS
SECTION 3: DRAINAGE CALCULATIONS

LIST OF ATTACHMENTS

Attachment No.	Title
III.3.A	PHILIPS, CHRISTOPHER S.; EASTERLING, CHARLES M.; HEGGEN, RICHARD J.; AND SCHALL, JAMES D. 1995. *DRAINAGE MANUAL, VOLUME I: HYDROLOGY*. NEW MEXICO STATE HIGHWAY AND TRANSPORTATION DEPARTMENT.
III.3.B	U.S. DEPT. OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE OFFICE OF HYDROLOGIC DEVELOPMENT HYDROMETEOROLOGICAL DESIGN STUDIES CENTER, JUNE 2006, NOAA ATLAS 14, VOLUME 1, VERSION 5 , POINT PRECIPITATION FREQUENCY ESTIMATES FOR LATITUDE: 32.2031°, LONGITUDE: -103.5431°, PDS-BASED POINT PRECIPITATION FREQUENCY ESTIMATES WITH 90% CONFIDENCE INTERVALS (IN INCHES)
III.3.C	AUTODESK,® INC, 2016, *STORM AND SANITARY ANALYSIS*, MODEL OUTPUT

APPLICATION FOR PERMIT
OWL LANDFILL SERVICES, LLC

VOLUME III: LANDFILL ENGINEERING CALCULATIONS
SECTION 3: DRAINAGE CALCULATIONS

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1.2 Description

The OWL Surface Waste Management Facility will comprise approximately 500 acres of the 560-acre site, and will include two main components: an oil field waste Processing Area and an oil field waste Landfill Disposal Area, as well as related infrastructure. Oil field wastes are anticipated to be delivered to the OWL Facility from oil and gas exploration and production operations in southeastern NM and west Texas. The Permit Plans (**Attachment III.1.A**) identify the locations of the Processing Area and Landfill Disposal Area.

1.3 Interim Drainage Plan

While the design shown on the Permit Plans primarily addresses landfill completion conditions, it is anticipated that site development will take place in “Units” (generally east to west) that consist of portions of Cells 1-7. Interim drainage during initial site development captures and controls run-on that enters the site from the north and east. “Unit 1” (see **Permit Plans**, **Volume III.1**) excavation includes construction of berms along a portion of the north and east landfill boundary to divert, stormwater away from the first unit excavation and to provide a lined western bulwark for the planned processing area ponds. Within a Unit, there are perimeter stormwater berms that serve to separate stormwater from leachate. As a Unit is developed, base grade elevations remain below the site natural flow paths.

Pumping will be required to evacuate the accumulated stormwater within the excavation to the temporary basins, and natural and constructed flow paths, that exit the site’s natural outfall along the southwest perimeter. As units develop along with the site perimeter channel systems, the retention and detention basins will be developed incrementally as the operation progresses. Channel configurations and temporary stormwater and erosion control measure that may be implemented during interim construction are shown on the **Permit Plans** (**Volume III.1**). The permanent stormwater management designs, including planned lined and unlined retention/detention basins, are likely not needed for decades into the future (see Volumetric Analysis, **Volume III.2**). All interim (temporary) and permanent (Landfill Completion Plan) installations will be subject to routine maintenance and silt removal.

2.0 DESIGN CRITERIA

The stormwater management systems for the OWL Landfill and Processing Facility are designed to meet the requirements of the regulatory standards identified in the New Mexico Oil Conservation Department Rules 19.15.36 NMAC. More specifically, closure standards in 19.15.36.13.M specifies:

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.

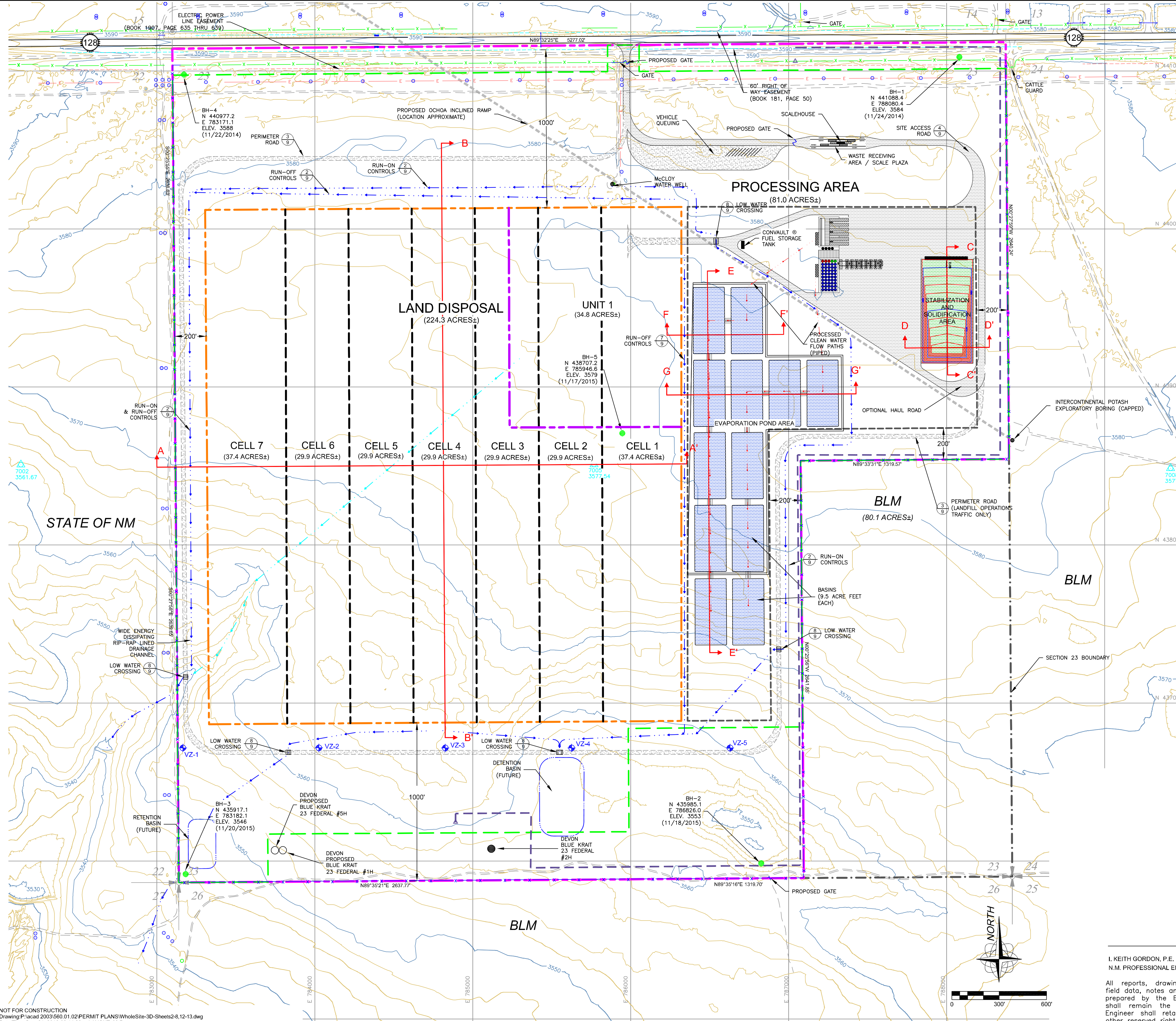
19.15.36.18.D(2)(a) NMAC requires:

"…soil contoured to promote drainage of precipitation…" and "...prevent the ponding of water…"

3.0 METHODOLOGY

The methodology for the calculation of runoff stormwater flows is similar to that outlined by the New Mexico State Highway and Transportation Department (NMSHTD) Drainage Manual, Volume 1: Hydrology (Philips et al., 1995; **Attachment III.3.A**). The NMSHTD Drainage Manual specifies that the Simplified Peak Flow Method (NMSPFM) be used on drainage areas that are no larger than 5 square miles, and where land use is consistent throughout the watershed. The total enclosed drainage basin acreage for the project area is determined to be approximately 466 acres or 0.73 square miles (**Figure III.3.2**). The Simplified Peak Flow Method is a specially simplified version of the Soil Conservation Service's (SCS) TR-20/TR-55 computerized rainfall modelling system, specific to NM watersheds, precipitation types, etc., and allowing for calculations to be done manually.

Calculation of runoff from the post-development ~224-acre landfill conditions (i.e., approximate averaged 5H:1V final grading) was modeled according to the SCS TR-20 Method's hydrology model, and the SCS TR-55 time-of-concentration formulae using *Autodesk,® Inc.'s Storm and Sanitary Analysis* software package. The same method and model software package was used in an iterative process for projecting the effects and sizing of the run-on collection network including drainage channels and stormwater basins.



LEGEND

- SITE BOUNDARY WITH BEARING AND DISTANCE (559.5 ACRES±)
- SURFACE WASTE MANAGEMENT FACILITY BOUNDARY (500.0 ACRES)
- SOLID WASTE DISPOSAL AREA LIMITS (224.3 ACRES±)
- PROCESSING AREA LIMITS (81.0 ACRES±)
- UNIT 1 BOUNDARY (34.8 ACRES±)
- CELL BOUNDARY
- EXISTING 2FT CONTOUR
- EXISTING 10FT CONTOUR
- EXISTING 2FT DEPRESSION CONTOUR
- EXISTING 10FT DEPRESSION CONTOUR
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING POWER POLE
- EXISTING CULVERT
- PROPOSED DEVON PIPELINE
- PROPOSED UNPAVED ROAD (GRAVEL)
- PROPOSED UNPAVED ROAD (SOIL)
- PROPOSED 3-STRAND BARBED WIRE FENCE
- FINAL DRAINAGE FLOW LINE AND DIRECTION OF FLOW
- INTERMEDIATE DRAINAGE FLOW LINE AND DIRECTION OF FLOW
- PROPOSED PROCESS WATER FLOW PATHS
- PROPOSED VADOSE ZONE MONITORING WELL
- BOREHOLE LOCATION
- PRODUCED WATER TANK
- CRUDE OIL RECOVERY TANK
- OIL SALES TANK
- CROSS-SECTION LOCATION
- SURVEY CONTROL POINT
- SITE GRID

NOTES:

1. AERIAL TOPOGRAPHIC SURVEY BY AEROTECH MAPPING INC., 6565 AMERICAN PARKWAY N.E., ALBUQUERQUE, NM 87111 PHONE: (520-561-6537) FAX (505 256-3328) EMAIL: TimBurrows@atmlv.com DATE OF PHOTOGRAPHY: 06-06-2015.
2. SURVEY CONTROL POINTS BY HARCROW SURVEYING, INC., 2314 W. MAIN ST., ARTESIA, NM 88210 PHONE: (575-746-2158).
3. THE DESIGN OF THE FACILITIES SHOWN IS PRELIMINARY. CONSTRUCTION PLANS AND SPECIFICATIONS FOR EACH MAJOR ELEMENT WILL BE SUBMITTED TO OCD IN ADVANCE OF INSTALLATION.

CONTROL POINT DATA

POINT	NORTHING	EASTING	PANEL ELEVATION	DESCRIPTION
7001	434845.57	782160.25	3530.07	PP-7001
7002	438508.13	782138.97	3561.67	PP-7002
7003	442131.34	782096.47	3600.88	PP-7003
7004	434859.95	785795.31	3548.81	PP-7004
7005	438509.15	785767.60	3577.54	PP-7005
7006	442207.86	785773.10	3598.28	PP-7006
7007	434883.93	789423.36	3567.38	PP-7007
7008	438485.16	789417.70	3577.60	PP-7008

NOTES:

1. ALL POINTS ARE FLUSH WITH THE GROUND.
2. THE COORDINATES AND ELEVATIONS FOR THE PHOTO CONTROL POINTS ON THE ABOVE REFERENCED PROJECT ARE MODIFIED (SURFACE) NEW MEXICO STATE PLANE COORDINATES – EAST ZONE, NAD 83 AND HAVE BEEN ADJUSTED USING AN "OPUS" SOLUTION". TO OBTAIN TRUE STATE PLANE GRID COORDINATES, MULTIPLY THE COORDINATES BELOW BY THE PROJECT AVERAGE COMBINED FACTOR CF = 0.99981059648. THE COORDINATES AND ELEVATIONS ARE EXPRESSED IN U. S. SURVEY FEET.

I. KEITH GORDON, P.E.
N.M. PROFESSIONAL ENGINEER NO. 10984

SITE DEVELOPMENT PLAN

OWL LANDFILL SERVICES, LLC
LEA COUNTY, NEW MEXICO

Gordon Environmental, Inc.
Consulting Engineers
213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 09/08/2016	CAD: WholeSi~2.DWG	PROJECT #: 560.01.02
DRAWN BY: ASM	REVIEWED BY: CRK	FIGURE III.3.1
APPROVED BY: IKG	gei@gordonenvironmental.com	

NOT FOR CONSTRUCTION
Drawing:P:\acad 2003\560.01.02\PERMIT PLANS\WholeSite-3D-Sheets2-8,12-13.dwg
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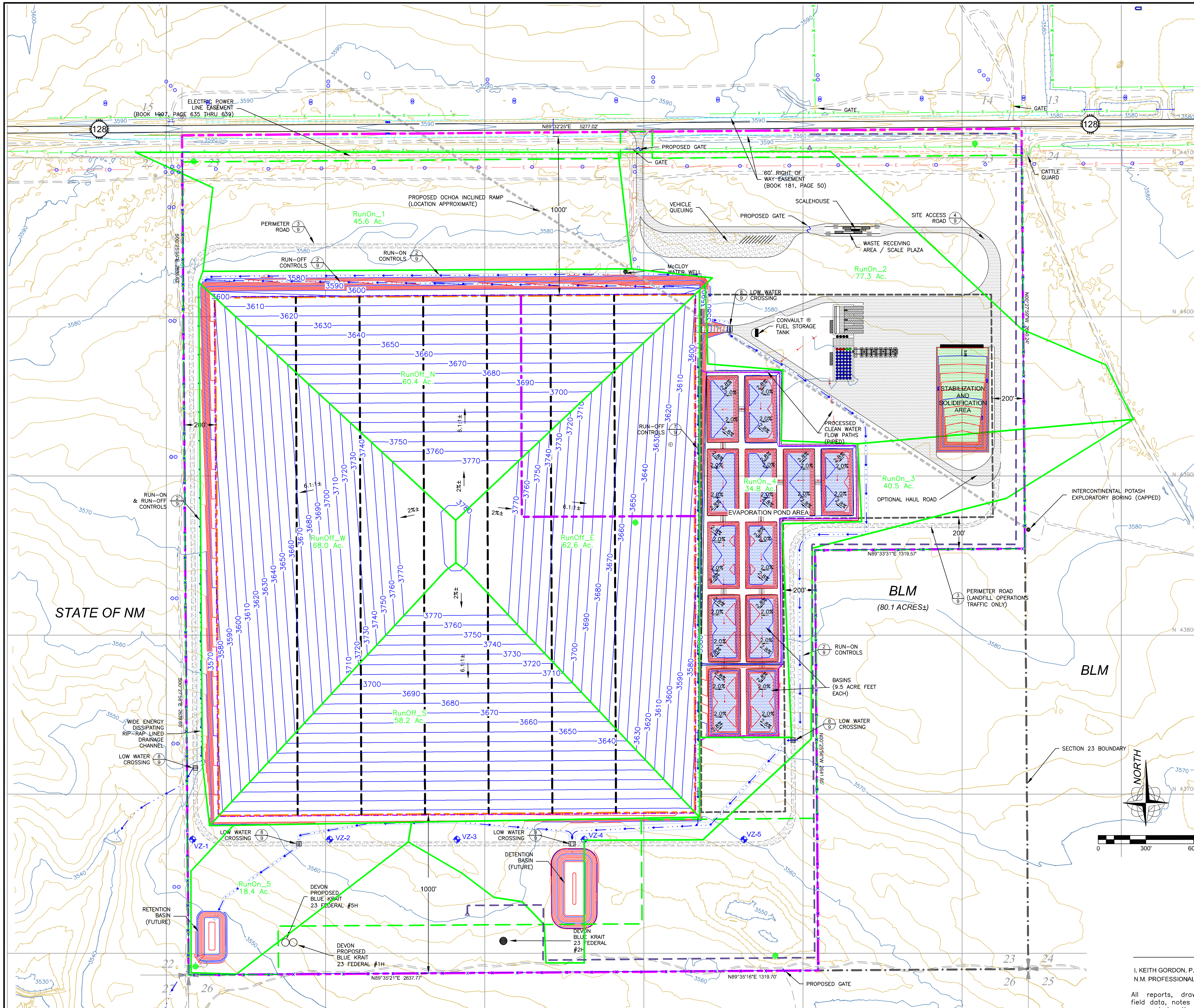

LEGEND

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- EXISTING CULVERT
- PROPOSED 2FT BASE GRADE CONTOUR
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- PROPOSED UNPAVED ROAD (GRAVEL)
- PROPOSED UNPAVED ROAD (SOIL)
- PROPOSED 3-STRAND BARBED WIRE FENCE
- FINAL DRAINAGE FLOW LINE AND DIRECTION OF FLOW
- PROPOSED PROCESS WATER FLOW PATHS
- PROPOSED EXTENT OF LINER – LAND DISPOSAL (INCLUDING ANCHOR TRENCH)
- PROPOSED EXTENT OF LINER – EVAPORATION PONDS (INCLUDING ANCHOR TRENCH)
- PROPOSED VADOSE ZONE MONITORING WELL
- BOREHOLE LOCATION
- PRODUCED WATER TANK
- CRUDE OIL RECOVERY TANK
- OIL SALES TANK
- SURVEY CONTROL POINT
- SITE GRID

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I. KEITH GORDON, P.E.
N.M. PROFESSIONAL ENGINEER NO. 10984

LANDFILL COMPLETION DRAINAGE PLAN

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Consulting Engineers
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Bernalillo, New Mexico, USA
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Fax: 505-867-6991

DATE: 09/08/2016	CAD: WholeSi~2.DWG	PROJECT #: 560.01.02
DRAWN BY: ASM	REVIEWED BY: CRK	FIGURE III.3.2
APPROVED BY: IKG	gei@gordonenvironmental.com	

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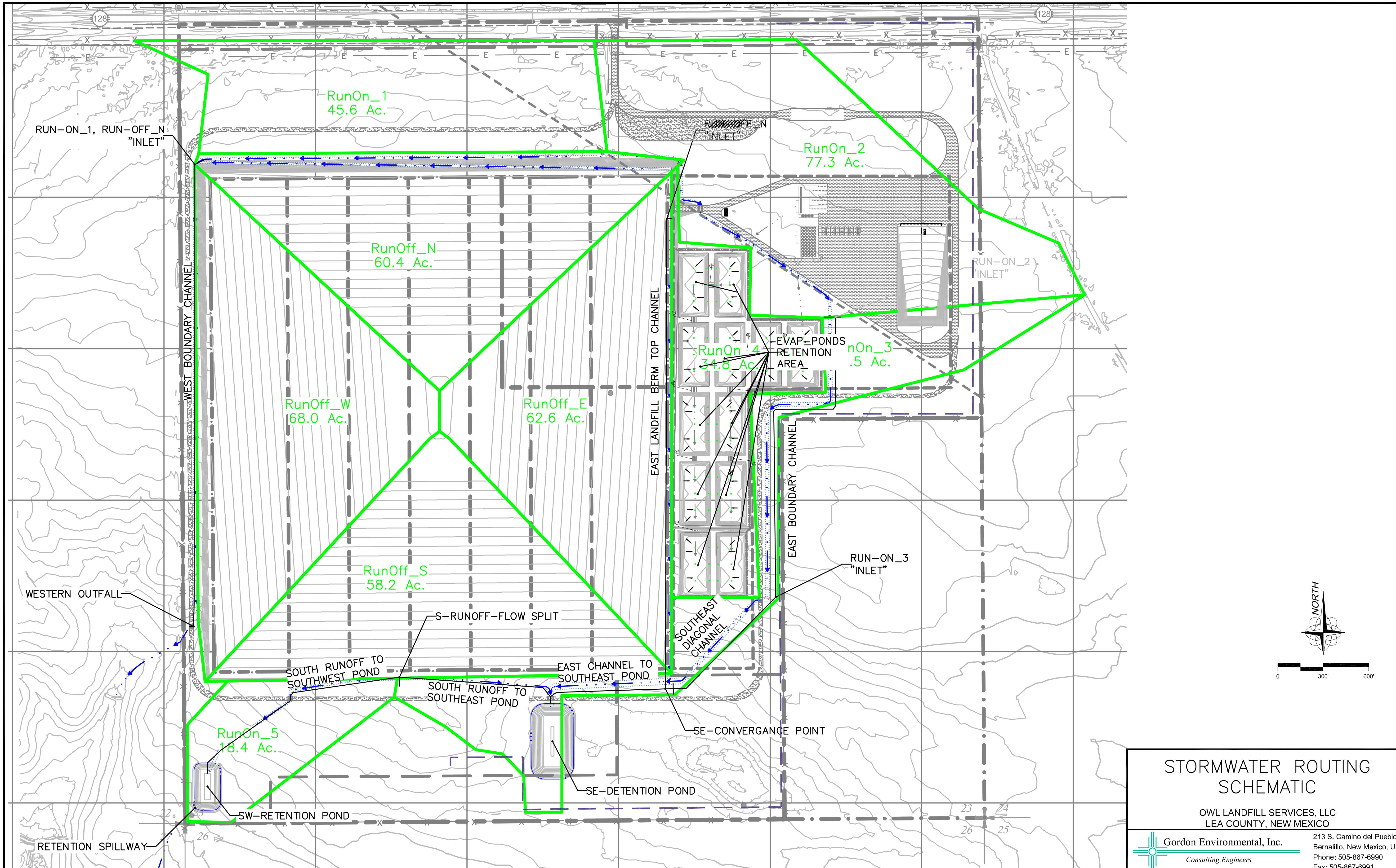

STORMWATER ROUTING SCHEMATIC

OWL LANDFILL SERVICES, LLC
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Gordon Environmental, Inc.
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213 S. Camino del Pueblo
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DATE: 02/17/2016	CAD: WHOLESI~2.DWG	PROJECT #: 560.01.02
DRAWN BY: ASM	REVIEWED BY: CRK	FIGURE III.3.3
APPROVED BY: IKG	gei@gordonenvironmental.com	

NOT FOR CONSTRUCTION
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Date/Time:Sep. 21, 2016-10:54:42 ; LAYOUT: FigIII.3.3

4.0 SURFACE WATER RUNOFF CALCULATIONS

The SCS TR-20 Method is used to determine run-off surface water flow from the landfill, as well as contributory run-on. The TR-20 Method is a computerized model for estimating the peak rate of runoff and runoff volume from small to medium watersheds. Infiltration and other losses are estimated using the SCS Curve Number (CN) methodology while Time Of Concentration is calculated using the SCS TR-55 method, which is more accurate than the NMSHTD specified Upland/Kirpich methods. The TR-20 Method is limited to single basins less than 5 square miles in area, and is to be used when the Time of Concentration (T_c) is expected not to exceed 8.0 hours; and where channels will be used to convey runoff. The OWL meets these criteria, at 466 acres (i.e., 0.73 square miles) with appropriate channelization. The TR-20 Method calculations used to determine stormwater runoff flows at OWL site are presented in **Attachment III.3.C.** **Figure III.3.2** provides landfill runoff drainage areas for the finished landform (i.e. final contours):

- Obtain the 24-hour rainfall depth directly from the table in **Attachment III.3.B**
  P_{24} = 4.31 inches.
- Calculate the drainage area, A, in acres (**Tables III.3.1** and **III.3.2**):

TABLE III.3.1
Run-on Drainage Summary
OWL Landfill Services, LLC

RUN-ON DRAINAGE AREAS				
SUB-BASIN ID	**AREA (ACRES)**	**PEAK DISCHARGE(CFS)**	**VOLUME (ACRE-FT)**	**DISCHARGE TO:**
RunOn_1	45.6	86.81	6.38	West Outfall
RunOn_2	77.3	193.05	10.81	SE Retention
RunOn_3	40.5	63.40	5.66	SE Retention
RunOn_4	34.8	150.92	4.86	Evaporation Ponds
RunOn_5	18.4	53.24	2.57	SW Detention

TABLE III.3.2
Runoff Summary
OWL Landfill Services, LLC

RUNOFF DRAINAGE AREAS				
WATERSHED	**DRAINAGE AREA (ACRES)**	**PEAK DISCHARGE(CFS)**	**VOLUME (ACRE-FT)**	**DISCHARGE TO**
RunOff_E	62.6	243.96	8.75	SE Retention
RunOff_N	60.4	134.04	8.43	West Outfall
RunOff_S	58.2	247.24	8.13	33% To SE Retention, 66% to SW Detention
RunOff_W	68.0	279.91	9.50	West Outfall

- Determine curve number "CN": From Table 3-1 "Runoff Curve Numbers for Arid and Semiarid Rangelands" in **Attachment III.3.A pg. 3-23**; for Desert shrub-mixture of grass, weeds, and low growing brush, with brush the minor element, Soil Group **B** (consisting of sandy soils, the predominate soils on-site) and 30-70% Vegetation Cover; Hydrologic Condition "fair"; **CN = 72**.
- Based on the final cover design, input the parameters describing the catchment for the electronic TR-55 Time of Concentration, $\mathbf{T_c}$ calculations. Catchments are described by one subarea, and information is located in **Attachment III.3.C pages 5 thru 14**. The calculations are based on Sheet Flow, using a Manning's Roughness of 0.08 for Sparse Vegetation and the accepted maximum flow length of 100'; Shallow Concentrated Flow, using the remaining distance the water must travel to the nearest intentional channel; and Channel Flow, using a Manning's roughness of 0.03 for a vegetated earthen channel and the channel dimensions derived iteratively. TR-55's methodology yields a total Time of Concentration.
- The model then uses the Curve Number, rainfall data, and Time of Concentration to derive the Total Runoff (in depth, inches), Peak Runoff (in flow rate, CFS). From there, the system also calculates the Total Runoff Volume, as shown in the table in **Attachment III.3.C pg 2**, and summarized in **Tables III.3.1** and **III.3.2**.

5.0 STORMWATER BASIN DESIGN

Stormwater Retention Basin are designed to store the design volume of runoff flow, while the detention basin is designed to reduce the off-site flow rate, and detain some of the flow. To determine the volume required of the basins, contributory catchments were analyzed based on design stormwater routing, and the catchment runoff volumes from the TR-20 method. Autodesk's *Storm and Sanitary Analysis* package was used to expedite these calculations, and the corresponding data is shown in **Attachment III.3.C pages 19-21**, and is summarized in **Table III.3.3.**

TABLE III.3.3
Stormwater Basin Design Summary
OWL Landfill Services, LLC

BASIN	CONTRIBUTING DRAINAGE AREAS	RUNOFF VOLUME (ACRE-FT)	BASIN CAPACITY W/ 1FT. FREEBOARD (ACRE-FT)	BASIN MAX. CAPACITY W/O 1FT. FREEBOARD (ACRE-FT)	FACTOR OF SAFETY W/O FREEBOARD
SW Detention	RunOff_S(2/3) RunOn_5	5.42	6.95	8.12	1.3
SE Retention	RunOn_2, RunOn_3, RunOff_E RunOff_S(1/3)	28.65	34.54	37.55	1.2

Based on the available volume in the Southwest Detention Stormwater Basin compared to the incoming flow, peak storage in the Southwest Detention Stormwater Basin is at elevation 3549 ft. At this elevation, available volume = 6.95 acre-ft, and the peak inflow from the 25-year, 24-hour storm event is 5.42 acre-ft; therefore, the basin size is more than sufficient to store the stormwater run-on and runoff as a result of the 25-year, 24-hour design storm event.

Based on the available volume in the Southeast Detention Stormwater Basin compared to the incoming flow, peak storage in the Southeast Detention Stormwater Basin is at elevation 3557 ft. At this elevation, available volume = 34.54 acre-ft, and the peak inflow from the 25-year, 24-hour storm event is 28.65 acre-ft; therefore, the basin size is more than sufficient to store the stormwater run-on and runoff as a result of the 25-year, 24-hour design storm event.

The Factor of Safety for each basin does not include freeboard designed into each basin. As such, considerable additional volume is available when the freeboard is considered.

Note that catchments RunOff_N, RunOff_W and RunOn_1 all drain out an outfall along the western property line, as the flow velocity is low enough that any particulates should settle out, maintaining the cited standards set forth in NMAC. Additionally, catchment RunOn_4 is assumed to be added directly to the evaporation basins, which indicates that the basins should maintain at least 4.86 acre-ft of available capacity to accommodate for the design storm.

6.0 TYPICAL CHANNEL DESIGN AND CAPACITY

The design frequency peak flow (Q_p) from the TR-20 Method was used to size the landfill perimeter drainage channels. Drainage channels are sized to convey the volume of runoff, using the hydrodynamic modelling included in Autodesk's *Storm and Sanitary Analysis* software package. *Storm and Sanitary Analysis* software uses the runoff information calculated using the TR-20 Method, and computes the velocity and depth of flow in the channels based on design values for channel length, slope and cross section dimensions. Channel design parameters, shown in **Attachment III.3.C pages 17-18**, are summarized in **Table III.3.4**, which demonstrates that each of the channels has more than adequate carrying capacity.

TABLE III.3.4
Channel Design Summary
OWL Landfill Services, LLC

CHANNEL	Q_{25} (CFS) [1]	SLOPE (%)	VELOCITY (FT/S)	WATER DEPTH (FT)	CHANNEL DEPTH (FT)
East Property Boundary	111.7	0.31	3.75	2.62	3.0
East Inlet to SE pond	215.9	0.46	5.38	2.63	3.5
East Landfill Berm Top	105.5	0.87	8.45	2.85	3.0
SE Diagonal	170.0	0.99	5.74	2.45	2.5
South Run Off to SE pond	25.5	0.60	3.55	1.59	2.0
South Run Off to SW pond	152.1	0.88	6.18	2.31	2.5
West Property Boundary [2]	207.7	0.90	6.35	2.80	3.0

Notes: 1. Q_{25} represents 25-year, 24-hour storm event flow.
2. model does not include effects from the outflow riprap check dam