

NM1-62

**Permit
Application**

**Volume 4
Part 3 of 11**

**APPLICATION FOR PERMIT
SUNDANCE WEST**

**VOLUME IV: SITING AND HYDROGEOLOGY
SECTION 2: HYDROGEOLOGY**

ATTACHMENT IV.2.B

**COMPLETION REPORT – DRILLING AND SAMPLING – SUNDANCE
SERVICES, INC., LEA COUNTY, NEW MEXICO – DECEMBER 2009**

COMPLETION REPORT SUPPLEMENTAL DRILLING AND SAMPLING

**SUNDANCE SERVICES, INC.
LEA COUNTY, NEW MEXICO**

DECEMBER 2009

SUBMITTED TO:

New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division
1220 S. St. Francis Drive
Santa Fe, New Mexico 87505
Phone: (505) 476-3440

PREPARED FOR:

Sundance Services, Inc.
P.O. Box 1737
Eunice, NM 88231

PREPARED BY:

Gordon Environmental, Inc.
213 South Camino del Pueblo
Bernalillo, New Mexico 87004
Phone: (505) 867-6990



**COMPLETION REPORT
SUPPLEMENTAL DRILLING AND SAMPLING**

**SUNDANCE SERVICES, INC.
LEA COUNTY, NEW MEXICO**

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**COMPLETION REPORT
SUPPLEMENTAL DRILLING AND SAMPLING**

**SUNDANCE SERVICES, INC.
LEA COUNTY, NEW MEXICO**

1.0 INTRODUCTION

Gordon Environmental, Inc. (GEI), on behalf of Sundance Services, Inc. (SSI), has overseen the drilling of four continuous core borings (coreholes), and two geotechnical borings at the proposed Sundance West Site near Eunice in southeastern New Mexico. This subsurface investigation was proposed to OCD in the September Workplan in order to supplement data from previous site-specific drilling; and was discussed and approved to implementation (Section 3.0). Rodgers Environmental Services, Inc. (Rodgers) of Albuquerque, New Mexico was contracted by GEI to complete the following services for this project:

- Drill four coreholes using a CME 75 hollow stem auger (HSA) and continuously sample using a 5-foot long split barrel sampler.
- Drill two additional geotechnical borings using the same CME 75 HSA and sample at selected intervals using a 2-foot long split barrel (split spoon) sampler, or a 2-foot long split barrel ring sampler (California sampler).

This Completion Report (Report) provides documentation regarding the project and as-built conditions. The Report includes:

- a description of the project and location of the site
- purpose, scope, and previous investigations
- drilling, sampling, plugging and abandonment, and laboratory analyses

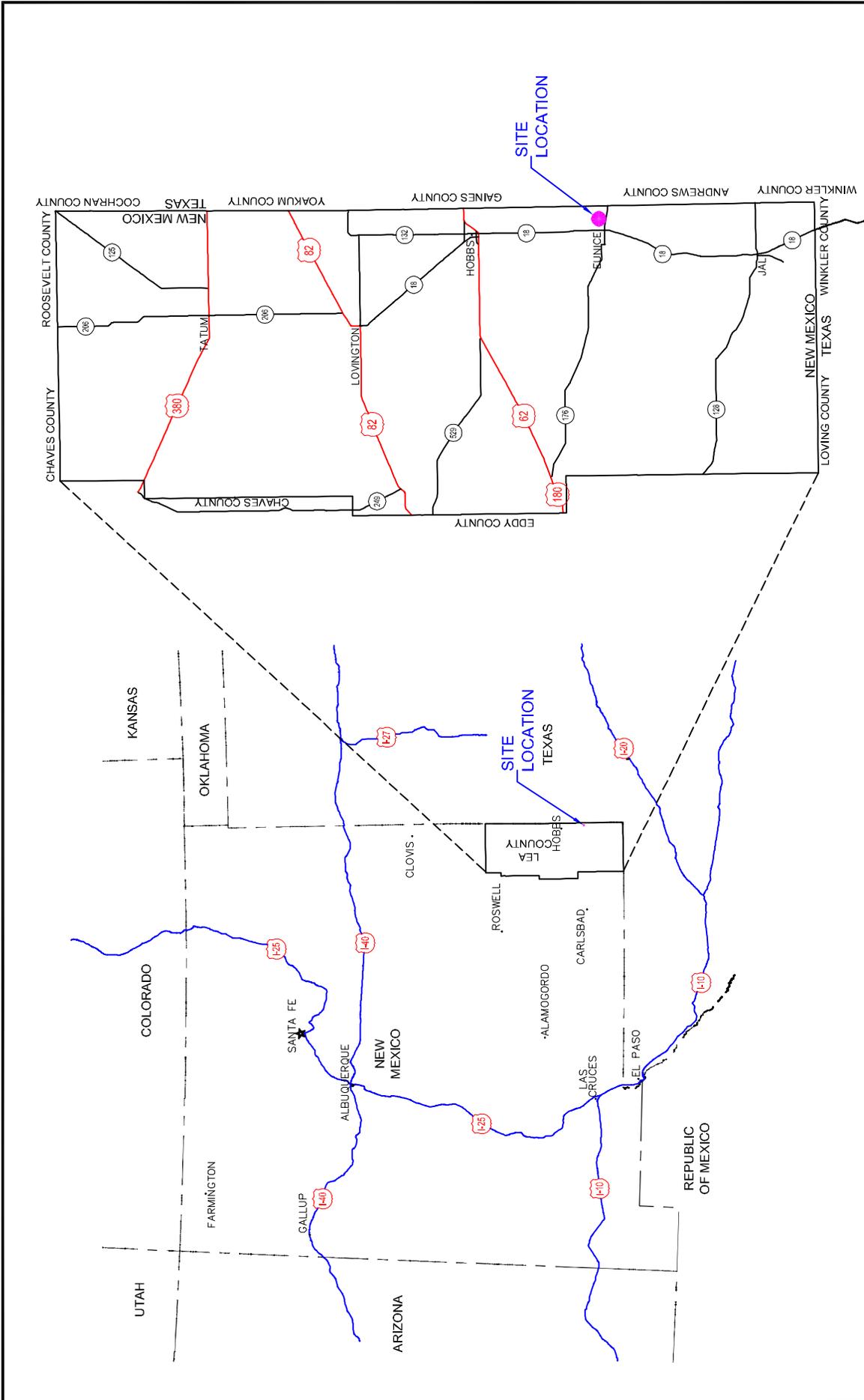
Selected photographs of the work are included in **Attachment A**. Also included are the permits granted from the Office of the State Engineer, approving the drilling program (**Attachment B**). The results of this investigation, the previous drilling program, and extensive local/regional subsurface data will be compiled into a comprehensive Hydrogeology and Groundwater component of the pending OCD Part 36 Permit Application for a surface waste management facility.

2.0 SITE LOCATION AND PROJECT DESCRIPTION

The proposed facility is located approximately four miles east of Eunice, N.M., on approximately 320 acres of vacant land owned by Wallach, et.al and leased by SSI (S ½ Section 30, T31S, R38E, NMPM; **Figure 1**). The “Vicinity Map” (**Figure 2**) shows the location of “Sundance West” with respect to other local facilities which have been the subject to extensive siting investigations. The proposed facility is located on undeveloped land immediately west of current SSI operations, and is otherwise surrounded by vacant land. Oil and gas exploration and extraction activities are not conducted on-site, but are concentrated to the west of the site (**Figure 3**).

Existing site conditions have been documented via aerial photogrammetry; and a site topograph is provided as **Figure 4**. Also included on **Figure 4** are the locations of the borings, wells and coreholes; and the preliminary landfill footprint of 155 ± acres on the 320 ± acre site. There is an existing right-of-way for a 14’ diameter water supply line shown on **Figure 4** that provides water from Eunice to the LES project, which may be relocated in the future.

The Sundance West site is proposed as an OCD Landfill pursuant to the “Part 36” surface waste management facility standards. SSI is planning to submit an Application for Permit to OCD in compliance with the regulations for siting, design, and operations of surface waste management facilities for oil and gas wastes [19.15.36.NMAC]. The Application for Permit will address the requirements of the regulations for site-specific geological and hydrological characterization [19.15.36.8.C(15) NMAC and 19.15.36.13.A NMAC]. There are ancillary operations proposed for the remaining 165 acres that will be further detailed in the Application for Permit.



NOT TO SCALE

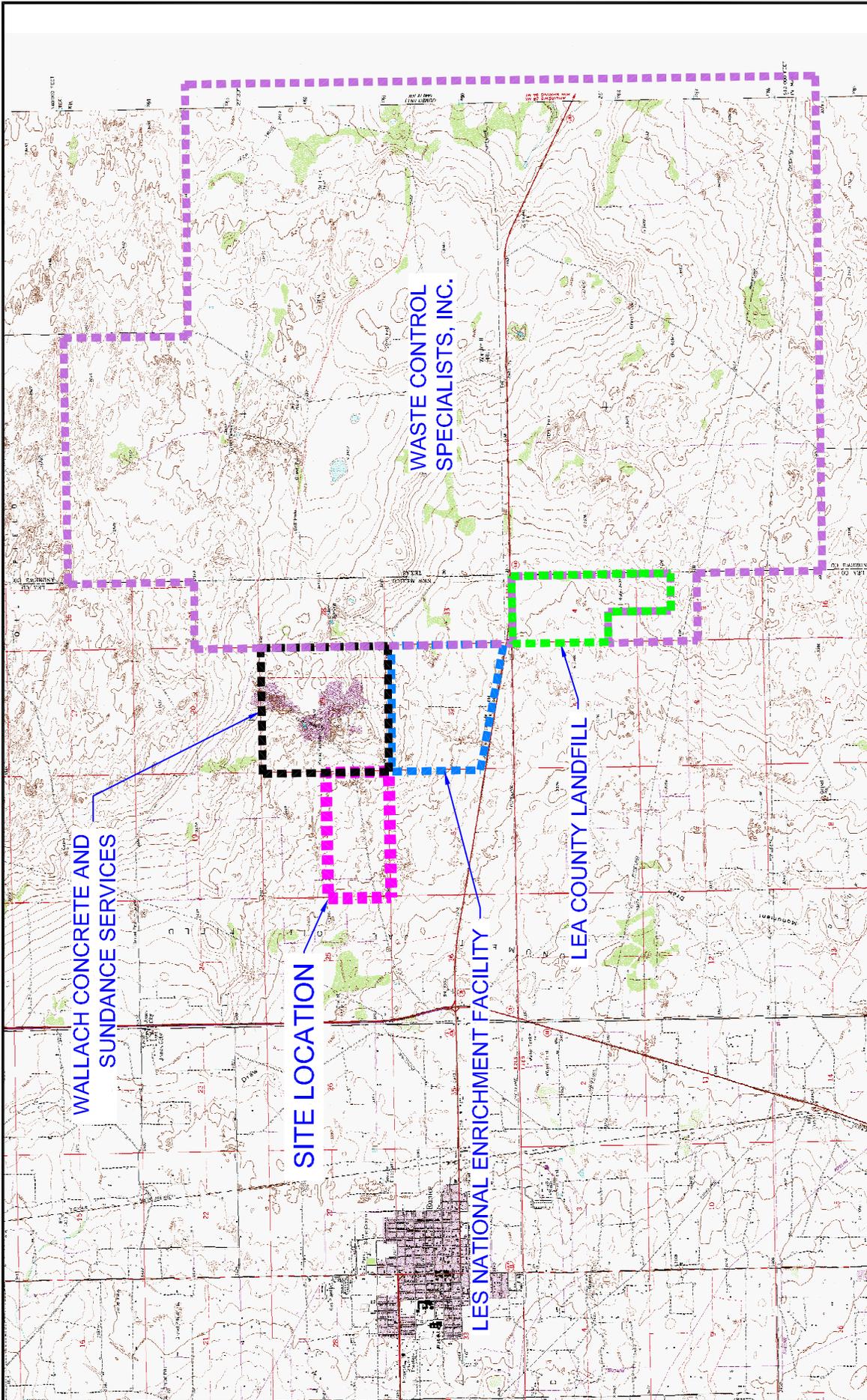
SITE LOCATION MAP

SUNDANCE WEST
 SUNDANCE SERVICES INC.
 LEA COUNTY, NEW MEXICO



213 S. Camino del Pueblo
 Bernalillo, New Mexico, USA
 Phone: 505-867-8990
 Fax: 505-867-8991

DATE: 08/24/09	CAD: SITE LOCATIONMAP GIS.dwg	PROJECT #: 530,01.01
DRAWN BY: MLH	REVIEWED BY: DRT	FIGURE 1
APPROVED BY: IKG	gei@gordonenvironmental.com	



WALLACH CONCRETE AND
SUNDANCE SERVICES

SITE LOCATION

WASTE CONTROL
SPECIALISTS, INC.

LES NATIONAL ENRICHMENT FACILITY

LEA COUNTY LANDFILL

VICINITY MAP

SUNDANCE WEST
SUNDANCE SERVICES INC.
LEA COUNTY, NEW MEXICO

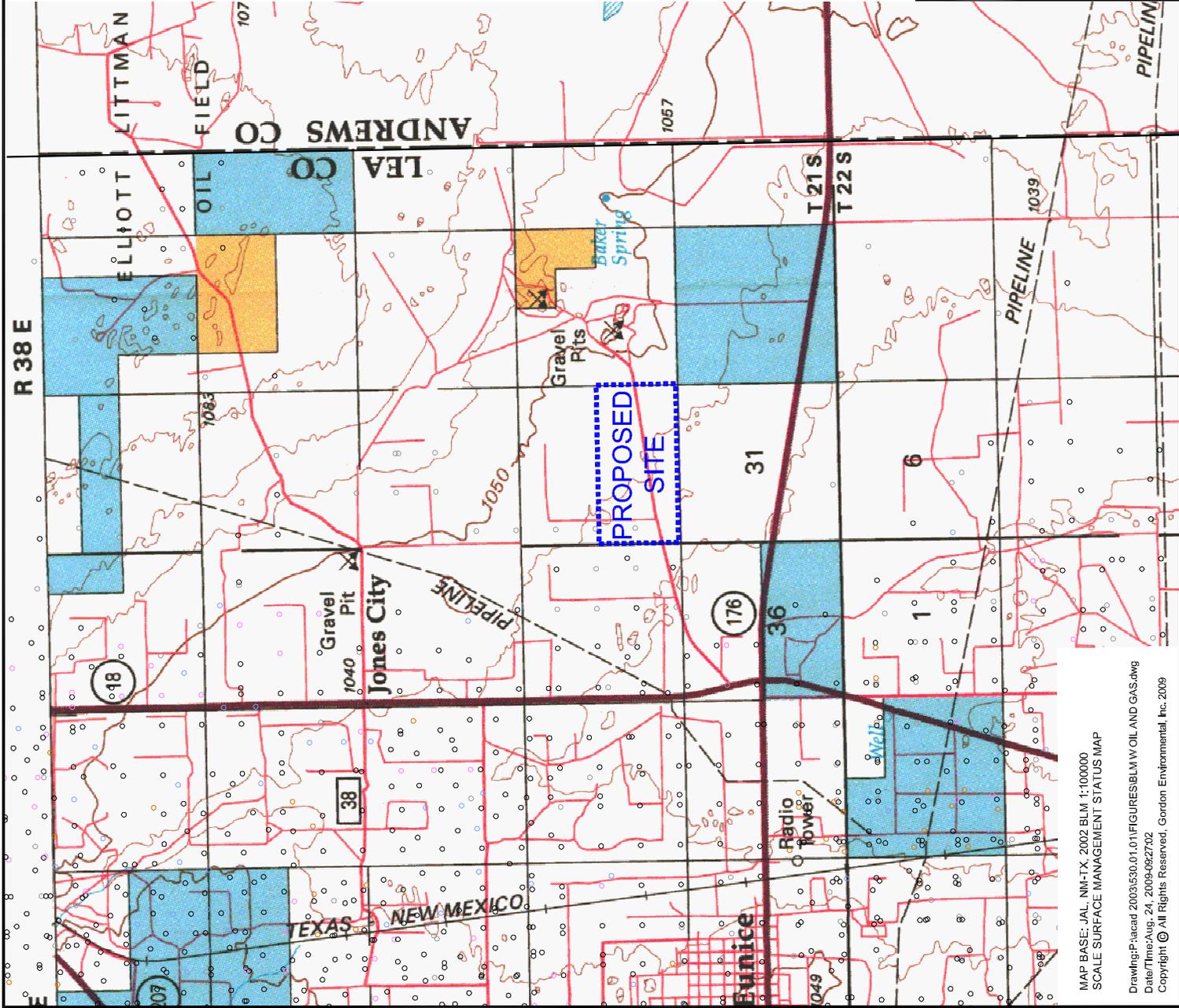


213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 08/24/09	CAD: VICINITY MAP GIS.dwg	PROJECT #: 530.01.01
DRAWN BY: MLH	REVIEWED BY: DRT	FIGURE 2
APPROVED BY: IKG	gei@gordonenvironmental.com	



MAP BASE:
EUNICE N. MEX. 1969, PHOTOREVISED 1979 AND
EUNICE NE. TEX.-N. MEX. 1969, PHOTOREVISED 1979.
1:24000, USGS 7.5 MIN. SERIES TOPOGRAPHIC QUADRANGLES



LEGEND

- PUBLIC LANDS (ADMIN BY BLM)
- STATE LANDS
- PRIVATE LANDS

- OIL/GAS WELL (ACTIVE)
- OIL/GAS WELL (NEW OR NOT COMPLETED)
- OIL/GAS WELL (NEVER DRILLED)
- OIL/GAS WELL (PLUGGED)
- OIL/GAS WELL (ZONE PLUGGED)
- OIL/GAS WELL (DRY HOLE)
- OIL/GAS WELL (STATUS UNKNOWN)
- OIL/GAS WELL (TEMPORARILY ABANDONED)

SUNDANCE WEST SITE BOUNDARY

OIL WELL DATA FROM:
 GO-TECH PETROLEUM WEB (OCTANE, NMI, EDUGOTECH)
 PERMAN BASIN DATABASE UPDATED 05-09-2008
 NOTE: ONLY OIL/GAS WELLS WITHIN NEW MEXICO ARE SHOWN



**BLM LAND STATUS MAP
 WITH OIL/GAS WELLS**

SUNDANCE WEST
 SUNDANCE SERVICES, INC.
 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: 08/24/09	CAD: BLM W OIL AND GAS.dwg	PROJECT #: 530.01.01
DRAWN BY: MLH	REVIEWED BY: IKG	FIGURE 3
APPROVED BY: IKG	get@gordonenvironmental.com	

MAP BASE: JAL, NM-TX, 2002 BLM 1:100000
 SCALE SURFACE MANAGEMENT STATUS MAP
 Drawing: P:\acad 2003\530.01.01\FIGURES\BLM W OIL AND GAS.dwg
 Date/Time: Aug. 24, 2009 09:27:02
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3.0 PURPOSE, SCOPE AND PREVIOUS INVESTIGATIONS

3.1 Purpose

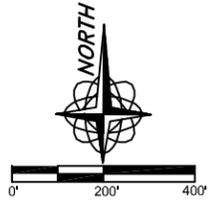
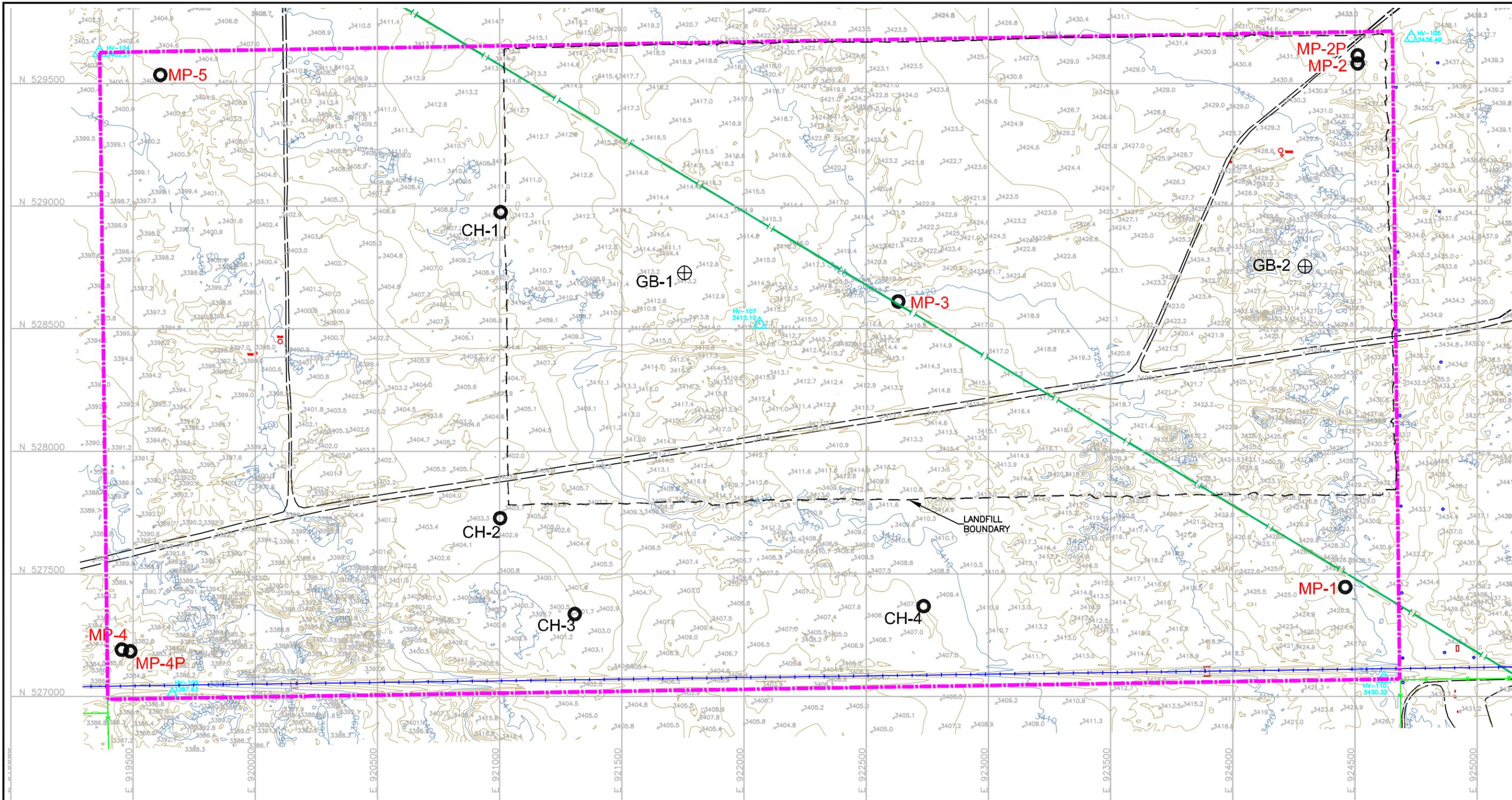
In accordance with the requirements set forth in 19.15.36.8.C(15) NMAC; this Report documents the field program to collect site-specific geological and hydrological data for the proposed facility. The primary purposes of the supplemental investigation was to confirm the depth-to-groundwater was suitable to meet the appropriate vertical setbacks for an OCD Part 36 Landfill (19.15.36.13.A) NMAC; and to collect data to characterize the site soils for geotechnical design in conformance with 19.15.36.8.C(15)(g) NMAC.

3.2 Scope

The scope of the work documented herein was developed in consultation with the OCD following an initial site investigation; a meeting with OCD on 07/01/09; and subsequent phone and e-mail correspondence. The scope of work for the supplemental drilling is presented in *Supplemental Drilling Plan – Sundance Services, Inc., Lea County, New Mexico, September 2009* (Supplemental Plan) as submitted to OCD by GEI. Approval of the Supplemental Plan was issued by OCD via e-mail (**Attachment C**) that also included approval of two additional coreholes (CH-3 and CH-4) that were not a part of the original Supplemental Plan.

3.3 Previous Investigations

The initial site-specific investigation was conducted in April 2009 as documented in *Completion Report – Drilling, Sampling, and Monitoring Well Installation – Sundance Services Inc., Lea County, New Mexico, June 2009* (Completion Report). Five soil borings (MP-1 through MP-5) were drilled at the locations shown on **Figure 4**. Two additional soil borings were drilled adjacent to MP-2 and MP-4 (MP-2P and MP-4P, respectively) in order to install shallow groundwater monitoring wells near these locations (**Figure 4**). Borings MP-1 through MP-5 were drilled at locations within the site area to characterize the shallow geology and hydrogeology to depths up to 150 feet below existing site grade (corresponding to a potential 50' depth of cell excavation). Wells MP-2P and MP-4P were completed subsequent to drilling and sampling of borings MP-1 through MP-5 to monitor thin, isolated zone(s) of free water perched on top of, and/or within, the upper Chinle Formation (Chinle) as described in the Completion Report.



- - - - - PROJECT BOUNDARY
- LANDFILL BOUNDARY
- GB-1 ⊕ GEOTECHNICAL BORING LOCATION
- CH-1 ● COREHOLE LOCATION
- MP-1 ● BOREHOLE LOCATION
- MP-2P ● MONITORING WELL LOCATION

AERIAL SURVEY BY THOMAS B. MANN & ASSOCIATES
 AERIAL MAPPING SERVICES
 5115 COPPER NE, ALBUQUERQUE, NM 87108
 DATE OF PHOTOGRAPHY 10-01-08

LEGEND

- - - - - EXISTING FENCE SECTION, 1/4 SECTION LINE
- UNPAVED ROAD
- POST
- POWER POLE
- LIGHT POLE
- MISC./UNIDENTIFIED OBJECT
- RAILROAD TRACK
- PIPE CULVERT
- BOX CULVERT
- STORAGE TANK
- CONCRETE SLAB

- - - - - EXISTING PIPELINE
- SPOT ELEVATION
- INTERMEDIATE CONTOUR
- INDEX CONTOUR
- INTERMEDIATE DEPRESSION
- INDEX DEPRESSION
- CONTROL POINT
- GRID LINE/LABEL

LOCATIONS OF BORINGS, CORE HOLES AND MONITORING WELLS

SUNDANCE WEST
 SUNDANCE SERVICES INC.
 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: 11/20/09	CAD: WEST BOREHOLES-MW.dwg	PROJECT #: 530.01.01
DRAWN BY: MLH	REVIEWED BY: IKG	FIGURE 4
APPROVED BY: IKG	gel@gordonenvironmental.com	

Drawing: P:\acad 2003\530.01.01\PERMIT FIGURES\WEST BOREHOLES-MW.dwg
 Date/Time: Nov, 20, 2009-09:37:25
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The local hydrogeology and geotechnical conditions have been studied more intensively than any other locale that we are familiar with. There are four projects within 1.5 miles that have each implemented subsurface investigations in response to regulatory siting requirements:

1. Waste Control Specialists, Inc. (TCEQ, NRC, USEPA)
2. Lea County Landfill (NMED)
3. LES Nuclear Enrichment Facility (NRC)
4. Sundance Services, Inc. (OCD)

4.0 DRILLING, SAMPLING, PLUGGING AND ABANDONMENT, AND LABORATORY ANALYSES

This section provides a summary of the work performed and details of the materials encountered. **Attachment B** includes the *Well Record & Log* submitted by Rodgers to the New Mexico Office of the State Engineer (OSE) for each of the coreholes and borings, and **Table 1** provides surveyed coordinates for the coreholes and borings.

Table 1
Summary of Surveyed Coordinates for Coreholes and Borings

Boring	CH-1	CH-2	CH-3	CH-4	GB-1	GB-2
Northing ¹	528975.83	527727.07	527335.92	527368.07	528727.98	528754.35
Easting ¹	921004.45	921002.39	921307.46	922734.70	921756.64	924294.95
Surface Elevation ²	3410.89	3403.40	3401.30	3408.44	3412.93	3427.14

Notes:

Survey by Pettigrew & Associates, Hobbs, New Mexico on October 30, 2009

All borings were plugged and abandoned to surface

¹Modified ground coordinates; NM State Plane – East Zone NAD83

²Elevations are NAVD88

4.1 Continuous Coreholes CH-1 through CH-4

Coreholes CH-1 through CH-4 were drilled with a single, portable CME 75 drill rig using the hollow-stem auger (HSA) methods. Drilling of the coreholes began on October 3, 2009; and concluded on October 10, 2009. Samples of auger drill cuttings were examined continuously to aid in visual and physical classification of the subsurface materials. During HSA drilling, the materials were cored continuously using a 5-foot long, 3.5-inch OD (2.5-inch ID) split barrel sampler. At each 5-foot interval to total depth, the sampler was tripped to the surface for

detailed examination of the core, and collection of samples at selected intervals for visual classification and laboratory analysis for geotechnical properties. The coreholes were drilled to depths ranging from 79 feet (CH-3 and 4) to 154 feet (CH-1) below existing grade. Coreholes CH-3 and CH-4 were drilled to a depth of 79' in order to confirm compliance of the south corridor for other non-landfill operations subject to the 50' vertical groundwater setback (i.e., lined ponds and processing facilities). **Attachment D** includes the boring logs for coreholes CH-1 through CH-4, and photographs of the coring operations are included in **Attachment A**.

As illustrated in the boring logs in **Attachment D**, the shallow stratigraphy consists of very fine to medium-textured sand with variable silt from the surface to the top of the Chinle. This layer is referred to as the Ogalalla/Antlers/Gatuña (OAG) formation in other local studies (Section 3.3). Variable thickness of caliche and/or caliche-cemented sand is typical at depths starting approximately 5 to 20 feet below the surface. The Chinle redbeds below the unconsolidated sand are typically claystone to siltstone, with limited zones of very fine-to fine textured sand/sandstone. All materials encountered in coreholes CH-1 through CH-4 were dry or occasionally slightly moist. No free water or saturated materials were encountered in the coreholes. The stratigraphy encountered in coreholes CH-1 through CH-4 is consistent with that encountered during the initial site investigation, and with regional investigations.

4.2 Geotechnical Borings GB-1 and GB-2

Following drilling of the CH coreholes (see Section 4.1), two geotechnical borings were drilled at the locations shown on **Figure 4** to characterize geotechnical conditions within the proposed landfill footprint. Each boring was drilled using the same CME 75 HSA drill rig used to drill the coreholes on October 10, 2009. **Attachment D** includes the borehole logs for borings GB-1 and GB-2 and **Attachment A** includes photographs of the drill rig at borings GB-1 and GB-2.

Boring GB-2 was drilled first, and drive samples were attempted at five-foot intervals to a total depth of 46 feet below existing grade. Below a depth of 10 feet, the materials were hard/dense and standard blow counts using either a standard split spoon sampler or California sampler were greater than 50 per 6 inches. Competent samples of the material below 10 feet were not always possible because of their hard/dense nature. However, good, undisturbed ring samples

were retrieved at depths of 15 and 45 feet for analysis of geotechnical properties. Selected additional auger cuttings samples were collected for material classification and Proctor density (“compaction ratios”) as required in 19.15.36.8.C(15)(g) NMAC.

Boring GB-1 was also completed to a total depth of 46 feet below grade. Because of the difficulty driving the split spoon in boring GB-2, only two samples were collected from GB-1 for laboratory analysis at depths of 20 feet and 45 feet, respectively using the California sampler. Selected additional auger cuttings samples were collected for material classification and proctor density (“compaction ratios”) as required in 19.15.36.8.C(15)(g) NMAC.

All of the materials encountered in borings GB-1 and GB-2 were dry to slightly moist. No free water or saturated materials were encountered in the borings. The stratigraphy encountered in GB-1 through GB-2 is consistent with that encountered in coreholes CH-1 through CH-4; with the materials encountered during the initial site investigation; and with regional investigations.

4.3 Plugging and Abandonment

Each corehole and geotechnical boring was abandoned to the surface using 5 percent bentonite-cement grout slurry. **Attachment E** includes the borehole plugging certification as provided by Rodgers.

4.4 Laboratory Analyses

Table 2 summarizes the samples submitted to AMEC Earth Environmental, Inc. (AMEC) for analysis of the engineering properties indicated. **Attachment F** includes the laboratory report from AMEC. Selected properties are included on the borehole logs in **Attachment D**. The engineering properties of the materials tested will be used to help characterize the site materials in conformance with 19.15.36.8.C(15)(g) NMAC; and for design of the site containment features.

Table 2
Summary of samples submitted for geotechnical laboratory testing

Sample ID	Depth	Perm^a	Dry Density/ Porosity	GAMC^b	Standard Proctor	Consol/ Swell^c
GB-1	15-20			X	X	
	20	X	X	X		X
	40-45			X	X	
	45	X	X	X		X
GB-2	5			X		
	10-20			X	X	
	15	X	X	X		X
CH-1	154			X		
CH-2	149			X		
CH-3	79			X		
CH-4	64			X		
Total:		3	3	8	3	3

See **Attachment F** for laboratory testing results and specific ASTM designations

^aPermeability (saturated hydraulic conductivity)

^bGAMC = grain size; Atterberg limits; moisture content; USCS classification

^cconsolidation or swell, dependent upon material