Engineering Solutions & Design, Inc.
SOLID WASTE PLANNING, DESIGN AND CONSTRUCTION SERVICES

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51 Corporate Woods
9393 W. 110th Street, Ste 500
Overland Park, KS 66210

October 25, 2018

Mr. Fonda Apostolopoulos, Project Manager
Voluntary Clean-Up Program
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South, Building B-2
Denver, CO 80246

RE: Application for Voluntary Clean-Up
Remediation of Existing Landfill on Property Located in the Northwest Quarter of Section 1, Township 14 South, Range 67 West in Colorado Springs, CO

Dear Mr. Apostolopoulos:

On behalf of MVS Development, LLC, I am submitting two copies of the referenced document. The review fee of $2,000.00 is being forwarded separately. We appreciate the opportunity to submit this application and your consideration of our request. Improvements are planned for the entire property; and, significant improvements are planned to address the existing abandoned landfill, which will be of benefit to the citizens of Colorado Springs. As requested, we are also submitting one copy of the application to the City of Colorado Springs.

Should you have any questions regarding this matter, please do not hesitate to contact me at: (800) 298-1851 Ext. 1.

Sincerely,

ENGINEERING SOLUTIONS & DESIGN, INC.

Jack P. Chappelle, P.E.

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APPLICATION FOR VOLUNTARY CLEAN-UP

Remediation of Existing Abandoned Landfill Mesa Valley Springs Property Colorado Springs, Colorado

Prepared for
MVS Development, LLC
5300 DTC Parkway, Ste 270
Greenwood Village, CO 80111

COLORADO REGISTERED PROFESSIONAL ENGINEER
JACK PATRICK CHAPPELLE
19749

10/25/18

Prepared by
Engineering Solutions & Design, Inc.
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(800) 298-1851

October 25, 2018

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VOLUNTARY CLEANUP AND REDEVELOPMENT ACT
CHECKLIST AND INFORMATION COMPARISON TABLE

This table provides a checklist of information that may be included in a Voluntary Cleanup Program application. Although not all information requirements apply to all sites, the applicant should review this list carefully and include in the application any information that is relevant to the property in question. The table should be submitted in the application, with the page numbers in the application where this information can be found inserted into the last column. This is not an application requirement, but it does greatly assist the reviewer.

This table may also be used to compare the information normally contained in Phase I and Phase II Environmental Audits, with the requirements of the Voluntary Cleanup Program application. Since these audits are commonly performed, the table will assist owners in determining any additional information that may be needed, if you have already performed a Phase I or Phase II audit.

DIRECTIONS FOR COMPARISON TABLE INTERPRETATION

The table that follows is organized like the one below.

P I	P II	VC	I. General Information	Page

The first three columns provide the comparison between the information requirements of Phase I (PI) and Phase II (P II) Environmental Audits and the Voluntary Cleanup Program application (VC). In each column you will either see a blank space, a zero (0), a plus sign (+) or a minus sign (-). These can be interpreted as follows:

+	means requirements are more detailed than other documents
-	means requirements are less detailed than other documents
0	means requirements are similar to other documents
	a blank means that the requirement does not exist for that document

So, for example, if you saw a (+) in the VC column, it means that there are additional information requirements for the Voluntary Cleanup Program application in comparison to the audit reports for that item. If there was a (0) in the VC column, then the information contained in the Phase I or Phase II audit is adequate for the Voluntary Cleanup Program application.

The fourth column provides the checklist of information items required in the Voluntary Cleanup Program application.

The fifth column provides a place for you to insert the page number from the Voluntary Cleanup Program application that pertains to this informational item. If the applicant fills this portion out and returns the table with the application, it greatly assists the reviewer in finding information within the application.

VOLUNTARY CLEANUP, ASTM PHASE I, ASTM PHASE II COMPARISON

P I	P II	VC	I. GENERAL INFORMATION	Page
0	0	0	Name and address of owner	GI-1
0	0	0	Contact person and phone number	GI-1
0	0	0	Location of property	GI-1
-	+	+	Type and source of contamination	GI-1
		+	Voluntary Clean-up (VC) or No Action Determination (NAD)	GI-1
0		0	Current Land Use	GI-1
		+	Proposed Land Use. Proposed future land use is not covered in a Phase I or II assessment. A voluntary cleanup approval is contingent upon this item.	GI-1

P I	P II	VC	II. PROGRAM INCLUSION	Page
-		+	Is the applicant the owner of the property for the submitted VC or NAD? In a Phase I assessment, the owner is not always the party preparing the assessment. The Voluntary Cleanup Program requires owner/designated representative to complete the submittal.	GI-1
-		+	Is the property submitted for the VC or NAD the subject of corrective action under orders or agreements issued pursuant to provisions of Part 3 of Article 15 of this Title or the federal RCRA 1976 as amended? Although Phase I assessments review state records for RCRA corrective actions, the Voluntary Cleanup Program requires details of a corrective action for an eligibility determination.	NO
-		+	Is the property submitted for the VC or NAD subject to an order issued by or an agreement with the Water Quality Control Division pursuant to Part 6 of Article 8 of this Title? Although Phase I assessments review state records, detail is not discussed. If Water Quality has issued a permit, the applicant is ineligible.	NO
-		+	Is the property submitted for the VC or NAD a facility that has or should have a permit or interim status pursuant to Part 3 of Article 15 of this Title for treatment, storage or disposal of hazardous waste? Although Phase I assessments review state records, detail is not discussed. For the Voluntary Cleanup Program, details of permits or interim status are necessary for an eligibility determination. Based on the site specifics of the permitted facility, the applicant may qualify for the program.	NO
-		+	Is the property submitted for the VC or NAD subject to the provisions of Part 5 of Article 20 of Title 8 (Underground Storage Tanks) CRS or of Article 18 of this Title (RCRA)? Although Phase I assessments review state records, detail is not discussed. For the Voluntary Cleanup Program details of Underground Storage Tank or RCRA requirements are necessary to make an evaluation. In some cases (e.g., tanks were removed prior to 12/22/88), the applicant may be eligible for the program.	NO
-		+	Is the property submitted for the VC or NAD listed or proposed for listing on the National Priorities List of Superfund sites established under the federal act (CERCLA)? Although Phase I assessments review state records, detail is not discussed. For the Voluntary Cleanup Program, details of CERCLA action are necessary to make an evaluation. In some cases, the applicant may not be eligible for the program.	NO

P I	P II	VC	III. ENVIRONMENTAL ASSESSMENT	Page
0	0	0	Qualified environmental professionals must submit environmental assessments. The applicant must submit documentation, in the form of a statement of qualifications or resume.	GI-1
0	0	0	The applicant should provide the address and legal description of the site and a map of appropriate scale identifying the location and size of the property.	GI-1
0		0	The applicant should describe the operational history of the property in detail, including the most current use of the property.	GI-1
0		0	A description of all business/activities that occupy or occupied the site as far back as record/knowledge allows.	PD1
-		+	A brief description of all operations that may have resulted in the release of hazardous substances or petroleum products at the site, both past and present, including the dates activities occurred at the property and dates during which the contaminants were released into the environment. Although Phase I & II assessments may reveal the release of hazardous substances or petroleum products, the exact dates and quantities may not be discussed. For the Voluntary Cleanup Program, the dates of activities, releases, etc., are necessary for an evaluation of eligibility.	PD1
-		+	A list of all site-specific notifications made as a result of any management activities of hazardous substances conducted at the site, including any and all Environmental Protection Agency ID numbers obtained for management of hazardous substances at the site from either the state or the Environmental Protection Agency. The Phase I assessment will reveal whether a facility has an Environmental Protection Agency ID number, but will not list the notifications made as a result of management activities of hazardous substances. This information is necessary for a Voluntary Cleanup Program evaluation.	NA
0		0	A list of all notifications to county emergency response personnel for the storage of reportable quantities of hazardous substances required under Emergency Planning and Community Right-to-Know statutes.	NA
0		0	A list of all notifications made to state and/or federal agencies, such as reporting of spills and/or accidental releases, including notifications to the State Oil Inspection Section (OIS) required under 8-20-506 and 507 and 25-18-104 CRS 1989 as amended and 6 CCR 1007-5 subpart 280.50 Part 3 of the OIS regulations, etc.	NA
-	-	+	A list of all known hazardous substances used at the site with volume estimates and discussion of relative toxicities. A Phase I & II assessment does not require such detail, however, the hazardous substances used, volumes and toxicities are important for a VC in the overall evaluation of risk and sampling efforts.	NA
-		+	A list of all wastes generated by current activities conducted at the site and manifests for shipment of hazardous wastes off site. A Phase I & II assessment does not require such detail, however, the manifest information is important for a VC evaluation, as in the above item.	NA
		+	A list of all permits obtained from state or federal agencies required as a result of activities conducted at the site. A listing of all permits is beyond a Phase I or II assessment. These are important for the Voluntary Cleanup Program so the Department can evaluate what potential sources may be at the site.	NA
0		0	A brief description of the current land uses, zoning and zoning restrictions of all areas contiguous to the site.	PD-6

P I	P II	VC	III. ENVIRONMENTAL ASSESSMENT	Page
			The applicant shall describe the physical characteristics of the site, including a map to scale, and an accompanying narrative showing and describing the following, utilizing historic knowledge as well as current data:	
0	0	0	• Topography	PD-3
0	-	0	• All surface water bodies and waste water discharge points	NA
0	-	0	• Ground water monitoring and supply wells	PD-3
0	-	0	• Facility process units and loading docks	NA
0		0	• Chemical and/or fuel transfer and pumping stations	NA
0		0	• Railroad tracks and rail car loading areas	NA
0		0	• Spill collection sumps and/or drainage collection areas	NA
0		0	• Wastewater treatment units	NA
0		0	• Surface and storm water runoff retention ponds and discharge points	PD-3
0		0	• Building drainage or wastewater discharge points	NA
0		0	• All above or below ground storage tanks	NA
0		0	• Underground or above ground piping	NA
0		0	• Air emission control scrubber units	NA
0		0	• Water cooling systems or refrigeration units	NA
0		0	• Sewer lines	NA
0		0	• French drain system	NA
0		0	• Water recovery sumps and building foundations	NA
0		0	• Surface impoundments	NA
0		0	• Waste storage and/or disposal areas/pits, landfills	PD-3
0		0	• Chemical or product storage areas	NA
0		0	• Leach fields	NA
0		0	• Dry wells or waste disposal sumps	NA
			If ground water contamination exists or the release has the potential to impact ground water, the applicant should provide the following information for areas within a one-half mile radius of the site:	
	0	0	• The state engineers office listing of all wells within one-half mile radius of the site, together with a map to scale showing the locations of these wells.	PD-4
	0	0	• Documentation of due diligence in verifying the presence or absence of unregistered wells supplying ground water for domestic use, when the potential for such wells is deemed likely as in older residential neighborhoods, or in rural areas.	APP-D
	0	0	• A statement about each well within the half-mile radius of the site, stating whether the well is used as a water supply well or ground water monitoring well.	APP-D
	0	0	• Lithologic logs for all on-site wells; copies of field log notes may be appropriate.	NA
	0	0	• Well construction diagrams for all on-site wells showing screened interval, casing type and construction details including gravel pack, interval, bentonite seal thickness and cemented interval.	NA

P I	P II	VC	III. ENVIRONMENTAL ASSESSMENT	Page
	0	0	• Description of the current and proposed use of on-site ground water in sufficient detail to evaluate human health and environmental risk pathways. In addition, the applicant will provide a discussion of any state and/or local laws that restrict the use of onsite ground water.	PD-4
			The applicant should provide information concerning the nature and extent of any contamination and releases of hazardous substances or petroleum products that have occurred at the site, including but not limited to:	
	-	+	• Identification of the chemical nature and extent, both onsite and offsite, of contamination that has been released into soil, ground water or surface water at the property, and/or releases of substances from each of the source areas identified, including estimated volumes and concentrations of substances discharged at each area, discharge point, or leakage point as per Section 25.16.308(2)(b). Although Phase II assessments identify the nature of contamination, the extent is not always fully defined. For Voluntary Cleanup Program purposes, the source, nature, extent and estimated volumes of the release are important in the overall evaluation of risk and eligibility.	PD-4
	0	0	• A map to scale showing the depth to ground water across the site, direction and rate of ground water movement across the site using a minimum of three measuring points.	APP A-G
	0	0	• A discussion of all hydraulic tests performed at the site to characterize the hydrogeologic properties of any aquifers onsite and in the area.	APP A-G
	0	0	• All reports and/or correspondence, which detail site soil, ground water and/or surface water conditions at the site, including analytical laboratory reports for all samples and analyses.	APP A-G
	0	0	• A discussion of how all environmental samples were collected, including rationale involved in sampling locations, parameters and methodology, a description of sampling locations, sampling methodology and analytical methodology and information on well construction details and lithologic logs. All sample analyses performed and presented as part of the environmental assessment should be appropriate and sufficient to fully characterize all constituents of all contamination that may have impacted soil, air, surface water and/or ground water on the property. The applicant should use Environmental Protection Agency approved analytical methods when characterizing the soil, air, surface water and/or ground water.	APP A-G

P I	P II	VC	IV. APPLICABLE STANDARDS/RISK DETERMINATION	Page
	-	+	The applicant should provide a description of any applicable standards/guidance (federal, state, or other) establishing acceptable concentrations of constituents in soils, surface water, or ground water, for the proposed land use. Although a Phase II assessment evaluates applicable regulations for the current land use, it does not cover the proposed land use that may be different (e.g., the current land use is industrial and the proposed land use is residential, which likely has more conservative levels for contaminant concentrations).	PD-8

P I	P II	VC	IV. APPLICABLE STANDARDS/RISK DETERMINATION	Page
	-	+	The applicant should provide a description of the human and environmental exposure to contamination at the site based on the property's current use and any future use proposed by the property owner, including:	
	0	0	• A table or list for site contaminants indicating which media are contaminated and the estimated vertical and areal extent of contamination in each medium.	NA
	-	+	• A table or list of site contaminants, indicating the maximum concentrations of each contaminant detected onsite in the area where contaminant was discharged to the environment, and/or where the worst effects of the discharge are believed to exist. A Phase II assessment will evaluate the extent of site contaminants, not the maximum point or worst effects. The Voluntary Cleanup Program requests this item so that an understanding of the source and nature of the contaminants can be made as it relates to risk.	APP A-G
	-	+	• A table or list for site contaminants indicating whether the contaminant has a promulgated state standard, the promulgated standard and the medium the standard applies to. A Phase II assessment will not necessarily compare the site contaminants with state standards. This is important to evaluate whether the remedy will meet risk-based cleanup objectives.	APP A-G
	-	+	• A description and list of potential human and/or environmental exposure pathways pertinent to the present use of the property. A risk determination is not usually completed as part of a Phase II assessment; the VC will use risk as part of the overall evaluation.	NA
		+	• A description and list of potential human and/or environmental exposure pathways pertinent to the future use of the property. (A risk determination is not usually completed as part of a Phase II assessment; the Voluntary Cleanup Program will use risk as noted above. Phase II assessments also do not evaluate future use of the property.)	PD-3
	-	+	• A list and map defining all source areas, areas of contamination or contaminant discharge areas. Phase II assessments do not always show source areas. The Voluntary Cleanup Program requires that these areas be defined to indicate the proximity of contaminant with respect to receptors and sampling efforts.	PD-3
	-	+	• A discussion of contaminant mobilities, including estimates of contaminants to be transported by wind, volatilization, or dissolution in water. For those contaminants that are determined to be mobile and have the potential to migrate and contaminate the underlying ground water resources, the applicant should also evaluate the leach ability/mobility of the contaminants. This evaluation should consider, but not be limited to the following: leachability/mobility of the contamination, health-based ground water standards for the contamination; geological characteristics of the vadose zone that would enhance or restrict contaminant migration to ground water, including but not limited to grain size, fractures and carbon content; and depth to ground water. This evaluation, and any supporting documentation, should be included in the plan submitted. A Phase II assessment usually does not include a risk determination. However, the Voluntary Cleanup Program will evaluate the risk involved with the proposed cleanup in order to evaluate the application.	PD-8

P I	P II	VC	IV. APPLICABLE STANDARDS/RISK DETERMINATION	Page
		+	The applicant should then provide, using the information contained in the application, a risk-based analysis of all exposure pathways, which details how the proposed remediation will obtain acceptable risk levels. A Phase II assessment usually does not include a risk analysis, however, the Voluntary Cleanup Program requires this analysis to show that the remediation propose will attain an acceptable risk or break pathways.	PD 8-9
		+	The Voluntary Cleanup Program includes remediation whereas a Phase I or II assessment does not. Usually remediation is considered a Phase III assessment. The following are the requirements for the clean-up proposal.	PD 8-9
		+	• A detailed description of the remediation alternative, or alternatives selected, which will be used to remove or stabilize contamination released into the environment or threatened to be released into the environment	PD 3
		+	• A map identifying areas to be remediated, the area where the remediation system will be located if it differs from the contaminated areas, the locations of confirmation samples, the locations of monitoring wells, areas where contaminated media will temporarily be stores/staged and areas where contamination will not be remediated.	NA
		+	• Remediation system design diagrams showing how the system will be constructed in the field.	NA
		+	• A remediation system operation and maintenance plan that describes, at a minimum, how the system will be operated to ensure that it functions as designed without interruptions and a sampling program that will be used to monitor its effectiveness in achieving the desired goal.	NA
		+	• The plan should describe the sampling program that will be used to verify that treatment of the contaminated media has resulted in attainment of the proposed cleanup goals.	PD 8-10
		+	• The plan should include a schedule of implementation	PD 8
		+	The cleanup completion report is necessary to demonstrate that the remediation was completed according to the application. Again, since remediation is involved, the report is beyond the scope of a Phase I or II assessment. The following items should be included in the completion report.	
		+	• A final list of all site contaminants, along with the remaining concentrations, and any deviations from the original plan.	PD 8-10
		+	• A final list defining which media are contaminated and the estimated vertical and areal extent of contamination to each medium.	PD 8-10
		+	• A final list and map defining all source areas, areas of contamination or contaminant discharge areas.	PD 3-10
			Soil Contamination: Remediation by Excavation Only:	
		+	• One confirmation sample per 500 ft^2 as measured at the base on the excavation OR two confirmatory samples, whichever method results in the collection of the most samples.	PD 8-10

P I	P II	VC	IV. APPLICABLE STANDARDS/RISK DETERMINATION	Page
		+	• One composite sample from each wall of the excavation. In excavations of an irregular shape, one composite sample for every 100 lineal feet of wall. For excavations grater than 5000 ft^2, preparation of a grid for randomization of sampling.	APP J
		+	• Explanation of the sampling method in the narrative as well as any modifications to 1 and 2 above used to better characterize the remedial efforts.	PD 3-10
		+	• If contamination is to be left in place, an additional sample should be collected from the area of the worst contamination, as verified or with a field-sampling device.	PD 3-10
		+	• Depth of samples collected	PD 3-10
		+	• Provision of waste disposal manifests	NA
			In-Situ Soil Remediation	
		+	• Completion of a minimum of two soil borings, with at least one completed in the area identified in the site assessment as the area of highest contamination. For larger areas of contamination, one boring per 10,000 ft^2 of plume area.	NA
		+	• Completion of the borings should employ a field-screening device and borings should be logged.	NA
		+	• Soil sample submitted for analysis from each boring would be the sample with the highest field screening or one located at the ground water interface for each boring.	NA
		+	Ground Water Remediation	
		+	• Field testing should include aquifer and contaminant characteristics such as gradient, partition coefficients, original contaminant levels, etc.	NA
		+	• At each regular monitoring event, a map showing ground water flow direction, depth to ground water and sampling locations	NA
		+	• Tabular presentation of data collected	NA
		+	Summary of Voluntary Cleanup Program participation	PD 3-10
		+	Summary of field activities, remedial activities, any deviations from original plans	PD 3-10
		+	Pertinent figures and drawings of remedial system	NA
		+	Conclusions made after remedial activities are completed	NA

Application for Voluntary Clean-up of Existing Landfill Located within Mesa Valley Springs Property Colorado Springs, Colorado

GENERAL INFORMATION

Property Owner:
MVS Development, LLC
5300 DTC Parkway, Suite 270
Greenwood Village, CO 80111

Contact Person:
Mr. Ted Waterman
(505) 248-1688

Property Location:
Southwest Corner of Van Buren Street and Centennial Boulevard; Section 1, Range 67 West, Township 14 South; Colorado Springs, Colorado

Type and Source of Contamination: Municipal Solid Waste and Construction Debris

Voluntary Clean-up: Yes

Current Land Use: Vacant Land

Proposed Land Use: Planned Unit Development; Residential Housing

Environmental Professionals Utilized:
Site Investigations and Soil Borings, 1986
Lincoln DeVore, Inc.
Colorado Springs, CO

Site Investigations and Soil Borings, 2005, 2006, 2007, 2011, and 2018
Kleinfelder, Inc.
Colorado Springs, CO

Site Analysis, Reconsolidation Program, and Application Preparation, 2006, Reapplication 2011, and Reapplication 2018
Engineering Solutions & Design, Inc.
Overland Park, KS

All individuals working on this project as a part of the environmental professional's team each possess more than 12 years of experience in site assessments, solid waste site analysis, and the development of closure plans and site improvements.

PROGRAM DESCRIPTION

INTRODUCTION

MVS Development, LLC (MVS) purchased a 48-acre property within the limits of Colorado Springs, Colorado, for the purpose of developing it as a residential community (see location map provided in Figure 1). A portion of this property – approximately 17.9 acres – is underlain by an old abandoned landfill. To allow for the optimal development of this property and to limit the impact of this landfill on future homeowners, MVS desires to consolidate the landfill into a smaller area and properly close it, which will significantly reduce any impact the landfill may have on surrounding properties and the environment.

SITE HISTORY

The subject property is located in Section 1, Range 67 West, Township 14 South, within the limits of Colorado Springs, Colorado (see site map provided in Figure 2). The entire parcel is 48 acres, of which 17.9 acres is underlain by an abandoned landfill, which is located in the middle to eastern portion of the property. The landfill appears to have been located within a large gully or stream that ran north-to-south through the site. The natural terrain of the area slopes to the south, southeast.

Numerous investigations have been performed at the site, with the first detailed investigation occurring in 1986. These investigations have included various assessments of the landfill and have included a number of soil borings into the landfill.

Aerial photographs of the site together with information from these investigations indicate that the landfill was active from the 1950's to at least 1966. Soil borings taken in 1986 and 2005 indicate the landfill follows the general course of the gully described above. The depth of solid waste appears to vary from less than 5 feet to over 40 feet. Cover over the solid waste also varies, with soil cover on portions of the landfill being less than 1 foot to more than 25 feet. The greatest depth of cover appears to be in the southern portion of the landfill.

Based upon a review of Colorado Department of Health and Environment (CDPHE) records, the landfill was not registered or permitted by the state or county. Further, from the types of materials found in the test pits and soil borings taken at the site, the landfill contains both municipal and construction wastes. The test pits, soil borings, and surface conditions indicate that the solid waste was not compacted or uniformly placed.

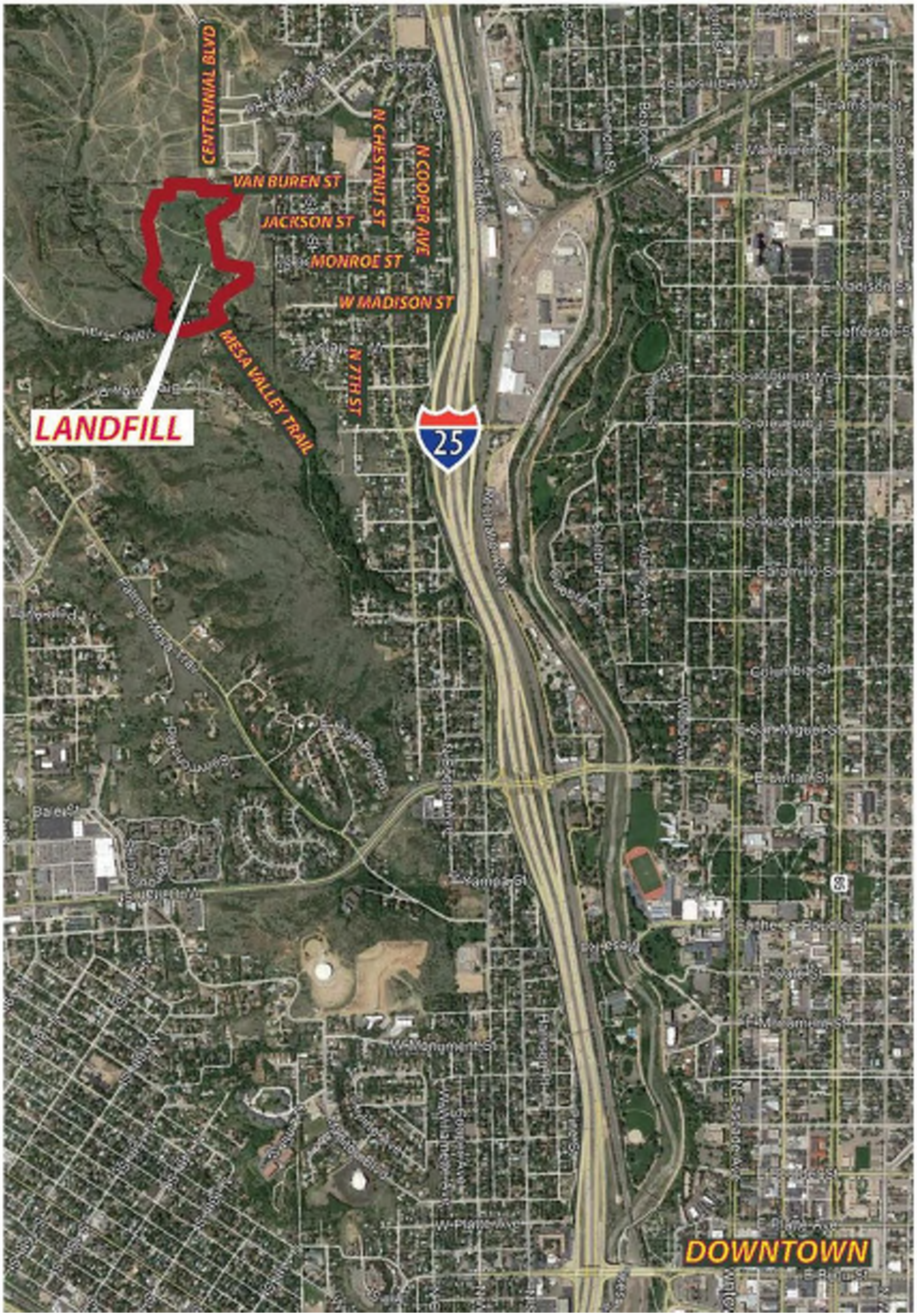


FIGURE 1.
LOCATION MAP

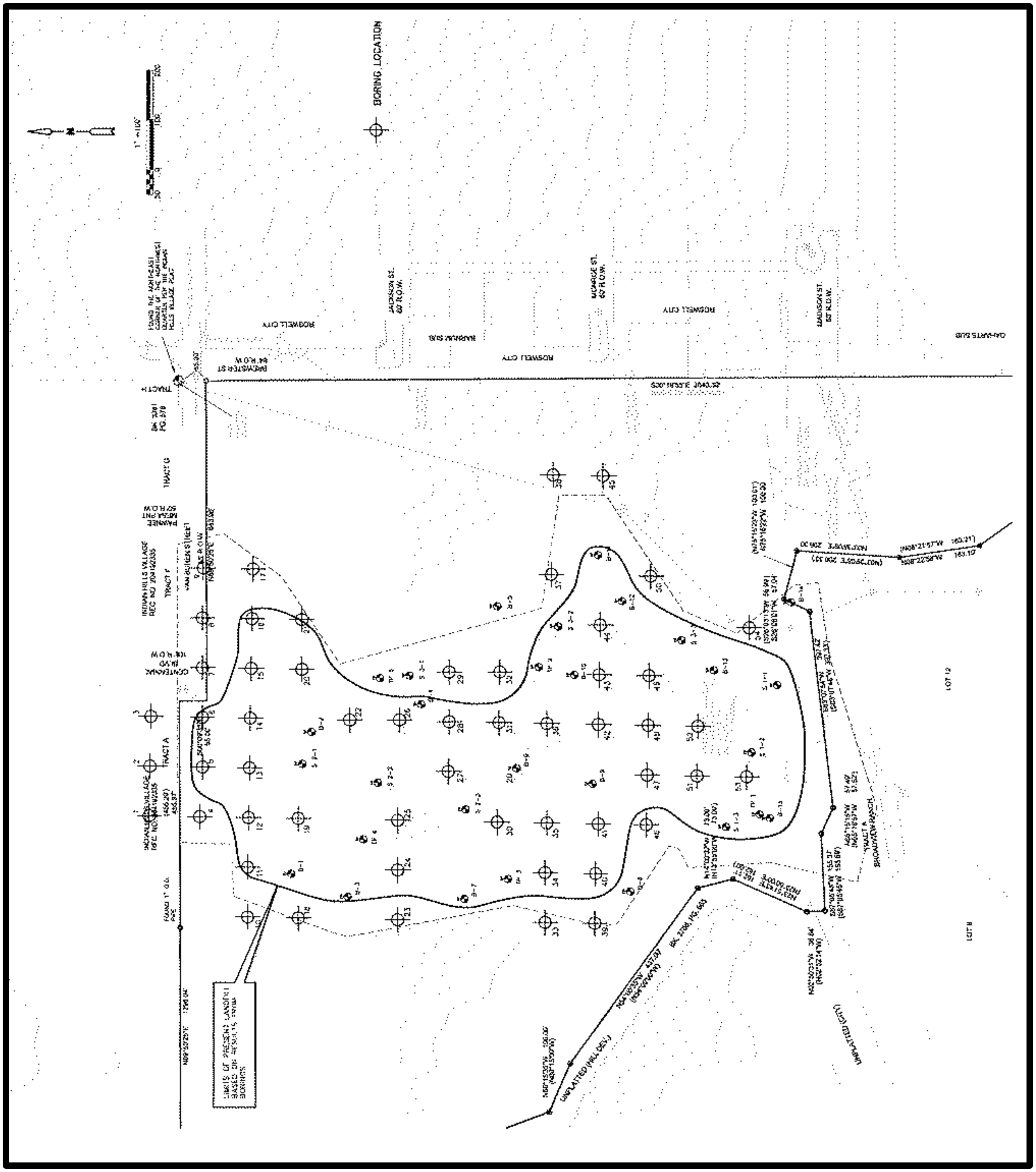


FIGURE 2. SITE MAP

SITE CHARACTERIZATION

As indicated previously, numerous investigations have been conducted on the landfill site. These investigative studies include:

“Landfill Site Assessment”, Lincoln Devore, Inc., August 12, 1986 (see Appendix A).

“Delineation and Evaluation of Existing Landfill”, Kleinfelder, Inc., August 26, 2005 (see Appendix B).

“Soil Boring Investigation”, Kleinfelder, Inc., November 30, 2005 (see Appendix C).

"Groundwater Sampling & Methane Gas Monitoring", Kleinfelder, Inc., April 3, 2006 (see Appendix D).

"Subsurface Investigation", Kleinfelder, Inc., January 17, 2007 (see Appendix E).

"Assessment Report", Kleinfelder, Inc. August 23, 2018 (see Appendix F).

A total of 50 soil borings, 5 test pits, 19 gas monitoring wells, and 20 groundwater wells were completed as a part of these six investigative studies. The following paragraphs describe the results of these investigations.

The soil borings and test pits excavated in 1986, 2005, and 2018 indicate the landfill follows the general course of a gully that bisects the property from north to south. The depth of solid waste appears to vary from less than 5 feet to more than 40 feet. Cover over the solid waste also varies, with soil cover on portions of the landfill being less than 1 foot to more than 25 feet. The greatest depth of cover appears to be in the southern portion of the landfill.

Groundwater depths vary at the site and appear to be related to drainage in the area and the relatively shallow bedrock, which varies in depth from 11 feet to a little less than 60 feet under the landfill. Groundwater depth varies from 11 feet to over 40 feet. The occurrence of groundwater appears to mirror the existing stream or gully channel through the existing landfill. In addition to these groundwater depths, groundwater wells were located in the sections of land that incorporated the site as well as those sections to the north, northwest, and east. It is important to note that all residential, commercial, and industrial units within the city limits must be connected to the city’s water supply system.

Fifteen gas monitoring wells were installed and sampled in 2005. These wells were sampled for landfill gas over a two-day period and methane concentrations ranging from 2% to 60%, by volume, were recorded in 8 of the wells. In 2006, another 4 gas monitoring wells were installed and sampled. Methane was not detected in any of these 4 wells.

Seven groundwater wells were sampled for landfill gas in July 2018 using a 4-gas monitor. Kleinfelder, Inc. collected measurement of methane (CH_4), hydrogen sulfide (H_2S), and oxygen (O_2) at these 7 wells. Methane and depressed oxygen levels were detected in 2 wells; therefore, air samples were collected from these wells and submitted to an accredited laboratory for methane analysis. Analytical results indicate methane concentrations of 82.4%, by volume, in one well; and, a second well had a methane concentration of 0.399%, by volume. There was no detection of methane in the other five wells.

It is not surprising to find areas of high gas readings because of the shallow groundwater and age of the landfill. Because of the soils utilized to cover the landfill and the variance in the depth of the soil cover over the site, the generation of landfill gas may occur and could be sustained for a number of years if the site remains in its present condition. Landfill gas generation is likely occurring because proper final cover was not installed, surface and groundwater is infiltrating into the solid waste, and the solid waste is poorly consolidated or compacted.

Soils at the site are silty sand and clayey materials that vary in consistency dependent on the amount of sand mixed with the clay. The clay material appears to be at the base of the landfill and the soil borings indicate that the solid waste material is mixed with the silty sands, which were also utilized to cover the landfill. The landfill material appears to consist of woods, plastics, newspaper, glass, metals, rubber, and some construction and demolition debris.

The properties around the subject property are mostly zoned for residential or planned unit development (see Figure 3). The subject property is zoned for planned unit development (see Figure 4). These zoning maps in Figure 3 and 4 include the project location and properties within one-half mile of the project.

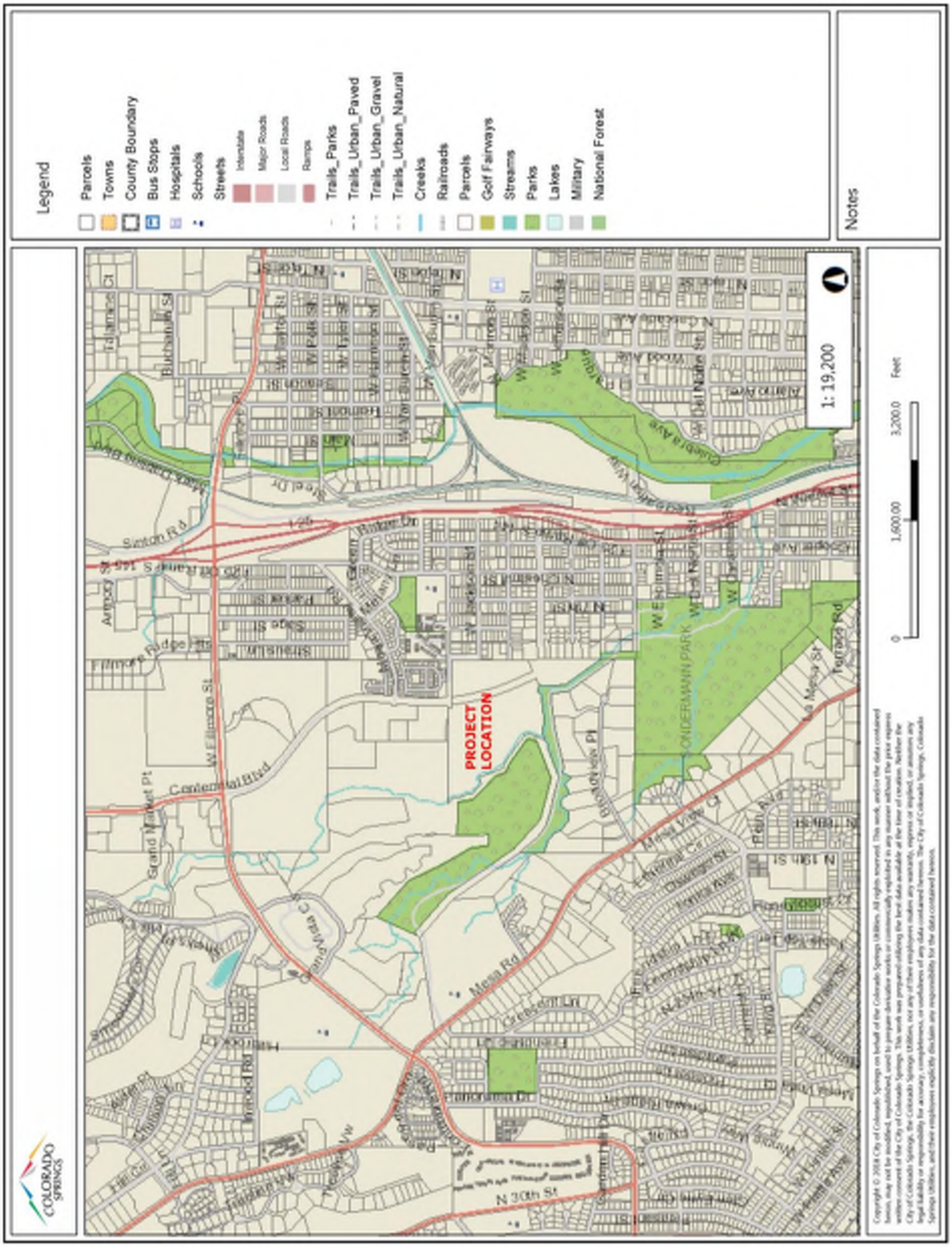


FIGURE 3.
ZONING MAP OF AREA SURROUNDING THE PROJECT LOCATION.

FIGURE 4.
ZONING MAP OF PROJECT LOCATION.

REMEDIATION PLAN

The centerpiece of the remediation plan is the consolidation of the landfill to provide a more environmentally-secure site that also allows for reclamation of a portion of the landfill. Based on site investigations, solid waste deposited in the landfill consists of a large amount of wood, paper, plastics, metals, and some construction and demolition debris. Because no CDPHE records exist regarding this landfill, it is suspected that the site was utilized as an open-dump site with limited or no supervision. Further, it is also likely that little, if any, effort was made to compact the waste. Given these circumstances, it is probable a number of voids exist within the landfill. In addition, because the site was not properly operated, it is expected that a large amount of the fill at the site was soil from other construction sites. Because of the amount of soil found in the various borings taken at the site, it is anticipated that a significant portion of the landfill is comprised of soil.

The age, types of waste, and varying depths of the solid waste in the abandoned landfill make it a prime candidate for consolidation. The consolidation process will involve exposing and excavating the existing solid waste, relocating the waste, and consolidating the waste into a much smaller and more secure landfill cell. The drawings provided in Appendix H provide a 15-step process for the consolidation and closure of the landfill. Consolidation will keep the landfill footprint within the limits of the existing landfill and over the deepest portions of the existing landfill. Solid waste in the shallower portions of the existing landfill will be relocated to the new consolidated landfill area and the area of consolidation will be recompacted to increase available air space.

The final cover for the consolidated landfill will meet the requirements of the State of Colorado, Department of Public Health and Environment, Solid and Hazardous Waste Commission/Hazardous Materials and Waste Management Division, "Regulations Pertaining to Solid Waste Disposal Sites and Facilities, Part B, Section 3, Subsection 3.5, Closure Requirements." The final cover will be designed to address the control of surface water run-off, water infiltration, and landfill gas generation. The final cover's vegetation will be designed to blend into the proposed development. An analysis of final covers and which are most applicable for the consolidated landfill area is provided in Appendix I.

In those areas of the existing landfill where solid waste will be excavated, the excavation will continue until clean soil has been reached. Procedures to be followed in sampling the soil to determine if the soil is clean is provided in the Soil Sampling Program found in Appendix J.

If it is found that the source of water within the landfill is the result of water following the old gully channel, a clay barrier will be installed between the solid waste and the channel to control water flowing freely into the consolidated landfill. This barrier, in conjunction with the compaction and consolidation of the solid waste, will reduce the introduction of water into the landfill.

Throughout the relocation process the materials excavated will be monitored to determine if any of the materials are potential harmful or hazardous. A Materials Management Plan has been developed for this project and can be found in Appendix L.

Efforts to address future erosion problems associated with the consolidated landfill are described in the Erosion Protection Program located in Appendix K. This program describes the approach that will be followed to control erosion of the site once the final cover is installed.

Table 1 provides the estimated quantities of material to be relocated and consolidated as a part of this project. These quantities are based upon available data and may vary based on the actual amount of material discovered during the consolidation process. The final design of the landfill consolidation will include systems to control groundwater infiltration from the gully channel, landfill gas migration, and surface water infiltration. These systems will be designed to function as simplistically as possible and with as little mechanical operation as possible. By establishing these systems and consolidating the landfill, the potential risk to the environment is substantially reduced.

TABLE 1.
ESTIMATED QUANTITIES OF MATERIALS

Existing Landfill Size	17.9 Acres
Consolidated Landfill Size	3.6 Acres
Area Reclaimed	14.3 Acres
Amount of Solid Waste Relocated	190,000 Cubic Yards
Amount of Solid Waste Compacted in Place	175,000 Cubic Yards
Minimum Amount of Soil Backfill Required	185,000 Cubic Yards

In addition to relocating and consolidating the existing solid waste, the southern-most portion of the abandoned landfill will be developed into a detention pond for the site as well as for the new Centennial Boulevard. Appendix O provides information on the proposed approach to develop the stormwater detention pond.

It is anticipated that work at the project location will commence as soon as possible after acceptance of this application. Engineering work will begin as soon as the application is submitted and should be completed within 45 days. The anticipated length of time for completion of the remediation work is 90 to 120 days.

CERTIFICATION PROCESS

As a part of the project, all activities relating to the consolidation of the landfill will be observed, confirmed as complete, and certified by a Professional Engineer registered in Colorado, who will certify the:

- Area where solid waste is removed is clear of solid waste;
- Actual depth of the solid waste in consolidated sections of the landfill;
- Groundwater controls are properly installed;
- Landfill gas controls are properly installed and functioning;
- Drainage system around the consolidated landfill is properly installed;
- Detention pond liner system is properly installed;
- Final cover is properly installed; and
- Final cover is properly revegetated.

A report presenting these certifications will be provided to CDPHE with photographs of the work and all test results. In addition to these certifications, the final design for the consolidation project, the final cover, and any groundwater and landfill gas control systems will be provided to CDPHE prior to commencing any work at the site.

Appendix A

Site Investigation
1986

62841

LANDFILL SITE
SECTION 36, TWP. 13S.
R67W OF THE 6TH P.M.
VAN BUREN AND CENTENNIAL
EL PASO COUNTY, COLORADO

PREPARED FOR

Mr. A. C. Nicholson, Architect
2993 Broadmoor Valley Road
Suite 200
Colorado Springs, CO 80915

PREPARED BY

Lincoln DeVore, Inc.
1000 West Fillmore Street
Colorado Springs, Colorado 80907

TABLE OF CONTENTS

August 12, 1986

Mr. A. C. Nicholson, Architect
2993 Broadmoor Valley Road
Suite 200
Colorado Springs, CO 80915

RE: Landfill Site, Section 36, Twp. 13S., R67W of the 6th P.M., near Van Buren and Centennial.

Dear Mr. Nicholson:

At your request, Lincoln DeVore has drilled six test borings on the site of an existing landfill, covered and abandoned, on the east flank of the Mesa, Colorado Springs, Colorado. The site of the fill is centered approximately 2000' west of Sage Street between Madison Street and Mesa Valley Road in northwestern Colorado Springs. This site lies along the route of Centennial Blvd. as proposed.

Project Scope

The purpose of this explanation was to drill exploration borings generally along the west and south edges of the fill. The results of these borings were then to be added to the results of previous borings in the fill to obtain an approximate depth of fill pattern. The previously drilled borings did not cover the west and south sides of the fill. Types of materials found in the fill were also to be reported.

Scope

The scope of our geotechnical exploration consisted of a surface reconnaissance, a geophoto study, subsurface exploration, laboratory testing, analysis of field and laboratory data, and a review of geologic literature.

For the purposes of this study, the depth of uncontrolled fill was the only site factor to be determined at various points. No further work was intended or ordered. Therefore, few samples of the materials found were taken and no laboratory work was completed other than laboratory examination of the material to verify field classification.

Site Description

The existing, abandoned landfill lies over a large gulley which existed in the side of the Mesa prior to placing the fill. The surface of the landifll is rough, but is reasonably level east-west except for the grades constructed for drainage purposes. This fill lies between two ridges east and west of the fill, which connect to the north of the fill, near Mesa Valley Road, extended. The fill is bounded on the south by an unnammed intermittent stream which discharges into Monument Creek near Caramillo St. This stream was displaced slightly by the fill, but a channel still exists and is open to carry the intermittant flow across the toe of the fill.

Field Exploration

The field exploration was performed on August 1, 1986 and consisted of a site reconnaissance by our geotechnical personnel and the drilling of 6 exploration borings over the fill. The locations of these borings were marked by others and the borings were drilled as staked except for No. 5. This boring was moved ± 90 feet southeast due to poor access of the marked pont. Boring locations are shown on the attached location plan.

The borings were drilled to depths varying from 15' to 30' and all borings were bottomed in the Pierre Shale formation. All exporation borings were drilled using a CME 45 drill and 4 inch solid stem auger. Samples were taken rarely, but both the modified California sampler and Shelby tubes were used. Logs describing the subsurface soils found are presented in the attached figures.

The lines defining the change between soil types or rock materials on the boring logs and soil profiles are determined by interpolation and are therefore approximations. The transition between soil types may be abrupt or may be gradual.

Findings:

General

Previous exploration borings were drilled on this landfill by Lincoln DeVore and the approximate fill depths found have been used in this report to supplement the information found by these recent borings. Previous borings were drilled in 1968, 1976, 1983 and 1985. Those borings pertinent to the site were located on the topographic map and the depth to the bottom of the fill was recorded. In addition to the six exploration borings drilled for this report, the logs for 10 previously drilled borings were used to estimate the depth of fill material on the site.

The site area is largely undeveloped and appears not to have been changed or disturbed appreciably since the landfill was covered over. Topographically the site slopes to the south, draining into an unnamed, intermittant stream. The oversite flow tends to be concentrated in shallow swales due to the roughness of the surface. At least two areas on the surface of the fill are depressed, allowing the ponding of some rain water. Erosion has cut into the fill at the sourtheast corner, leaving a depressed area over the old stream bed caused by removal of the landfill soil and debris. If lack of maintenance continues, erosion will increase by head cutting.

Fill Material and Bedrock

The fill material in the landfill is predominately a lean, silty, slightly sandy clay. It appears to have originated from the weathering of the native local Pierre Shale and has been mixed with some sandy soils. This mixing either is the result of natural colluvial action in the borrow area or is the result of mixing soils during the fill process. This fill material is generally soft, moist to wet and generally of medium plasticity. In place density is low, indicating that it was not properly compacted when placed.

The types of debris found within the clay matrix consisted of various kinds of household waste for the most part. Glass, metal, plastics and tile were all found together with some pieces of furniture and wood. The debris contained quite a bit of paper and other rapidly degrading organic material also, although none was found which could be recognized. The amount of decomposed organics in layers indicates this. Except in borings 5 and 6, no evidence of garbage or gas producing material was found. In these two borings however, the emission of detrimental gases should be expected. Testing for gas was outside the scope of work so that no tests were conducted. The amount of organics and the odor indicate that gases will be produced in this area, however. No definately toxic material could be identified visually, but tests should be performed prior to removing the fill or constructing buildings on the fill to definitely verify the presence or absence of such material.

Pierre Shale bedrock was encountered in the bottom of all exploratory borings. The top foot to two feet of this bedrock was found to be weathered and consists of a medium to high plastic, stiff to very stiff clay. Below this weathered layer the bedrock is hard to very hard and is dry. Due to its plastic properties and low moisture content, the Pierre Shale should be considered to be expansive. Other than the thin weathered zone, no liner was found at the bottom of the landfill.

Groundwater

Groundwater was found in exploration borings 1 and 6. The other borings encountered wet fill immediately above the claystone, but no free water level was established. Since the landfill occupies an old filled gully, it appears that seepage moves down the surface of the claystone until it reaches a stabilized level near the center (deepest portion) of the old gully. At this point, it collects, forming a water surface. The level of this water surface is primarily dependent on the speed it can exit from the fill into the intermittent stream south of the fill.

The presence of groundwater in borings 1 and 6 thus indicates that these points are near the deepest part of the filled gully. Comparison with topographics taken before 1964 (USGS) verify this. No direct comparison of topography can be made due to scaling problems and the normal innaccuracies of air photos, but careful measurements indicate that the lowest line of the old gully follows a meandering line from a point about 80' east of boring 1 to a point about 100' east of boring 6. This lowest line is not straight, but appears to be west of previous borings 2 and 6 and between previous borings 3 and 5.

The level of this groundwater is shown on the boring logs for the date of measurement, August 1, 1986. This water level will vary depending on outside environmental influences and may vary as much as 5 to 6 feet from the measured elevation. Maintenance work on the eroded area of the fill at the southeast corner could also change the water level considerably.

Depth of Fill

The depth of the landfill material, as identified in the six borings drilled, ranges from 7 feet to 26 feet. The average depth of the fill found in these 6 borings is thus 14.9 feet. This is misleading, however, since the site was once a relatively "V" shaped gully. Combining all exploratory borings drilled in the landfill and excluding those drilled outside its limits, the depth of fill was found to range from 4 feet (PTB#7) to 40 feet (PTB#2). Simple averaging of the 17 borings shows an average depth of 18.3' actually measured in borings.

The sides of the unfilled gully were relatively steep prior to placing the landfill. As a result, the depth of fill is such that the borders of the landfill cannot be encroached upon very far before the fill exceeds 8' depth - or basement elevation. In most cases, edge encroachment is restricted to 50' or less. One exception to this appears to be in the north portion of the landfill, near Van Buren Street extended. In this area, encroachment exceeding 100' is possible around the endges of the landfill.

A very generalized topographic map has been prepared to show our best estimate of subsurface contours. Since these have been drawn on the basis of 17 exploratory borings and measured sections from a 1947 topography of the site, these subsurface contours cannot be fully accurate and should not be interpreted as such. They will serve to give a general indication of landfill depth, however, and can be used for preliminary estimating purposes.

The topography shown on the attached approximate depth of fill sketch was produced by aerial photographic methods. In working with this topography, it was noted that the elevations given did not match the USGS elevations by between 25' and 30'. This is about the difference between the USGS mean sea level datum and the old City of Colorado Springs datum. It may well be that this topography was based on the city datum. If so, modern topography will not match the elevations shown, but the slopes and general shape of the topography would be valid. Caution should be used in transferring the elevation data on this sketch to any map of the area. A full topographic survey, based on USGS datum should be completed prior to using the area for any possible construction.

Limitations

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in acceptable or appropriate standards may occur or may result from legislation or the broadening of engineering knowledge. Accordingly, the findings of this report may be invalid, wholly or partially by changes outside of our control. Therefore, this report is subject to review and should not be relied upon after a period of 3 years.

Lincoln DeVore makes no warranty, either expressed or implied, as to the findings, recommendations, specifications or professional advice, except that they were prepared in accordance with generally accepted professional engineering practice in the field of geotechnical engineering.

If you have any questions after reviewing this letter report, please do not hesitate to contact the undersigned engineer. This opportunity to be of professional service is sincerely appreciated.

Respectfully submitted,

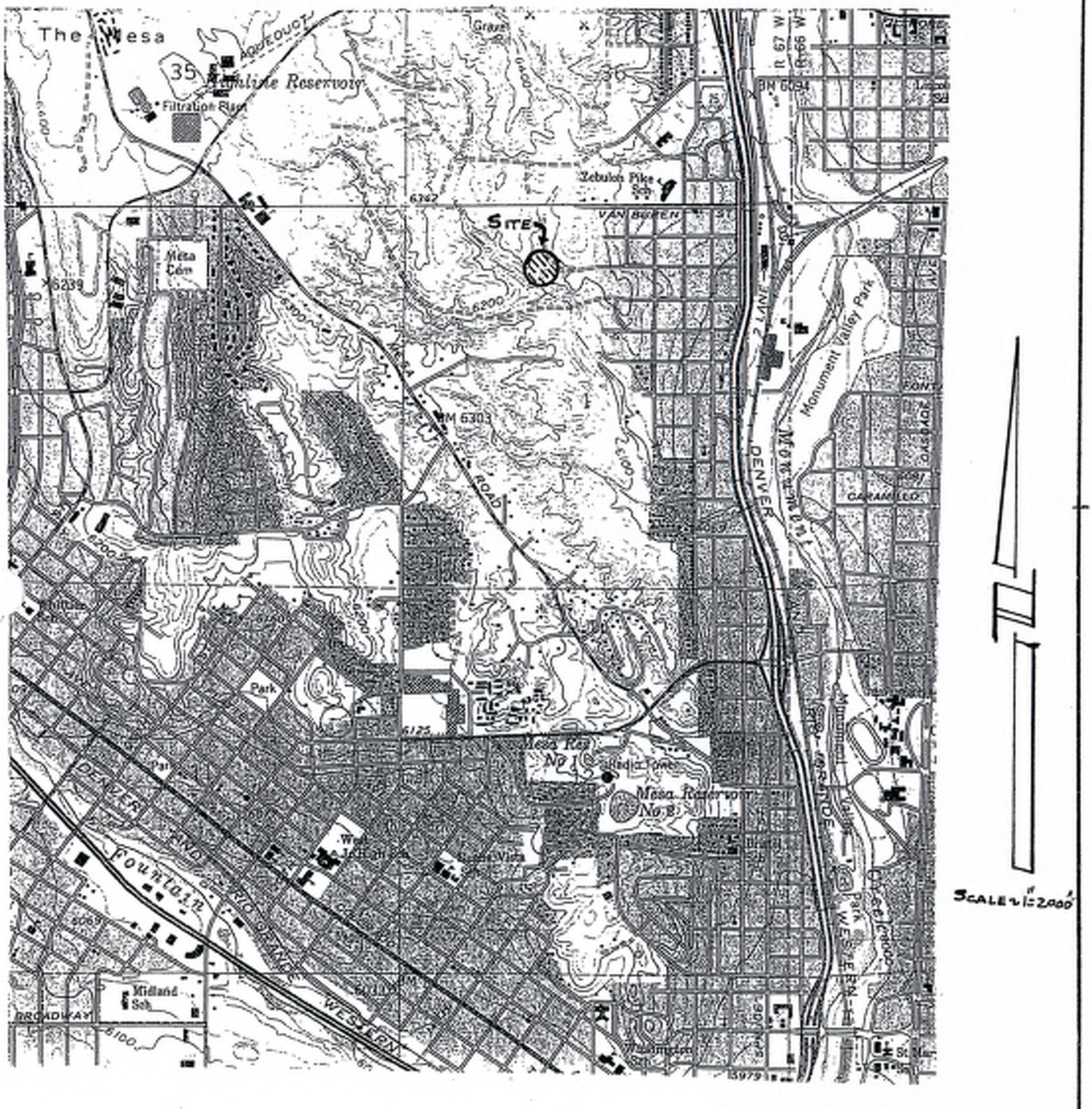
LINCOLN-DeVORE, INC.

2951

By: George D. Morris, P.E.
Professional Engineer

Reviewed by: Robert J. Huzjak
Project Engineer

GDM/wp
LD Job No. 62841



SCALE≈1"=2000'

Lincoln DeVore, Inc.
Geotechnical Consultants

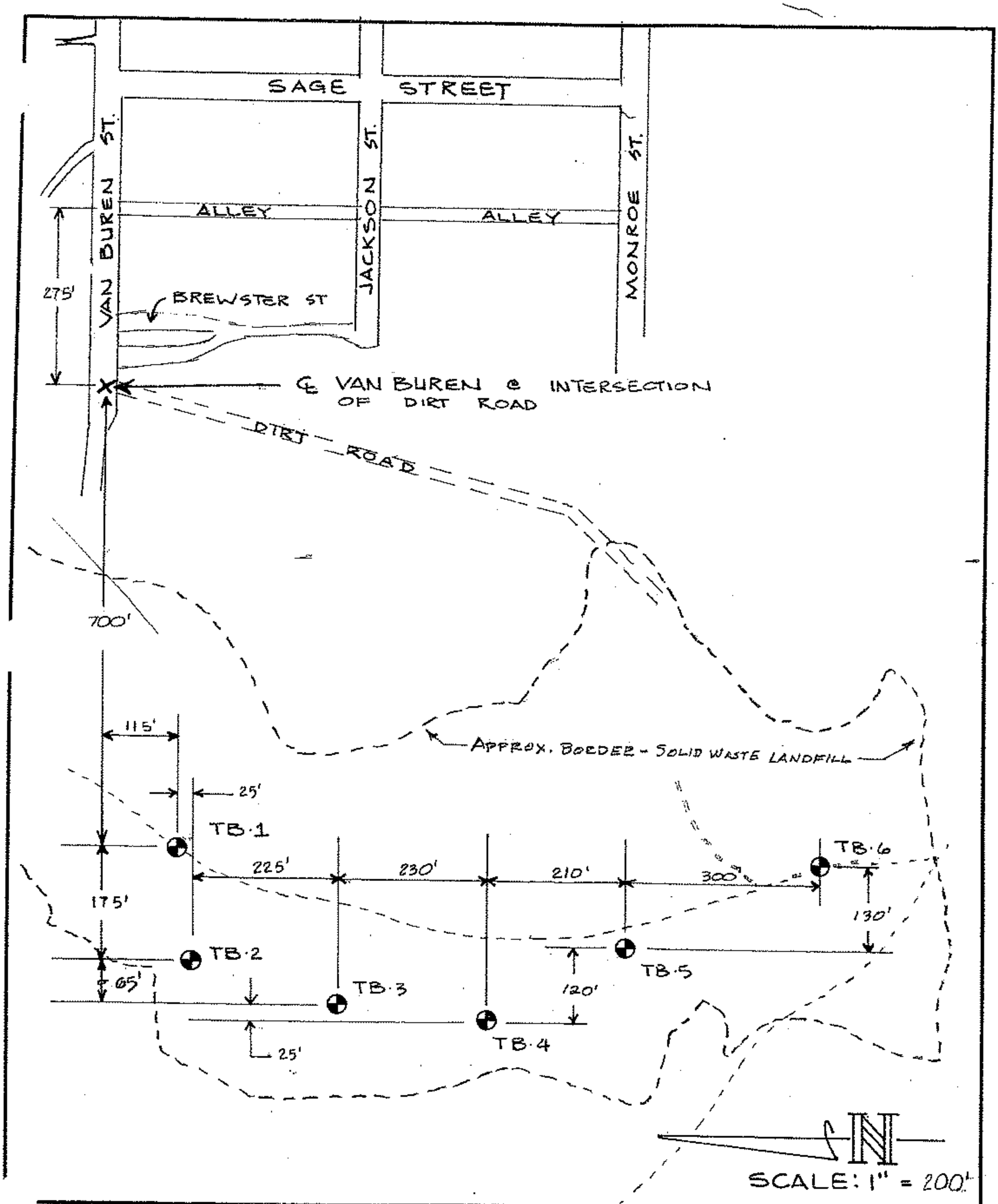
CENTENNIAL & VAN BUREN ST. A.C. NICHOLSON

BORING SITE LOCATION PLAN

DATE 8/4/86

JOB NO. 62841

DRAWN GDM



Lincoln DeVore, Inc.
Geotechnical Consultants

CENTENNIAL & VAN BUREN ST. A.C. NICHOLSON

BORING LOCATION PLAN

DATE 8/4/86

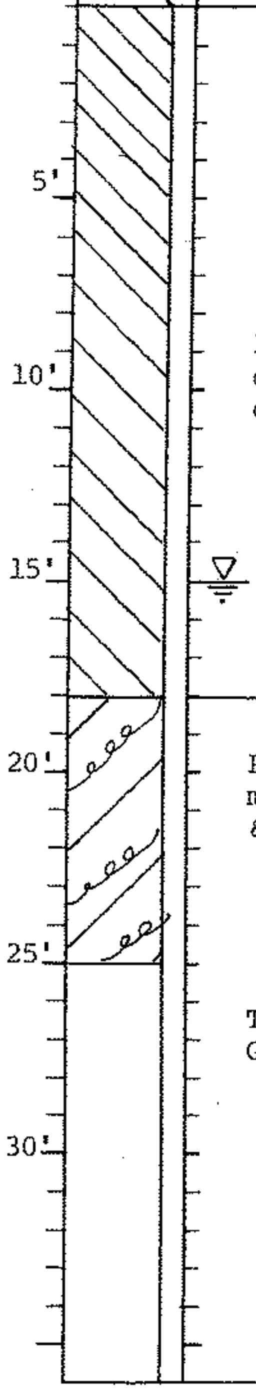
JOB NO. 62841

DRAWN chet

BORING NO. 1

ELEVATION:

DEPTH (FT)	SYMBOL	SAMPLE	DESCRIPTION	PENETRATION RESISTANCE	IN-SITU DENSITY (PCF)	MOISTURE CONTENT (%)
			FILL, CL, clay, silty, medium plasticity, contains debris of plastic, ceramics, some metal, contains carbonaceous material, soft, moist to wet			
			PIERRE FORMATION, CL/CH, clay with some silts & minor sands, hard to very hard, iron staining, & sulphate deposits, grey to black, moist to wet			



TOTAL DEPTH OF BORING: 25'
GROUND WATER AT 15' AT TIME OF BORING

LOG OF SUBSURFACE EXPLORATION

LINCOLN DeVORE
ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, GRAND JUNCTION, PUEBLO, GLENWOOD SPRINGS

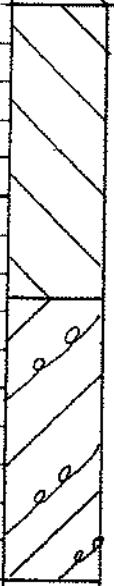
CENTENNIAL & VAN BUREN
A.C.NICHOLSON

DATE 8/4/86

JOB NO. 62841

DRILLED 8/1/86

DEPTH (FT)	SYMBOL	SAMPLE	BORING NO. 2 ELEVATION: DESCRIPTION	PENETRATION RESISTANCE	IN-SITU DENSITY (PCF)	MOISTURE CONTENT (%)
5			FILL, CL, clay, silty, with some sand layers, medium plasticity, soft, moist, contains debris of plastics & household type trash, organic layers			
10			PIERRE FORMATION, CL/CH, clay, with some silts, & minor sands, hard to very hard, brown, slightly weathered, iron staining & sulphate deposits, moist			
15						
20			TOTAL DEPTH OF BORING: 15' NO GROUND WATER ENCOUNTERED DURING DRILLING			
25						
30						



LOG OF SUBSURFACE EXPLORATION

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, GRAND JUNCTION, PUEBLO, GLENWOOD SPRINGS

CENTENNIAL & VAN BUREN
A.C. NICHOLSON

JOB NO. 62481

DATE 8/4/86

DRILLED 8/1/86

DEPTH (FT) | SYMBOL | SAMPLE

BORING NO. 3

ELEVATION:

DESCRIPTION

PENETRATION RESISTANCE | IN-SITU DENSITY (PCF) | MOISTURE CONTENT (%)

5

FILL, CL, clay, silty, with some sand layers, medium plasticity, soft, moist, contains debris of glass, metal, tile & pipe, organic layers.

10

15

PIERRE FORMATION, CL/CH, silty, with minor sand layers, high plasticity, hard to very hard, weathered near formational surfaces, iron staining, sulphate deposits, grey to black, moist

20

TOTAL DEPTH OF BORING: 20'
NO GROUND WATER ENCOUNTERED DURING DRILLING

25

LOG OF SUBSURFACE EXPLORATION

LINCOLN DeVORE
ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, GRAND JUNCTION, PUEBLO, GLENWOOD SPRINGS

CENTENNIAL & VAN BUREN
A.C. NICHOLSON

DATE 8/4/86

JOB NO. 62481

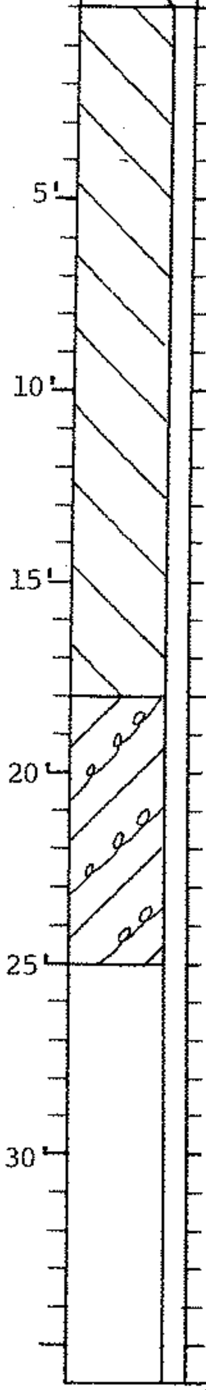
DRILLED 8/1/86

DEPTH (FT)	SYMBOL	SAMPLE	BORING NO. 4 ELEVATION: DESCRIPTION	PENETRATION RESISTANCE	IN-SITU DENSITY (PCF)	MOISTURE CONTENT (%)
5'			FILL, CL, clay, silty, with some sand layers, medium plasticity, soft, moist, contains household debris of glass, metal, etc... , numerous organic layers			
10'			PIERRE FORMATION, (TOP 2' WEATHERED), CL/CH, silty, with some sandy, areas, high plasticity, hard to very hard, iron staining, sulphate deposits grey to black, moist,			
15			TOTAL DEPTH OF BORING: 15' NO GROUND WATER ENCOUNTERED DURING DRILLING			
20						
25						
30						

LOG OF SUBSURFACE EXPLORATION

LINCOLN DeVORE ENGINEERS · GEOLOGISTS	COLORADO: COLORADO SPRINGS, GRAND JUNCTION, PUEBLO, GLENWOOD SPRINGS	CENTENNIAL & VAN BUREN A.C. NICHOLSON	DATE 8/4/86
		JOB NO. 62481	DRILLED 8/1/86

DEPTH (FT)	SYMBOL	SAMPLE	BORING NO. 5 ELEVATION: DESCRIPTION	PENETRATION RESISTANCE	IN-SITU DENSITY (PCF)	MOISTURE CONTENT (%)



FILL, CL, clay, silty, with some sandy layers, medium plasticity, firm to soft, brown, moist to we distinct odor, contains debris of wood, glass, bricks, and household trash, organic

becomes moderately stiff at 15.5' (still landfill)

PIERRE FORMATION, (TOP 2' WEATHERED), CL/CH, minor sands & silts; moderate to high plasticity, iron stained, sulphate deposits, hard to very hard, grey to black, moist

TOTAL DEPTH OF BORING: 25'
NO GROUND WATER ENCOUNTERED DURING DRILLING

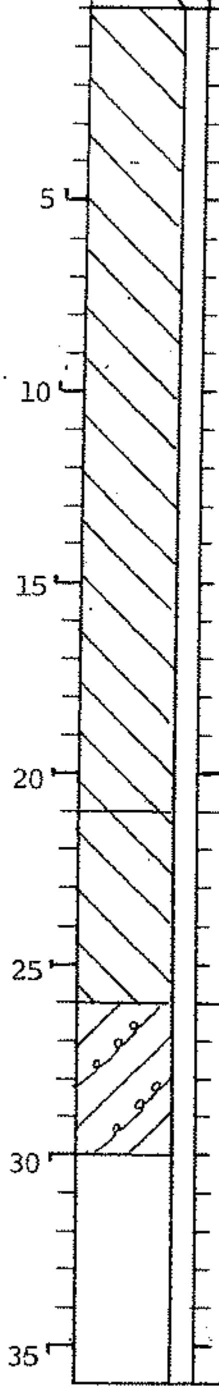
LOG OF SUBSURFACE EXPLORATION

LINCOLN DeVORE ENGINEERS-GEOLOGISTS	COLORADO: COLORADO SPRINGS, GRAND JUNCTION, PUEBLO, GLENWOOD SPRINGS	CENTENNIAL & VAN BUREN A.C NICHOLSON	DATE 8/4/86
		JOB NO. 62481	DRILLED 8/1/86

BORING NO. 6

ELEVATION:

DEPTH [FT]	SYMBOL	SAMPLE	DESCRIPTION	PENETRATION RESISTANCE	IN-SITU DENSITY [PCF]	MOISTURE CONTENT [%]



FILL, CL, clay, silty, slightly sandy, low to medium plasticity, soft, brown to black, very organic & black in layers, strong odor, contains debris of wood, glass, metal, etc...

▽

PROBABLE FILL, CL, clay, silty, & minor sands, medium plasticity, soft to firm, wet, does not contain debris or trash, but has strong odor & is organic.

PIERRE FORMATION, CL/CH, minor sands & silts, moderate to high plasticity, iron stained, hard to very hard, sulphate deposits, grey to black, moist

TOTAL DEPTH OF BORING: 30'
GROUND WATER AT 20' AT TIME OF BORING

LOG OF SUBSURFACE EXPLORATION

LINCOLN DeVORE
ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, GRAND JUNCTION, PUEBLO, GLENWOOD SPRINGS

CENTENNIAL & VAN BUREN
A.C. NICHOLSON

DATE 8/4/86

JOB NO. 62481

DRILLED 8/1/86

TABLE I
SUMMARY OF TEST HOLE LOGS

Test Holes 1-4 from Jan, 1976 report.
Test Holes 5-7 drilled 11/18/83.

These are apparently the old ones for Geo. Williams -

TH-1	0 - 4.5'	Clay cover
	4.5 - 33'	Landfill
	33 - 35'	Residual clays
		No water.
TH-2	0 - 3'	Clay cover
	3 - 40'	Landfill
	40 - 47	Residual clays
		Water at 37 feet.
TH-3	0 - 13'	Clay cover
	13 - 25'	Landfill
	25 - 30'	Residual Clays
		No water
TH-4	0 - 20'	Residual clays and weathered bedrock.
		No water.
TH-5	0 - 2.5'	Clay cover
	2.5 - 32'	Landfill
		Water at 19 feet. Gas probes set at 8 and 16.5 feet.
TH-6	0 - 2'	Clay cover
	2 - 27'	Landfill
	27 - 30'	Clay, possibly residual clays
		Water at 15 feet. Gas probes set at 8 and 13.5 feet.
TH-7	0 - 1.5'	Clay cover
	1.5 - 9'	Landfill
		Water at 4 feet. No probe set due to shallow groundwater.

Appendix B

Soil Investigation
August 2005

Delineation and Evaluation of Existing Landfill
South of West Van Buren Street
Colorado Springs, Colorado

August 26, 2005

KLEINFELDER
An employee owned company

August 26, 2005

Kleinfelder File No. 59292-1

Mr. Ted Waterman, President
Waterman, Inc.
P.O. Box 27560
Albuquerque, New Mexico 87125

Subject: **Delineation and Evaluation of Existing Landfill**
South of West Van Buren Street
Colorado Springs, Colorado

Dear Mr. Waterman:

Kleinfelder is pleased to present the results of our delineation and evaluation of the existing landfill located south of West Van Buren Street in Colorado Springs, Colorado (Subject Site). Our scope of work included; an investigation to delineate the boundary of the landfill area and estimate approximate depth of fill, a limited geotechnical evaluation of existing fill, methane testing within the landfill area to evaluate its potential impact on the proposed park, and methane testing beyond the perimeter of the landfill to evaluate potential impact of any methane migration outside the landfill limits on proposed adjacent developments. This report presents the results of our investigation including analytical data and recommendations.

SUMMARY

This investigation was conducted on a vacant parcel of land located south of West Van Buren Street in Colorado Springs, El Paso County, Colorado.

During this assessment the following tasks were completed:

- Review of existing data/site reconnaissance;
- Subsurface drilling;
- Excavation of exploratory test pits;
- Evaluation of existing fill;
- Installation of methane gas monitoring wells;
- Screening for methane gas; and,
- Laboratory Analysis for methane gas.

Subsurface analysis provided the following information:

- Excessive differential settlement of the solid waste landfill area;
- Large amounts of debris (wood, plastic, paper, cardboard, rubber, glass, aluminum, and metal) exist from ground surface to varying depths throughout the landfill area; and
- Fill material that has the potential to be suitable for use in construction, from a geotechnical standpoint, is only located within a small section of the southern portion of the landfill area. Sampling and testing of the fill material would be recommended to evaluate for any environmental contamination concerns.

Methane gas field and laboratory analysis provided the following information:

- High methane concentrations were found within the boundary of the landfill; and,
- Within the footprint of proposed future development on-site.

SCOPE

This Limited Phase II ESA was conducted in general accordance with our proposal dated June 23, 2005. The purpose of this investigation was to delineate the landfill boundaries, evaluate existing fill, and determine potential methane-related concerns associated with the existing landfill, that have the potential to affect the site development as planned. These concerns were evaluated through intrusive soil drilling, exploratory test pits, and methane gas monitoring. This study did not include investigating other environmental issues such as soil or groundwater contamination.

SITE LOCATION & HISTORY

The Subject Site is a vacant parcel encompassing approximately 48-acres of land, located south of West Van Buren Street in Colorado Springs, El Paso County, Colorado. The site location is indicated on the Site Location Map (Figure 1). The proposed development boundary, within which our investigation was performed, is shown on the Site Plan (Figure 2).

The Subject Site is generally located within the northwest ¼ of the southeast ¼ of Section 1, Township 13 South, and Range 67 West of the 6th PM. The El Paso County Assessor's parcel number is 7401200002. The Subject Site is approximately 6,230 feet above mean sea level (MSL) at the northern property boundary, falling to approximately 6,130 feet above MSL at the southeastern property boundary. The topography of the Site and the surrounding area slopes down to the south towards the intermittent stream that borders the Subject Site (Figure 2, Appendix A). The topography of the site is irregular, but is dominated in the northeast by a prominent ridge, in the central portion by a valley, in the northwest by a system of ridges. A drainage forms the westerly and southerly side boundaries.

Review of the 1947 and 1966 aerial photographs indicate that a considerable amount of site disturbance occurred between these periods of time. The 1947 photograph indicated that the site was essentially in its natural condition. The 1966 photograph indicated that most of the ground disturbance had occurred by this time. The historical topography of the landfill area is shown on Figure A-4 in Appendix A.

Previous work performed by Lincoln DeVore at the Subject Site includes the following reports:

- *Geologic and Soils Hazard Reconnaissance, Proposed Park Place Development,* Colorado Springs, Colorado, dated December 13, 1983, LD Job No. 51013.
- *Geotechnical Report, Proposed Centennial Blvd. Project from Fontanero Street to Fillmore Avenue,* Colorado Springs, Colorado, dated July 15, 1985, LD Job No. 55146.
- *Landfill Site, Section 36, Twp. 13S, R67W of the 6th P.M., near Van Buren and Centennial,* Colorado Springs, Colorado, dated August 12, 1986, LD No. 62841.

FIELD INVESTIGATION

Prior to the commencement of field activities at the Subject Site, Kleinfelder prepared a Site-Specific Health and Safety Plan as required by Occupational Safety and Health Administration ("OSHA"), to inform our personnel of the potential hazards that may be encountered and the required procedures to protect worker health and safety. Also, as required by law, Kleinfelder coordinated with utility companies to locate buried utilities in the vicinity of the Subject Site.

Subsurface Investigation

On July 14 and July 15, 2005, Kleinfelder mobilized to the Subject Site with a track-mounted drilling rig equipped with 4-inch continuous flight augers to drill fifteen (15) subsurface borings to delineate the approximate boundary and size of the landfill and also to evaluate what type of wastes were placed in the landfill. A map indicating the location of the borings is presented as Figure A-1 in Appendix A. All borings were drilled through the landfill material to bedrock. Bedrock depths are indicted on the boring logs, which are included in Appendix B. Samples were collected at regular intervals and observed in the field to determine if the soil material was native, soil fill, or landfill. The types of wastes encountered in the soil are also documented on the boring logs. Waste material observed in the landfill included solid wastes ranging mainly from wood, to organics, plastic, glass, rubber, metal, aluminum, galvanized wire, cloth, newspaper, and cardboard. Based on our observations and understanding of the history of the landfill, we expect waste that was placed within the landfill included debris, rubbish, and household waste.

Kleinfelder returned to the site within 24 hours of drilling to measure the static water level in each boring.

Table 1 summarizes the static water levels for each boring.

Boring ID	Static Water Level (feet below grade)
B-1	*
B-2	11.0
B-3	*
B-4	18.4
B-5	*
B-6	18.9
B-7	*
B-8	*
B-9	15.3
B-10	*
B-11	19.5
B-12	19.3
B-13	20.8
B-14	10.2
B-15	31.7

*DRY: Borings were dry and no groundwater was encountered.

During the period between 1947 and 1966, the site was apparently chosen for disposal of waste. Waste encountered in the subsurface investigation indicated that the central portion of the Subject Site was the main area used as a solid waste landfill. It appears that the drainage and valley, in the central portion of the site, was filled with a considerable amount of waste. The maximum thickness of this waste, based on our subsurface investigation, is estimated to be about 40 feet. The borings indicate that the surface soil cover ranges from about ground surface to 20 feet in thickness. Soil was also found layered and mixed within the solid waste landfill layer.

The Site is underlain by bedrock of the Pierre Shale. This formation consists of dark gray to brown, clay shale with a few interbedded fine-grained sandstone and limestone beds. The Pierre Shale is typically dense to hard where unweathered, thin-bedded, expansive and rich in sulfates. The depth to bedrock ranged from 11 feet at the northwest corner to 57 feet in the central portion of the Subject Site.

The approximate boundary of the landfill was mapped using data compiled from this investigation and previous reports completed by Lincoln DeVore. This landfill boundary is shown on Figure A-2 in Appendix A.

Methane Gas Assessment

The production of methane gas is a problem that is linked to abandoned landfills. Methane gas is generated by the decomposition of natural or man-made organics in a aerobic environment. The production of methane can vary from point to point in a landfill. Methane gas is explosive in concentrations between 5% and 15% by volume of air. Concentrations greater than 15% may be flammable and methane is also toxic.

Methane is lighter than air and tends to migrate vertically through the landfill to the surface.

On July 14 and July 15, 2005, Kleinfelder mobilized to the Subject Site with a track-mounted drilling rig equipped with 4-inch continuous flight augers to install fifteen (15) methane gas monitoring wells within the existing landfill and also around the perimeter, at the locations indicated on Figure A-3. Boring logs and monitoring well installation records (including depth and materials used) for each methane well, MW-1 through MW-15, are included in Appendix B.

Methane wells were constructed using factory cleaned 1-inch diameter, PVC well casing with 10 feet of 0.010-inch slotted screen and sufficient riser to reach the ground surface. The slotted screen PVC was surrounded with 10/20 silica sand that prevents entry of soil into the well. A 2 to 3-foot bentonite annular seal was placed at the top of the well, near the ground surface.

On July 19 and July 20, 2005, Kleinfelder performed gas monitoring at the fifteen (15) methane wells installed on the Subject Site. The gas in each well was analyzed using a GasTech Portable Gas Monitor. The meter is designed to measure concentrations of methane (CH_4), hydrogen sulfide (H_2S) and oxygen (O_2). Table 2 summarizes the gases detected in the methane wells.

TABLE 2 –SUMMARY OF GAS MONITORING

Monitoring Location	July 19, 2005				July 20, 2005			
	CH_4 (%LEL)	CH_4 (%GAS)	H_2S (ppm)	O_2 (%)	CH_4 (%LEL)	CH_4 (%GAS)	H_2S (ppm)	O_2 (%)
MW-1	0.0	0.0	0.0	20.9	0.0	0.0	0.0	20.7
MW-2	28.0	2.0	0.0	9.3	29.0	2.0	0.0	4.8
MW-3	0.0	0.0	0.0	20.7	0.0	0.0	0.0	20.9
MW-4	100	62.0	2.0	0.0	100	60.0	2.0	0.0
MW-5	0.0	0.0	0.0	20.4	0.0	0.0	0.0	20.4
MW-6	28.0	2.0	0.0	13.3	23.0	2.0	0.0	15.4
MW-7	0.0	0.0	0.0	20.9	0.0	0.0	0.0	20.8
MW-8	0.0	0.0	0.0	20.3	0.0	0.0	0.0	20.9
MW-9	1.0	0.0	0.0	20.2	0.0	0.0	0.0	18.7
MW-10	100	53.0	1.0	0.0	100	45.0	2.0	0.0
MW-11	63.0	6.0	0.0	7.8	75.0	7.0	0.0	0.0
MW-12	100	22.0	0.0	6.6	100	18.0	0.0	6.3

MW-13	28.0	2.0	0.0	11.4	23.0	2.0	0.0	12.6
MW-14	0.0	0.0	0.0	18.3	0.0	0.0	0.0	18.9
MW-15	100	49	0.0	0.0	100	50.0	1.0	0.0

Notes: CH_4 (% LEL) = Methane % of the lower explosive limit (LEL)
CH_4 (% Gas) = % Methane Gas by volume
H_2S = Hydrogen Sulfide parts per million by volume
O_2 = Oxygen % by volume

In the three monitoring wells that had the highest concentration of methane gas, an air sample was collected that was sent to an accredited laboratory to confirm the presence and level of methane gas. The three monitoring wells that were sampled were B-4, B-10, and B-15. According to the laboratory analysis, high concentrations of methane gas existed in each of the three wells. The results of the laboratory tests were as follows; monitoring well B-4 consisted of 58.33 % methane gas, monitoring well B-10 consisted of 43.38 % methane gas, and B-15 had 48.77% methane gas. The laboratory data sheets are included in Appendix C.

Existing Fill Evaluation/ Excavation of Exploratory Test Pits

On August 1, 2005, Kleinfelder mobilized to the Site with a John Deere 310G 4X4 #12 Backhoe to excavate exploratory test pits, labeled as TP-1 through TP-5, and to evaluate existing fill for potential construction use. Test pits locations are mapped on Figure A-1. All five-test pits were excavated to approximately fifteen feet below existing grade. Significant amounts of debris were observed in four of the five exploratory test pits. The waste generally included wood, plastic, paper, cardboard, rubber, glass, aluminum, and metal. The thickness of the debris was greater than the total depth excavated of fifteen feet in four of the five test pits (TP-2 to TP-5). These four test pits did not contain material that could be used as construction fill during the development of adjacent areas.

The first exploratory test pit (TP-1) was located at the southern end of the existing landfill. The test pit was excavated to approximately fifteen feet as well. No waste was observed within the test pit to the total depth investigated. The material observed in the test pit consisted of a sandy lean clay with gravel and cobbles. However, based on the borehole that was drilled within close proximately to this test pit, debris was encountered at that location at approximately 16 feet. Site photographs from the excavation of the test pits are included in Appendix D, except for TP-1.

CONCLUSIONS

Environmental Hazards

Environmental hazards, which exist on the Site, include methane gas and excessive differential settlement of the solid waste landfill area. Significant levels, based on local and federal guidelines, of methane exist in eight of the fifteen methane wells constructed on site. This is consistent and anticipated with the placement of high organic content and uncontrolled fill on the site. Methane gas is explosive in concentrations over 5% by volume in ambient air and can be produced for many decades from the initial deposition of wastes similar to those found in a landfill. Methane gas becomes a hazard if it is allowed to collect in poorly ventilated areas including crawl spaces, basements, utility vaults, or other enclosed spaces. On this site, the methane hazard can probably be mitigated by simple avoidance of the solid waste landfill area. Given the potential for gas development and possible gas mitigation into planned site development, additional protective measures must be implemented. These measures should be developed following additional investigation and be consistent with proposed site use, which we understand may include a park.

As a past site used for disposal of solid wastes, it is likely that the site is subject to Colorado Department of Public Health & Environment (CDPHE) explosive gas requirements for solid waste disposal sites. These regulations, found in Title 6 of the Code of Colorado Regulations (CCR), Section 1007-2, Part 1, state that *"The concentration of explosive gases generated by the facility for solid waste disposal shall not exceed:*

(A) Twenty-five percent [25%] of the lower explosive limit (LEL) (one percent [1%] by volume in air for methane) within facility structures (excluding gas control or recovery systems); and

(B) At the boundary, the lower explosive limit which is five percent (5%) by volume in air for methane."

Considering this rule, it is likely that any future development of the site would need to consider monitoring of any structure developed on the site as well as monitoring of the site perimeter in order to maintain compliance with these rules. The development of a vapor intrusion model and/or additional analysis to determine sufficient mitigation controls may be required as part of construction design.

Subsurface Hazards

Subsurface hazards, which exist on the Subject Site, are associated with large amounts of debris and other waste existing at ground surface and at differing depths throughout the existing landfill area. The only location within the boundary of the existing landfill that fill material may have the potential to be used in construction would be a small section of the southern portion of the landfill near boreholes B-14 and B-15. The ground surface surrounding B-14 was free of landfill debris and the upper fifteen feet of B-15. However, landfill debris was encountered in B-15 at approximately sixteen feet.

RECOMMENDATIONS

Kleinfelder recommends that a meeting be scheduled with CDPHE to discuss the planned development of the subject site, and what controls or mitigation would be considered by the agency. This limited Phase II ESA was performed for the purpose of evaluating methane levels on the known landfill area and also determine the location and depth of the landfill. Based on this assessment and the previous Lincoln DeVore reports, Kleinfelder and CDPHE will be able to provide guidance as to compatible land development and public safety considerations.

Since high methane concentrations were found throughout the site, any development of the site would have to address methane issues, including surface emission potential as well as migration issues. In addition, CDPHE may or may not require additional assessment activities such as additional long-term methane monitoring wells and/or soil and groundwater sampling as part of the site assessment. Additional work may include, but would not be limited to, probing of the site perimeter to check for methane migration on proposed areas of development. Also, by assessing the volume of solid waste that has been placed on the site, or how big the volumetric area of solid waste is on the subject site, the long-term production of methane gas could be calculated by using a landfill gas emissions model. This would provide necessary information as to how long the site will continue to produce methane over the years. If buried utilities are installed across the solid waste landfill area, the utility trenches may provide additional avenues for methane migration. As a result, methane venting may be required along the utility corridors.

It should be noted that presence of methane does not necessarily exclude the site from future development. Many successful methane mitigation and remediation solutions, both passive and active, have been developed and demonstrated on similar sites in the past. However, to adequately engineer appropriate remediation and management of the known landfill area, a more extensive understanding of the methane gas production potential, gas migration, permeability of soils onsite and groundwater flow direction may need to be assessed through additional investigation at the Site. This type of study would also require a detailed knowledge of proposed development in order to provide a thorough and meaningful evaluation/design.

Kleinfelder also recommends that fill material located within the boundary of the existing landfill, with the exception of the soil found at the southern edge, not be used in the planned development of the Subject Site. Large amounts of landfill debris are encompassed within soils throughout the landfill area. Kleinfelder also recommends that soil samples be collected and analyzed at an accredited laboratory for contamination, prior to the excavation of any fill material from the southern portion of the landfill area.

LIMITATIONS

The limited sampling performed during this investigation was performed to provide a general indication of methane production within the study area. Limited assessments such as this are non-comprehensive by nature and will not identify all environmental problems or eliminate all risk, associated with environmental issues. The scope of work on this project was presented in our proposal and subsequently approved by our client. Please be aware our scope of work was limited to those items specifically identified in the proposal. Environmental issues not specifically addressed in the proposal or this report is beyond the scope of our work and not included in this evaluation.

Although risk can never be eliminated, more detailed and extensive investigations yield more information, which may help you understand and better manage your risks. Since such detailed services involve greater expense, we ask our clients to participate in identifying the level of service that will provide them with an acceptable level of risk. Please contact the signatories of this report if you would like to discuss this issue of risk further.

Land use, site conditions (both on-site and off-site) and other factors will change over time. Since site activities and regulations beyond our control could change at any time after the completion of this report, our observations, findings and opinions can be considered valid only as of the date of this report.

The property owner is solely responsible for notifying all governmental agencies, and the public at large, of the existence, release, treatment or disposal of any hazardous materials or conditions detected at the project site. Kleinfelder assumes no responsibility or liability whatsoever for any claim, loss of property value, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

If you have any questions regarding this letter or need additional information, please do not hesitate to call our office at (719) 632-3593.

Respectfully submitted,

KLEINFELDER, INC.

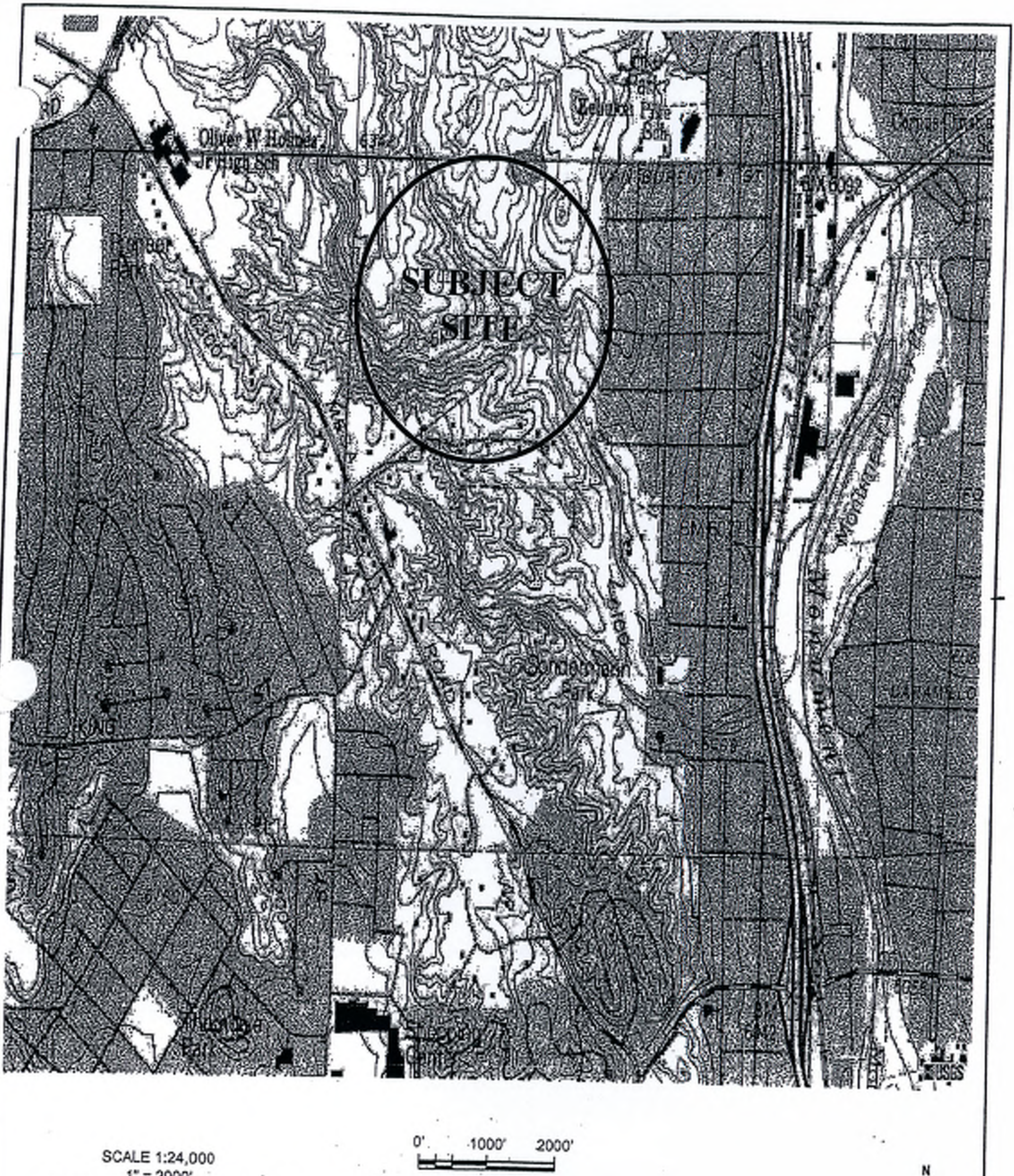
Rickey L Jones

Rickey L. Jones
Staff Environmental Scientist

William J Barrere

William J. Barriere, P.E.
Area Manager

RLJ:WJB:ss



SCALE 1:24,000
1" = 2000'
BASE MAP:PIKEVIEW, COLORADO
CONTOUR INTERVAL 20 FEET
USGS 7.5 MINUTE QUADRANGLE,1994

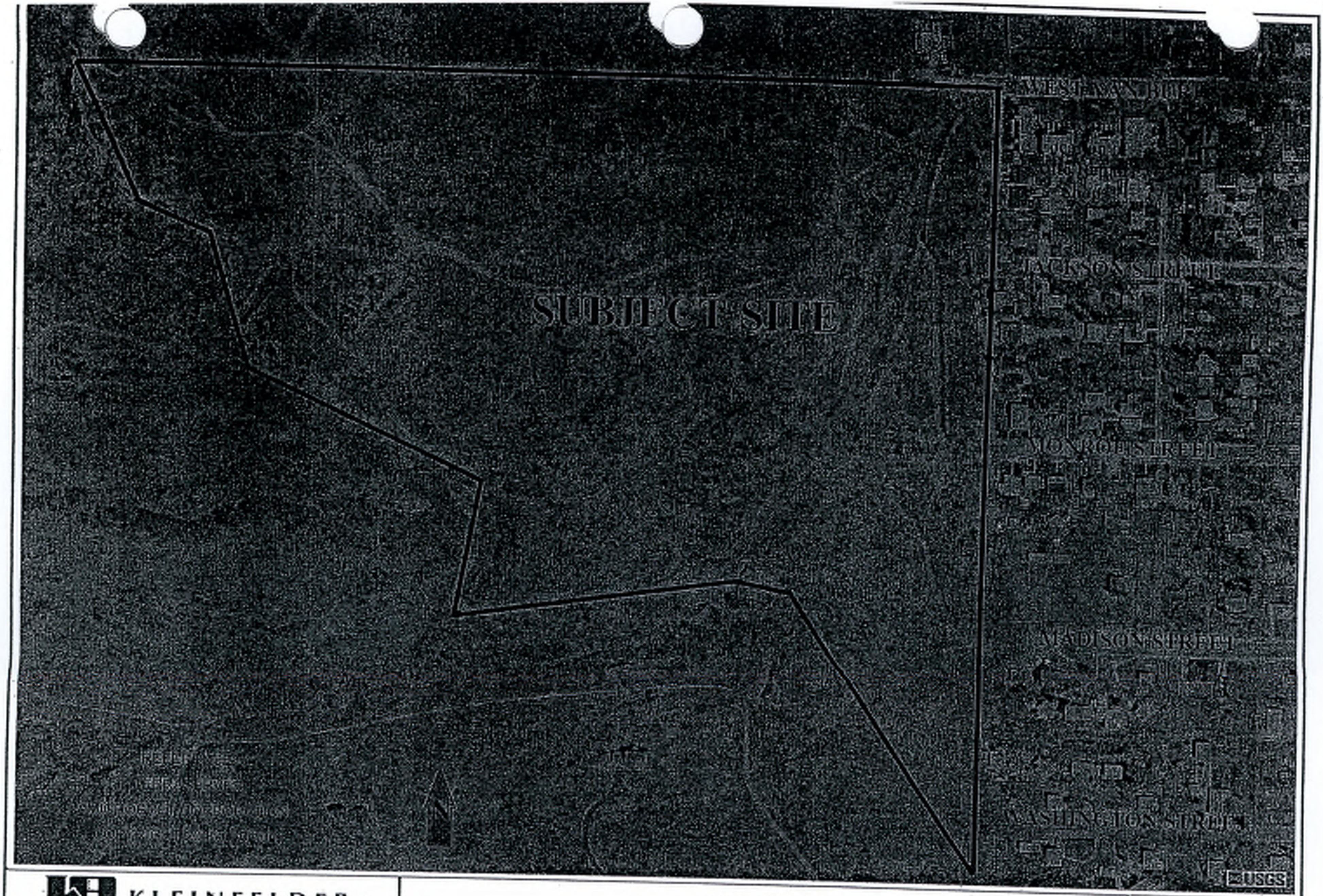
KLEINFELDER
4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

DOCUMENT NO.
PROJECT NO. 59292
FN: VICINITY
DATE: 07/19/05

SITE LOCATION MAP

LANDFILL EVALUATION
WEST VAN BUREN
COLORADO SPRINGS, COLORADO

FIGURE
1



KLEINFELDER
4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

DOCUMENT NO.	FN: Aerial
PROJECT NO. 59292	07/19/05

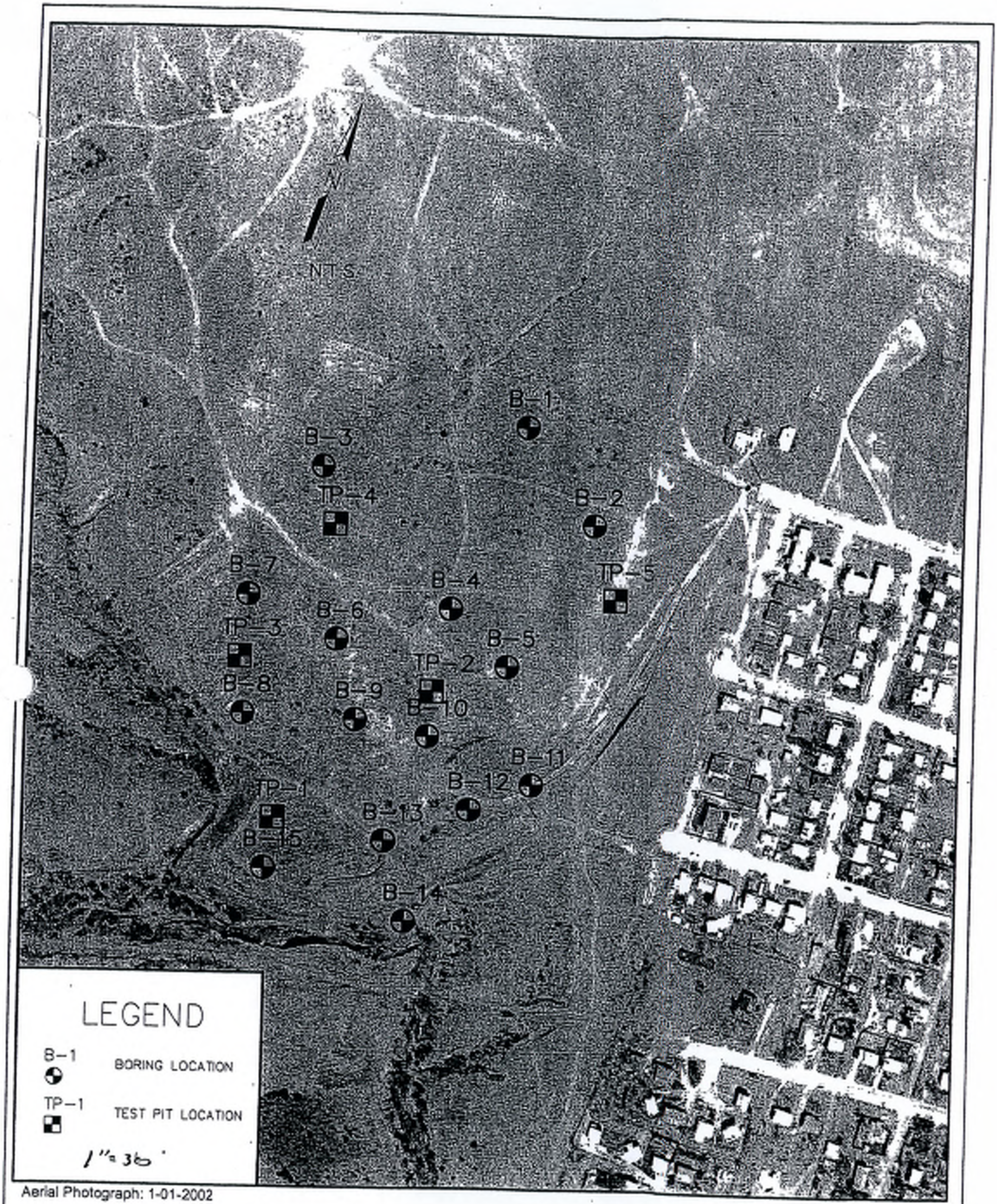
SITE PLAN

LANDFILL EVALUATION
WEST VAN BUREN
COLORADO SPRINGS, COLORADO

FIGURE
2

APPENDIX A

Boring Location Plan



Aerial Photograph: 1-01-2002

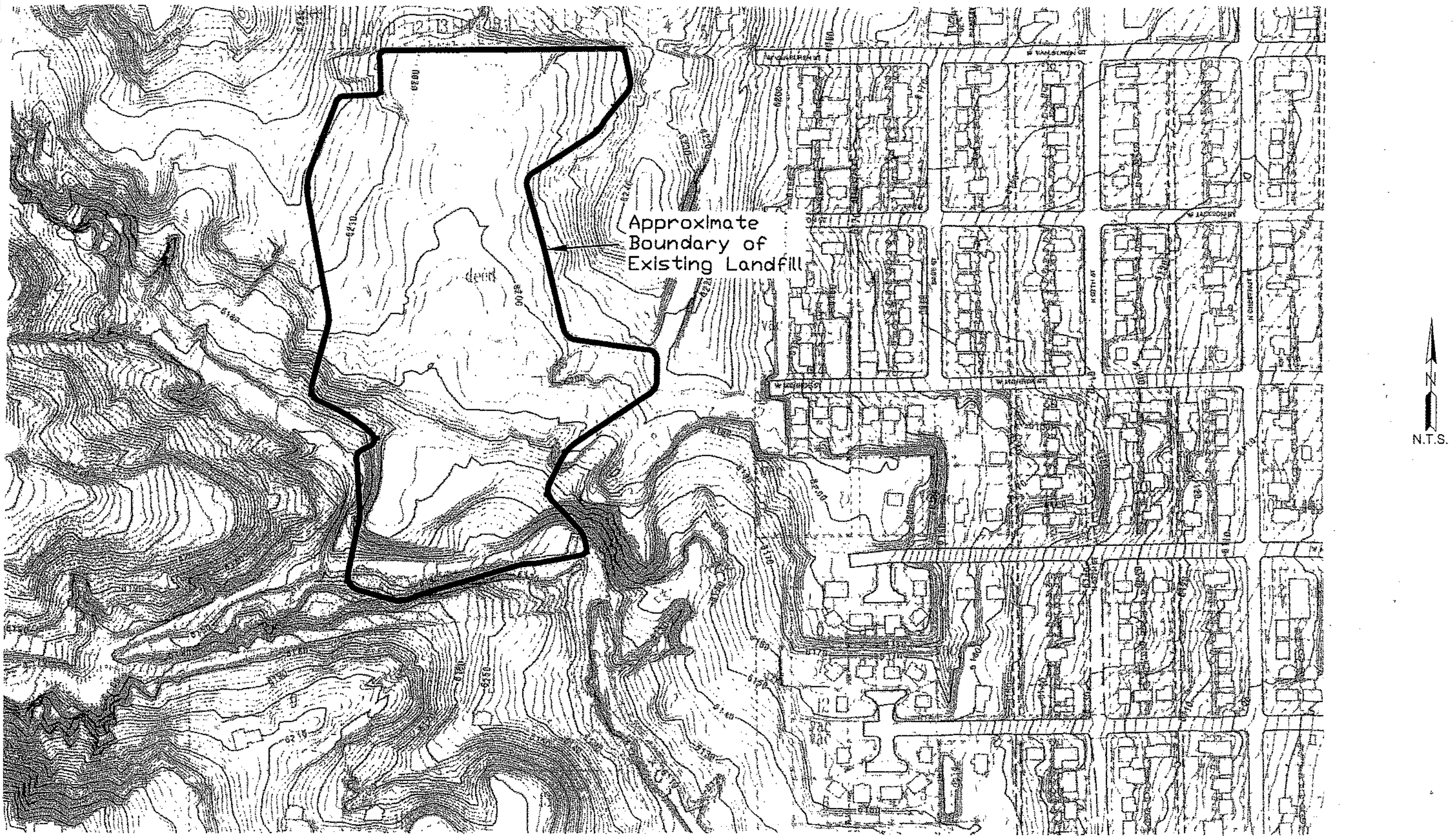
KLEINFELDER
An employee owned company

Checked By: R. Jones
Drafted By: R. Stump
Project Number: 59292-1
Date: July 29, 2005

BORING LOCATION PLAN

Landfill Evaluation
West Van Buren
Colorado Springs, Colorado

Figure
A-1



KLEINFELDER
An employee owned company

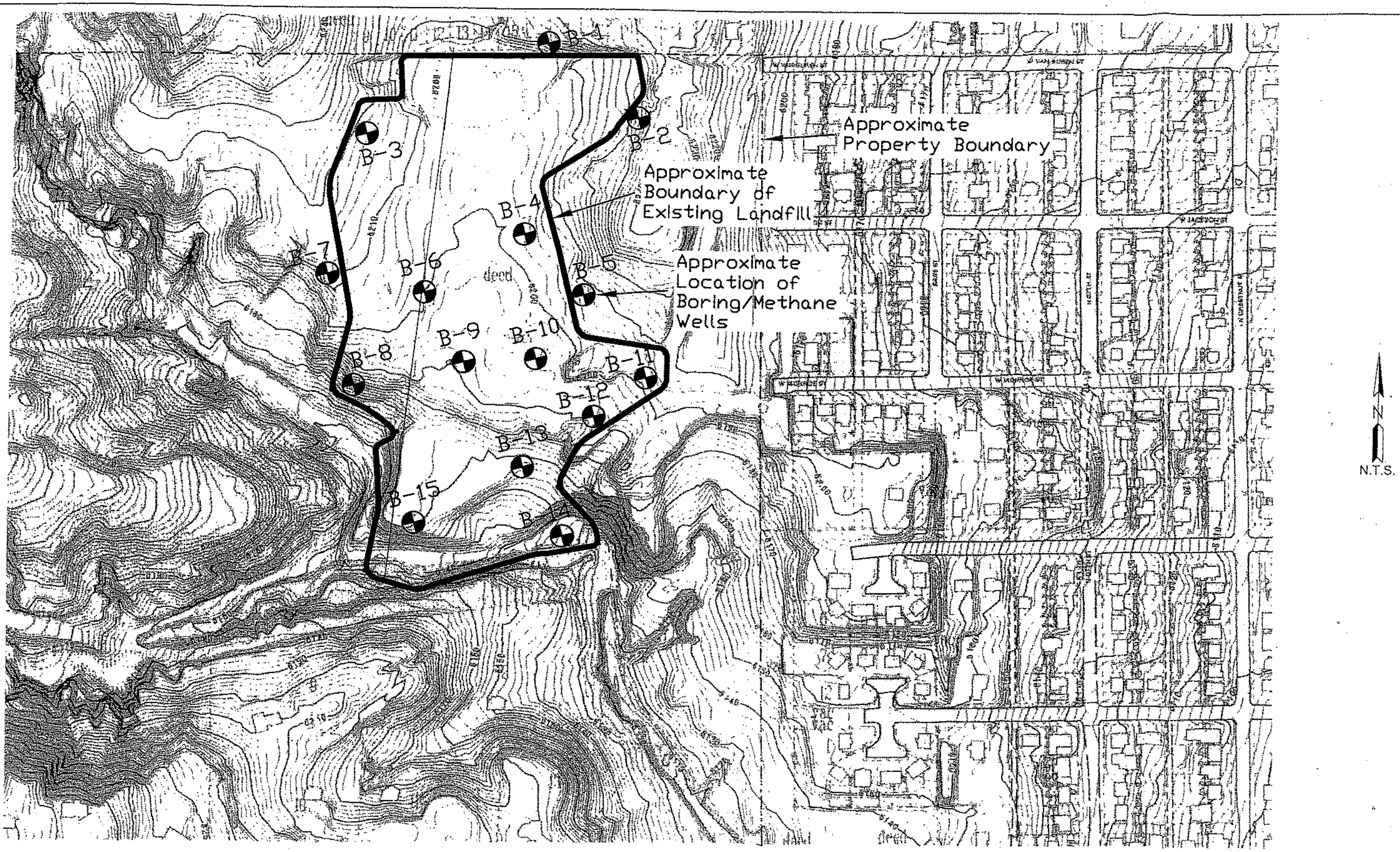
Checked By: R. Jones
Drafted By: R. Stump
Project Number: 59292-1
Date: July 29, 2005

LANDFILL LOCATION PLAN

Landfill Evaluation
West Van Buren
Colorado Springs, Colorado

Figure

A-2



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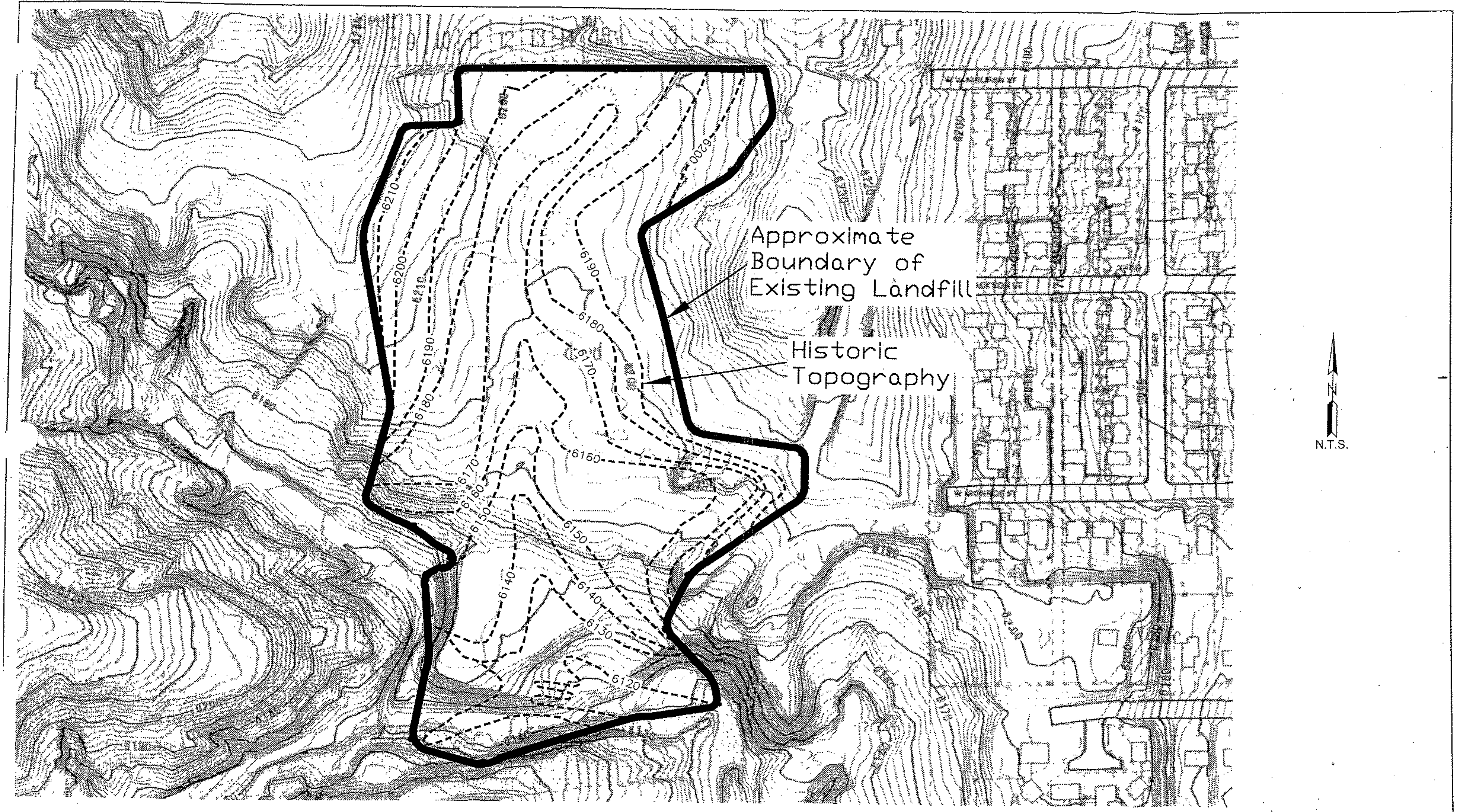
An employee owned company

Checked By: R. Jones
Drafted By: R. Stump
Project Number: 59292-1
Date: July 29, 2005

BORING VS LANDFILL LOCATION PLAN

Landfill Evaluation
West Van Buren
Colorado Springs, Colorado

Figure
A-3



orical topography information based on Lincoln DeVore 1986 Report #62841, 8-12-1986 and
incoln DeVore Aerial Photograph Review, 8-12-1986

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An employee owned company

Checked By: R. Jones
Drafted By: R. Stump
Project Number: 59292-1
Date: August 1, 2005

HISTORICAL TOPOGRAPH VS.
EXISTING LANDFILL MAP

Landfill Evaluation
West Van Buren
Colorado Springs, Colorado

Figure
A-4

APPENDIX B

Logs of Test Borings

PROJECT NO. 59292-1

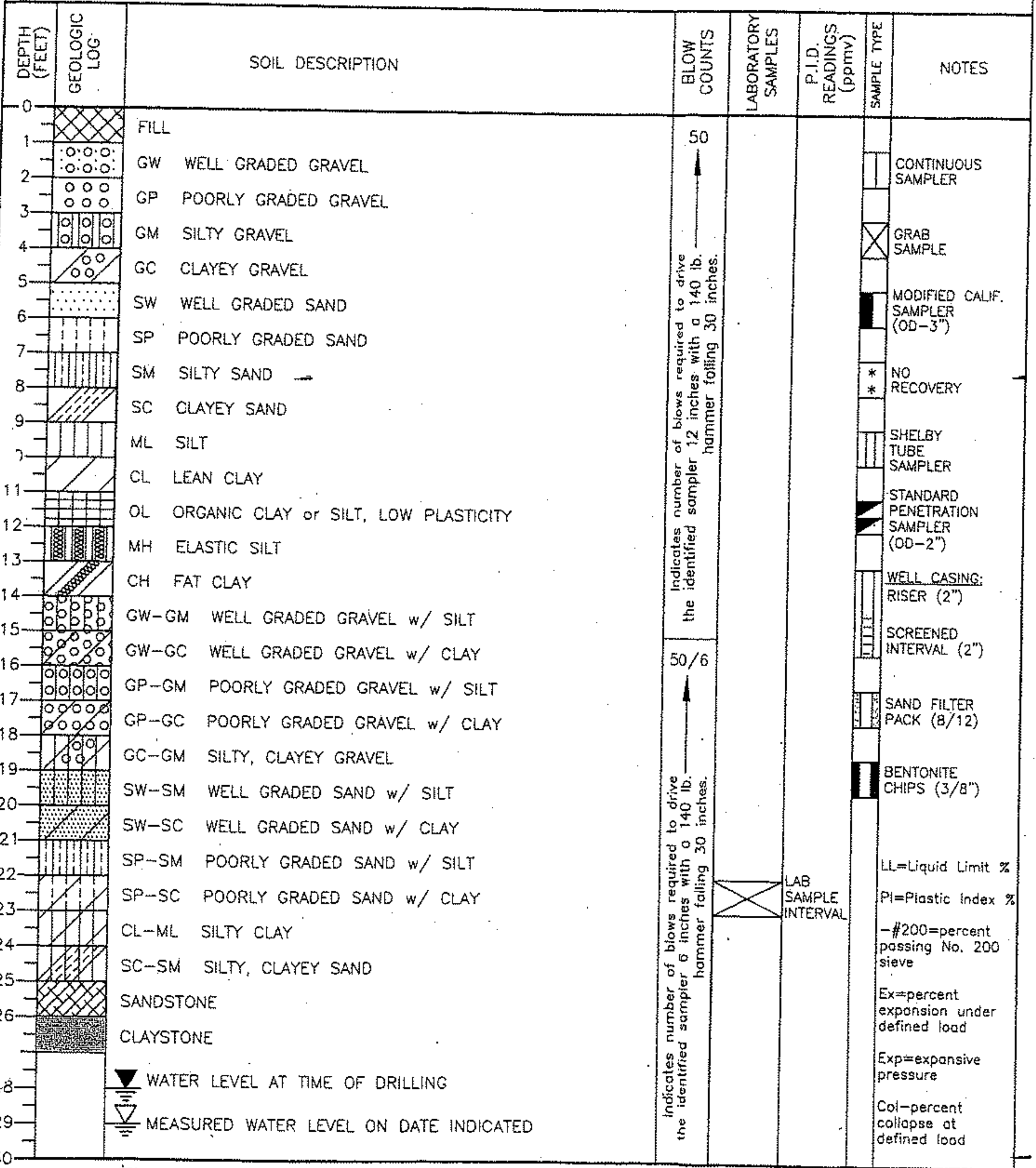
ENVIRONMENTAL BORING LEGEND

SHEET 1 OF 1

DRILLING EQUIPMENT XXX

PROJECT NAME Landfill Evaluation

LOCATION



	FILL
GW	WELL GRADED GRAVEL
GP	POORLY GRADED GRAVEL
GM	SILTY GRAVEL
GC	CLAYEY GRAVEL
SW	WELL GRADED SAND
SP	POORLY GRADED SAND
SM	SILTY SAND
SC	CLAYEY SAND
ML	SILT
CL	LEAN CLAY
OL	ORGANIC CLAY or SILT, LOW PLASTICITY
MH	ELASTIC SILT
CH	FAT CLAY
GW–GM	WELL GRADED GRAVEL w/ SILT
GW–GC	WELL GRADED GRAVEL w/ CLAY
GP–GM	POORLY GRADED GRAVEL w/ SILT
GP–GC	POORLY GRADED GRAVEL w/ CLAY
GC–GM	SILTY, CLAYEY GRAVEL
SW–SM	WELL GRADED SAND w/ SILT
SW–SC	WELL GRADED SAND w/ CLAY
SP–SM	POORLY GRADED SAND w/ SILT
SP–SC	POORLY GRADED SAND w/ CLAY
CL–ML	SILTY CLAY
SC–SM	SILTY, CLAYEY SAND
	SANDSTONE
	CLAYSTONE

▼ WATER LEVEL AT TIME OF DRILLING

▽ MEASURED WATER LEVEL ON DATE INDICATED

50 — Indicates number of blows required to drive the identified sampler 12 inches with a 140 lb. hammer falling 30 inches.

50/6 — Indicates number of blows required to drive the identified sampler 6 inches with a 140 lb. hammer falling 30 inches.

LAB SAMPLE INTERVAL

CONTINUOUS SAMPLER

GRAB SAMPLE

MODIFIED CALIF. SAMPLER (OD–3")

NO RECOVERY

SHELBY TUBE SAMPLER

STANDARD PENETRATION SAMPLER (OD–2")

WELL CASING:

RISER (2")

SCREENED INTERVAL (2")

SAND FILTER PACK (8/12)

BENTONITE CHIPS (3/8")

LL=Liquid Limit %

PI=Plastic Index %

–#200=percent passing No. 200 sieve

Ex=percent expansion under defined load

Exp=expansive pressure

Col=percent collapse at defined load

FN: LOGKEY

KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 1

SHEET 1 OF 1

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

TYPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 30

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

BACKFILLED:

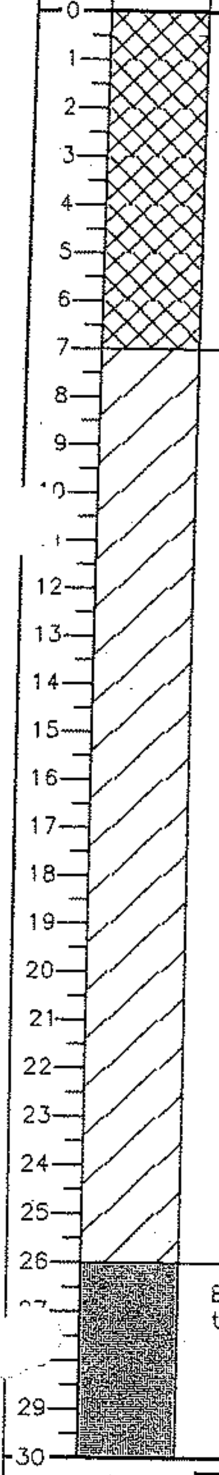
DRILLING AGENCY Spectrum Exploration

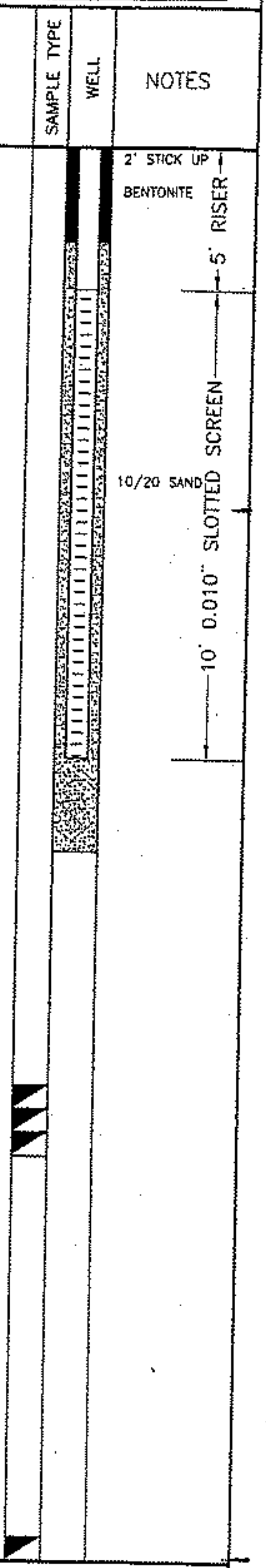
LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH NONE DATE AT DRILLING

DEPTH (FEET)	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	NOTES
0–7	FILL, Silty SAND, with debris (rubber, glass, metal, paper, wire, cloth), strong organic odor, dry, brown.			
7–26	CLAY, stiff to very stiff, moist, brown. No debris or odor.	20 30 35		
26–30	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	50/6		





FN: LOGS

KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 2

SHEET 1 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

TYPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 50

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

BACKFILLED:

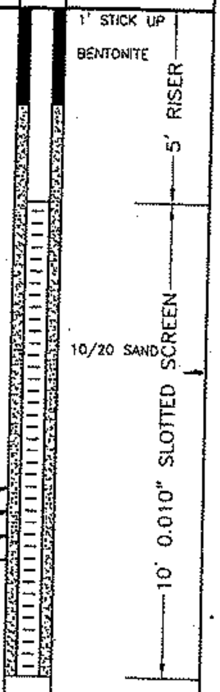
DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 11.0 DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0		FILL, Silty SAND, with debris (plastic, glass, rubber), strong organic odor, moist, light brown.					
11		▼ FILL, CLAY, with debris (glass, plastic), soft, moist, black to gray.	1 1 2				
21			1 1 2				
		Sandy CLAY, stiff to very stiff, moist, brown to black.					
30							



FN: LOGS

KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 2

SHEET 2 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)
PROJECT NAME Landfill Evaluation
LOCATION SEE TEST BORING LOCATION PLAN
YPE OF BIT 4" AUGER
HAMMER DATA: WT. 140 LBS. DROP 30 INCHES
SURFACE ELEVATION N/A
TOTAL DEPTH OF HOLE 50

DATE
STARTED: 07/15/05
COMPLETED: 07/15/05
BACKFILLED:
DRILLING AGENCY Spectrum Exploration
LOGGED BY R. Jones
SURFACE CONDITIONS Grass and Weeds
GROUNDWATER DEPTH NONE DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
30	▨	Sandy CLAY, stiff to very stiff, moist, brown to black (continued).	4 5 6		◣		
31	▨						
32	▨						
33	▨						
34	▨						
35	▨						
36	▨						
37	▨						
38	▨						
39	▨						
0	▨		16 25 36		◣		
41	▨						
42	▨						
43	▨						
44	▨						
45	▓	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.					
46	▓						
47	▓						
48	▓						
49	▓						
50							
51							
52							
53							
54							
55							
56							
7							
8							
59							
60							

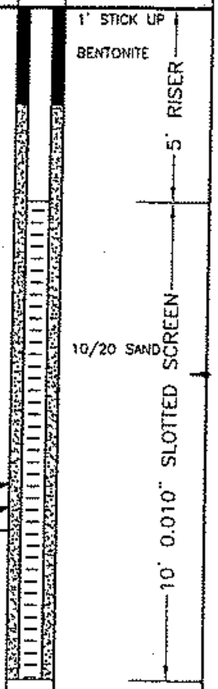
PROJECT NO. 59292-1

LOG OF BORING 3

SHEET 1 OF 1

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)
PROJECT NAME Landfill Evaluation
LOCATION SEE TEST BORING LOCATION PLAN
PE OF BIT 4" AUGER
HAMMER DATA: WT. 140 LBS. DROP 30 INCHES
SURFACE ELEVATION N/A
TOTAL DEPTH OF HOLE 20
DATE STARTED: 07/15/05
DATE COMPLETED: 07/15/05
BACKFILLED:
DRILLING AGENCY Spectrum Exploration
LOGGED BY R. Jones
SURFACE CONDITIONS Grass and Weeds
GROUNDWATER DEPTH NONE
DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0	▨	FILL, Silty SAND, with gravel, debris (rubber, plastic, glass, galvanized wire), dry, light brown, strong organic odor.	32 50		◣		
11	▩	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	50/6		◣		
20							



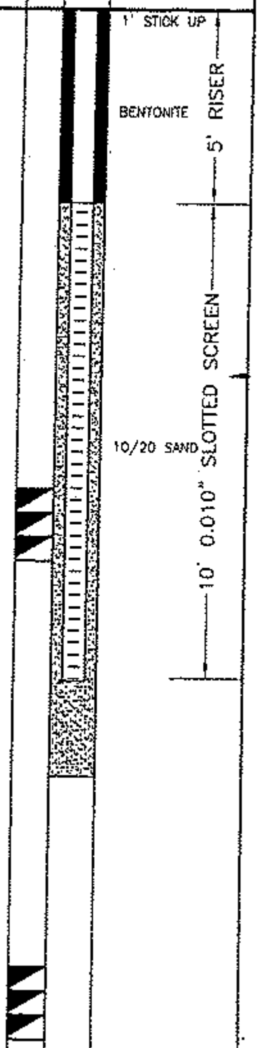
FN: LOGS

KLEINFELDER

PROJECT NO. 59292-1	# LOG OF BORING 4		SHEET 1 OF 2
DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)	PROJECT NAME Landfill Evaluation		LOCATION SEE TEST BORING LOCATION PLAN
TYPE OF BIT 4" AUGER	HAMMER DATA: WT. 140 LBS. DROP 30 INCHES	SURFACE ELEVATION N/A	TOTAL DEPTH OF HOLE 45

DATE			
STARTED: 07/15/05	DRILLING AGENCY Spectrum Exploration	GROUNDWATER DEPTH 18.4	DATE AT DRILLING
COMPLETED: 07/15/05	LOGGED BY R. Jones		
BACKFILLED:	SURFACE CONDITIONS Grass and Weeds		

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0		FILL, Silty SAND, with debris (plastic, wood), strong organic odor, moist, light brown.					
5		FILL, CLAY, with debris (wood, plastic), soft to medium stiff, moist, black to brown.					
11			3 5 5				
18	▼						
21			4 4 4				
30							



PROJECT NO. 59292-1

LOG OF BORING 4

SHEET 2 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

TYPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 45

DATE STARTED: 07/15/05

DATE COMPLETED: 07/15/05

BACKFILLED:

DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 18.4 DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
30		FILL, CLAY, with debris (wood, plastic), soft to medium stiff, moist, black to brown (continued).	16 28 45				
32		CLAY, stiff, moist, brown, no debris.					
42		BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.					
45							

30 31 32 33 34 35 36 37 38 39 0 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 8 59 60

FN: LOGS

KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 5

SHEET 1 OF 1

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

PE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 20.5

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

BACKFILLED:

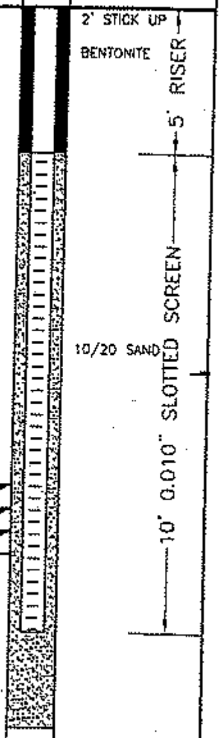
DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH NONE DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0	▨	CLAY, very stiff, moist, brown, no debris, no odor.					
1			16 33 37		◣ ◣		
19	▩	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	50/6		◣		



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KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 6

SHEET 1 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

YPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 58

DATE STARTED: 07/15/05

DATE COMPLETED: 07/15/05

BACKFILLED:

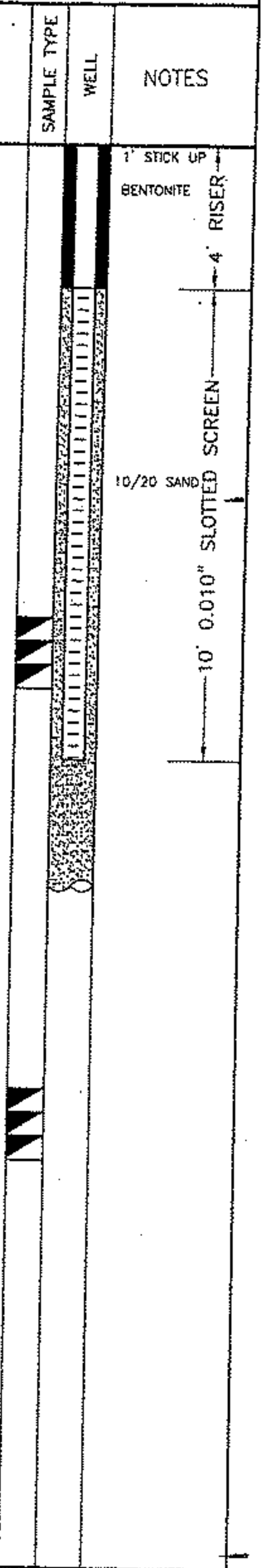
DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 18.9 DATE AT DRILLING

DEPTH (FEET)	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES
0	FILL, SAND with gravel, fine to coarse grained, moist, light brown.		
4	FILL, CLAY, with debris (glass, wood, plastic), soft to medium stiff, moist, light brown.		
	Dark clay layer at 10'		
11		3 2 2	
19	▼		
21		3 2 2	
30			



KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 6

SHEET 2 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

TYPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 58

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

BACKFILLED:

DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 18.9 DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
30	▨	FILL, CLAY, with debris (glass, wood, plastic), soft to medium stiff, moist, light brown (continued).	7 13 8		◣ ◣ ◣		
31	▨						
32	▨						
33	▨						
34	▨						
35	▨						
36	▨						
37	▨						
38	▨						
39	▨						
40	▧	Silty to sandy CLAY, soft to medium dense, moist, light brown.	0 4 5		◣ ◣ ◣		
42	▧						
43	▧						
44	▧						
45	▧						
46	▧						
47	▧						
48	▧						
49	▧						
50	▧						
51	▧						
52	▧						
53	▧						
54	▧						
55	▧						
56	▧						
57	░	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.					
59							
60							

PROJECT NO. 59292-1

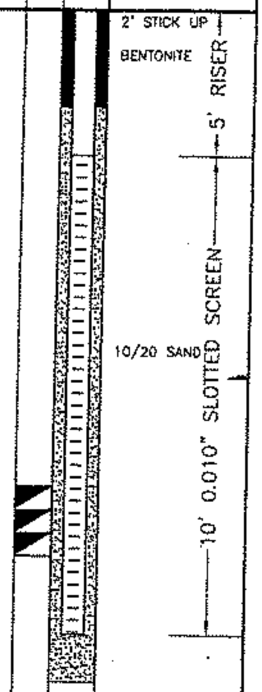
LOG OF BORING 7

SHEET 1 OF 1

DRILLING EQUIPMENT: CME 55 (w/ AUTOHAMMER)
PROJECT NAME: Landfill Evaluation
LOCATION: SEE TEST BORING LOCATION PLAN
TYPE OF BIT: 4" AUGER
HAMMER DATA: WT. 140 LBS. DROP 30 INCHES
SURFACE ELEVATION: N/A
TOTAL DEPTH OF HOLE: 25

DATE
STARTED: 07/15/05
COMPLETED: 07/15/05
BACKFILLED:
DRILLING AGENCY: Spectrum Exploration
LOGGED BY: R. Jones
SURFACE CONDITIONS: Grass and Weeds
GROUNDWATER DEPTH: NONE DATE: AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0	▨	FILL, Silty SAND, with some gravel, with debris (glass, plastic, galvanized wire, rubber), medium dense to dense, moist, brown.					
11	▨		24 32 42				
21	▩	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	14 20 35				
25							



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PROJECT NO. 59292-1

LOG OF BORING 8

SHEET 1 OF 1

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

YPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 30

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

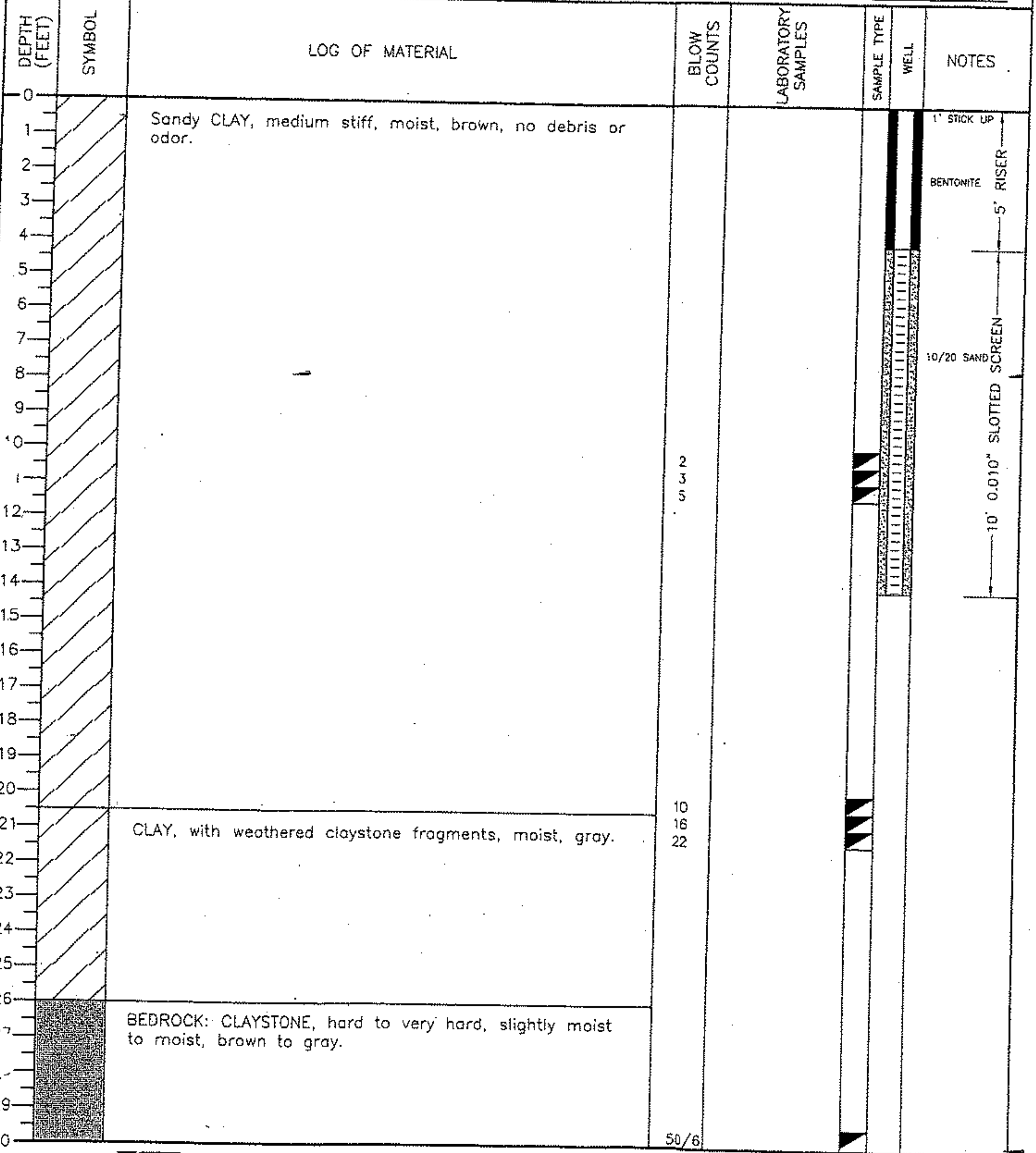
BACKFILLED:

DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH NONE DATE AT DRILLING



DEPTH (FEET)	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	NOTES
0	Sandy CLAY, medium stiff, moist, brown, no debris or odor.			1' STICK UP BENTONITE 5' RISER
5				10/20 SAND 10' 0.010" SLOTTED SCREEN
10		2 3 5		
20	CLAY, with weathered claystone fragments, moist, gray.	10 16 22		
26	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.			
30		50/6		

KLEINFELDER

PROJECT NO. 59292-1

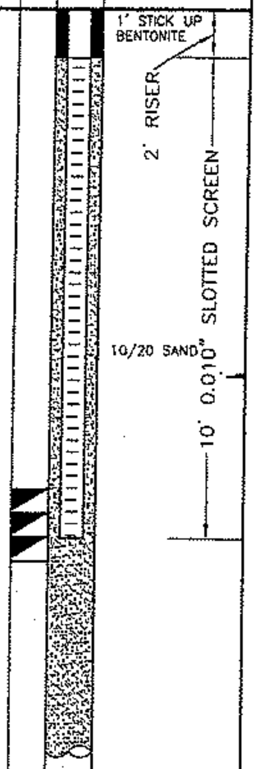
LOG OF BORING 9

SHEET 1 OF 2

DRILLING EQUIPMENT: CME 55 (w/ AUTOHAMMER)
PROJECT NAME: Landfill Evaluation
LOCATION: SEE TEST BORING LOCATION PLAN
TYPE OF BIT: 4" AUGER
HAMMER DATA: WT. 140 LBS. DROP 30 INCHES
SURFACE ELEVATION: N/A
TOTAL DEPTH OF HOLE: 50

DATE
STARTED: 07/15/05
COMPLETED: 07/15/05
BACKFILLED:
DRILLING AGENCY: Spectrum Exploration
LOGGED BY: R. Jones
SURFACE CONDITIONS: Grass and Weeds
GROUNDWATER DEPTH: 15.3 DATE: AT DRILLING

DEPTH (FEET)	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES
0	FILL, Silty SAND, with gravel, dry, brown.		
8	FILL, Silty SAND to CLAY, with gravel, with debris (plastic, wood, glass), dense (sand) to medium stiff (clay), moist, brown, strong organic odor.		
10.5		2 4 11	
15.3	▼		
20.5		5 6 6	
30			



PROJECT NO. 59292-1

LOG OF BORING 9

SHEET 2 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)
PROJECT NAME Landfill Evaluation
LOCATION SEE TEST BORING LOCATION PLAN
TYPE OF BIT 4" AUGER
HAMMER DATA: WT. 140 LBS. DROP 30 INCHES
SURFACE ELEVATION N/A
TOTAL DEPTH OF HOLE 50

DATE
STARTED: 07/15/05
COMPLETED: 07/15/05
BACKFILLED:
DRILLING AGENCY Spectrum Exploration
LOGGED BY R. Jones
SURFACE CONDITIONS Grass and Weeds
GROUNDWATER DEPTH 15.3 DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
30	▩	FILL, Silty SAND to CLAY, with gravel, with debris (plastic, wood, glass), dense (sand) to medium stiff (clay), moist, brown, strong odor (continued).	3 3 3		◤		
40	▩		4 5 7		◤		
41	▥	Silty SAND, moist, gray.					
47	▒	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.					
50							
60							

FN: LOGS

KLEINFELDER

PROJECT NO. 59292-1	# LOG OF BORING 10	SHEET 1 OF 2
DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)	PROJECT NAME Landfill Evaluation	LOCATION SEE TEST BORING LOCATION PLAN

PE OF BIT 4" AUGER

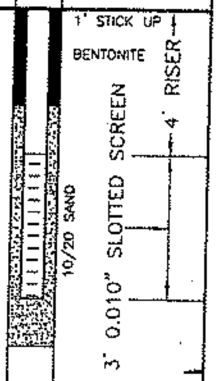
HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 41

DATE			
STARTED: 07/15/05	DRILLING AGENCY Spectrum Exploration	GROUNDWATER DEPTH NONE	DATE AT DRILLING
COMPLETED: 07/15/05	LOGGED BY R. Jones		
BACKFILLED:	SURFACE CONDITIONS Grass and Weeds		

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0		FILL, GRAVEL, fine to medium grained, moist, brown.					
3		FILL, CLAY, with debris (plastic, galvanized wire, pper, rubber), soft to medium stiff, moist, black, strong odor.					
11			2 4 5				
20		Clayey SAND, dense to very dense, moist, light brown.	9 12 17				
30							



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KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 10

SHEET 2 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

PE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 41

DATE STARTED: 07/15/05

DATE COMPLETED: 07/15/05

BACKFILLED:

DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH NONE DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
		Clayey SAND, dense to very dense, moist, light brown (continued).	14 18 23				
		BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	50/6				

FN: LOGS

KLEINFELDER

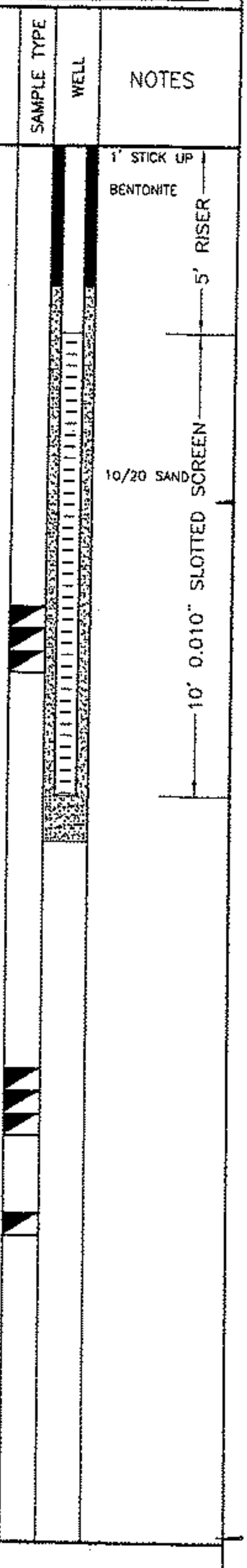
PROJECT NO. 59292-1	# LOG OF BORING 11	SHEET 1 OF 1
DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)	PROJECT NAME Landfill Evaluation	LOCATION SEE TEST BORING LOCATION PLAN
PE OF BIT 4" AUGER	HAMMER DATA: WT. 140 LBS. DROP 30 INCHES	SURFACE ELEVATION N/A TOTAL DEPTH OF HOLE 23.5

DATE
STARTED: 07/15/05
COMPLETED: 07/15/05
BACKFILLED:

DRILLING AGENCY Spectrum Exploration
LOGGED BY R. Jones
SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 19.5 DATE AT DRILLING

DEPTH (FEET)	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES
0	FILL, GRAVEL, medium grained, moist, light brown.		
10.5		3 2 2	
19.5	▼		
20	FILL, CLAY, with debris (rubber, galvanized wire, canvas), soft, wet, black, strong organic odor.	2 2 1	
23	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	50/6	



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KLEINFELDER

PROJECT NO.
59292-1

LOG OF BORING 12

SHEET 2 OF 2

DRILLING EQUIPMENT: CME 55 (w/ AUTOHAMMER)

PROJECT NAME: Landfill Evaluation

LOCATION: SEE TEST BORING LOCATION PLAN

TYPE OF BIT: 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION: N/A

TOTAL DEPTH OF HOLE: 31

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

BACKFILLED:

DRILLING AGENCY: Spectrum Exploration

LOGGED BY: R. Jones

SURFACE CONDITIONS: Grass and Weeds

GROUNDWATER DEPTH: 19.3 DATE: AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
30	▨	BEDROCK, CLAYSTONE, hard to very hard, wet, black (continued).	28 50		◤ ◤		
31							
32							
33							
34							
35							
36							
37							
38							
39							
0							
1							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
59							
60							

PROJECT NO. 59292-1

LOG OF BORING 12

SHEET 1 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

PE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 31

DATE STARTED: 07/15/05

DATE COMPLETED: 07/15/05

BACKFILLED:

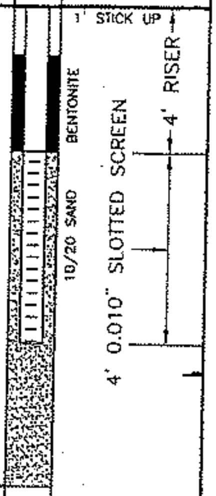
DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 19.3 DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0	▨	FILL, SAND and GRAVEL, loose, dry, light brown.					
8	▨	FILL, CLAY, with debris (aluminum, newspaper, cardboard), stiff, moist, black, strong organic odor.					
11	▨		12 8 6		◣		
19	▨	▼					
21	▨		3 4 4		◣		
29	▒	BEDROCK: CLAYSTONE, hard to very hard, wet, black.					
30							



PROJECT NO. 59292-1

LOG OF BORING 13

SHEET 1 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

TYPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 31.5

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

BACKFILLED:

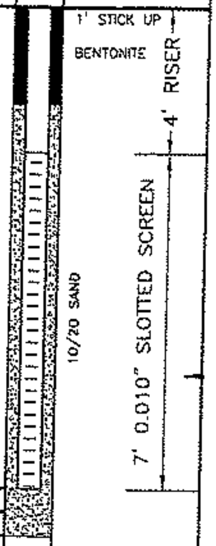
DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 20.8 DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0		FILL, Gravel, fine to medium grained, moist, light brown.					
6		FILL, CLAY, with debris (newspaper, wood), medium stiff, moist, dark black, strong organic odor.					
			3 4 4				
18		Possible FILL, sandy CLAY, stiff, moist, brown, no odor or debris.					
		▼	8 12 15				



PROJECT NO. 59292-1

LOG OF BORING 13

SHEET 2 OF 2

DRILLING EQUIPMENT CME 55 (w/ AUTOHAMMER)

PROJECT NAME Landfill Evaluation

LOCATION SEE TEST BORING LOCATION PLAN

TYPE OF BIT 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION N/A

TOTAL DEPTH OF HOLE 31.5

DATE

STARTED: 07/15/05

COMPLETED: 07/15/05

BACKFILLED:

DRILLING AGENCY Spectrum Exploration

LOGGED BY R. Jones

SURFACE CONDITIONS Grass and Weeds

GROUNDWATER DEPTH 20.8 DATE AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
30							
31	☒	Possible FILL, sandy CLAY, stiff, moist, brown, no odor or debris (continued).	9 14 20		▼		
32	▨	BEDROCK, CLAYSTONE, medium hard, moist.					
33							
34							
35							
36							
37							
38							
39							
)							
41							
42							
43							
44							
45							
46							
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48							
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55							
56							
58							
59							
60							

PROJECT NO. 59292-1

LOG OF BORING 14

SHEET 1 OF 1

DRILLING EQUIPMENT: CME 55 (w/ AUTOHAMMER)

PROJECT NAME: Landfill Evaluation

LOCATION: SEE TEST BORING LOCATION PLAN

TYPE OF BIT: 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION: N/A

TOTAL DEPTH OF HOLE: 20.5

DATE
STARTED: 07/15/05
COMPLETED: 07/15/05
BACKFILLED:

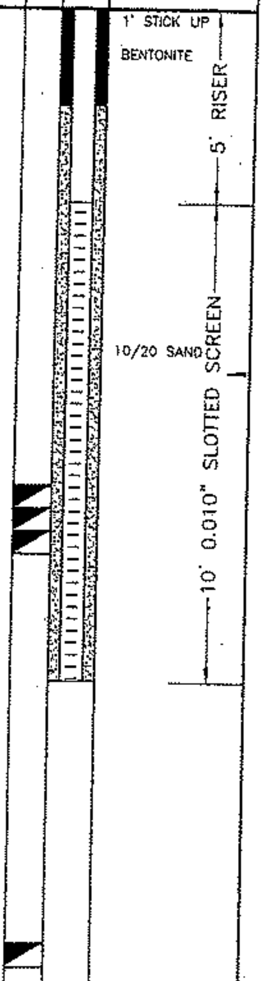
DRILLING AGENCY: Spectrum Exploration

LOGGED BY: R. Jones

SURFACE CONDITIONS: Grass and Weeds

GROUNDWATER DEPTH: 10.2 DATE: AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
0	▨	Sandy CLAY, with some gravel, stiff, moist, brown.					1' STICK UP BENTONITE
10	▼		3 5 6		◣		
16	▓	BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	50		◣		
20.5							



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KLEINFELDER

PROJECT NO. 59292-1

LOG OF BORING 15

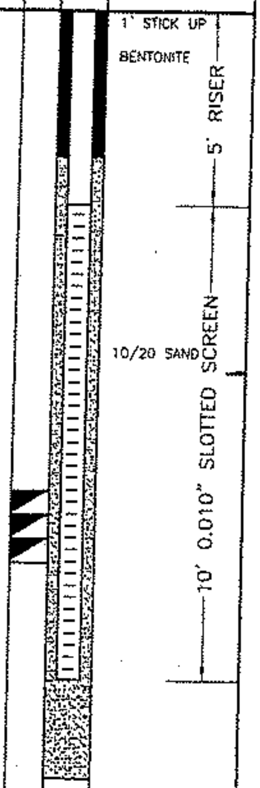
SHEET 1 OF 2

DRILLING EQUIPMENT: CME 55 (w/ AUTOHAMMER)
PROJECT NAME: Landfill Evaluation
LOCATION: SEE TEST BORING LOCATION PLAN
TYPE OF BIT: 4" AUGER
HAMMER DATA: WT. 140 LBS. DROP 30 INCHES
SURFACE ELEVATION: N/A
TOTAL DEPTH OF HOLE: 41.5

DATE
STARTED: 07/15/05
COMPLETED: 07/15/05
BACKFILLED:

DRILLING AGENCY: Spectrum Exploration
LOGGED BY: R. Jones
SURFACE CONDITIONS: Grass and Weeds
GROUNDWATER DEPTH: 31.7 DATE: AT DRILLING

DEPTH (FEET)	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES
0	FILL, GRAVEL, fine to coarse grained, medium dense, moist, light brown, no debris or odor.		
11		4 5 7	
16	FILL, GRAVEL, fine to coarse grained, with debris (glass, paper, wood), medium dense, moist, light brown.		
21		8 11 15	
30			



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KLEINFELDER

PROJECT NO.
59292-1

LOG OF BORING 15

SHEET 2 OF 2

DRILLING EQUIPMENT: CME 55 (w/ AUTOHAMMER)

PROJECT NAME: Landfill Evaluation

LOCATION: SEE TEST BORING LOCATION PLAN

YPE OF BIT: 4" AUGER

HAMMER DATA: WT. 140 LBS. DROP 30 INCHES

SURFACE ELEVATION: N/A

TOTAL DEPTH OF HOLE: 41.5

DATE STARTED: 07/15/05

DATE COMPLETED: 07/15/05

DATE BACKFILLED:

DRILLING AGENCY: Spectrum Exploration

LOGGED BY: R. Jones

SURFACE CONDITIONS: Grass and Weeds

GROUNDWATER DEPTH: 31.7 DATE: AT DRILLING

DEPTH (FEET)	SYMBOL	LOG OF MATERIAL	BLOW COUNTS	LABORATORY SAMPLES	SAMPLE TYPE	WELL	NOTES
30	▨						
31	▨	FILL, GRAVEL; fine to coarse grained, with debris (glass, paper, wood), medium dense, moist, light brown (continued).	2 3 3		◣ ◣ ◣		
32	▨ ▼						
33	▨						
34	▨						
35	▨						
36	▨						
37	▨						
38	▨						
39	▨						
40	▨						
		BEDROCK: CLAYSTONE, hard to very hard, slightly moist to moist, brown to gray.	15 20 32		◣ ◣ ◣		
42							
43							
44							
45							
46							
47							
48							
49							
50							
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59							
60							

EMPACT ANALYTICAL SYSTEMS INC.
365 S. MAIN ST.
BRIGHTON, CO
80601
303-637-0150

NATURAL GAS ANALYSIS

PROJECT NO. : 0507104
COMPANY NAME : **KLEINFELDER INC**
ACCOUNT NO. :
PRODUCER :
LEASE NO. :
NAME/DESCRIP : WATERMAN LANDFILL EVALUATION #59292
B-4 TAKEN @ 3:30

ANALYSIS NO. : 01
ANALYSIS DATE: JULY 22, 2005
SAMPLE DATE : JULY 20, 2005
TO:
CYLINDER NO. :

FIELD DATA
SAMPLED BY : RICKEY L JONES
SAMPLE PRES. :
SAMPLE TEMP. :
COMMENTS :

AMBIENT TEMP.:
GRAVITY :
VAPOR PRES. :

COMPONENTS	NORM. MOLE%	GPM @ 14.65	GPM @ 14.73
HELIUM	0.00	-	-
HYDROGEN	0.00	-	-
OXYGEN/ARGON	0.84	-	-
NITROGEN	25.36	-	-
CO2	15.47	-	-
METHANE	58.33	-	-
ETHANE	0.00	0.000	0.000
PROPANE	0.00	0.000	0.000
ISOBUTANE	0.00	0.000	0.000
N-BUTANE	0.00	0.000	0.000
ISOPENTANE	0.00	0.000	0.000
N-PENTANE	0.00	0.000	0.000
HEXANES+	0.00	0.000	0.000
TOTAL	100.00	0.000	0.000

BTU @ 60 DEG F	14.65	14.73
GROSS DRY REAL =	588.3	591.5
GROSS WET REAL =	578.0	581.3

RELATIVE DENSITY (AIR=1 @14.696 PSIA 60F) : 0.8135

COMPRESSIBILITY FACTOR : 0.99823

NOTE: REFERENCE GPA 2261(ASTM D1945), 2145, & 2172 CURRENT PUBLICATIONS

APPENDIX C

Laboratory Data Sheets

EMPACT ANALYTICAL SYSTEMS INC.
365 S. MAIN ST.
BRIGHTON, CO
80601
303-637-0150

NATURAL GAS ANALYSIS

PROJECT NO. : 0507104
COMPANY NAME : KLEINFELDER INC
ACCOUNT NO. :
PRODUCER :
LEASE NO. :
NAME/DESCRIP : WATERMAN LANDFILL EVALUATION #59292
B-10 TAKEN @ 1:50

ANALYSIS NO. : 02
ANALYSIS DATE: JULY 22, 2005
SAMPLE DATE : JULY 20, 2005
TO:
CYLINDER NO. :

FIELD DATA
SAMPLED BY : RICKEY L JONES
SAMPLE PRES. :
SAMPLE TEMP. :
COMMENTS :

AMBIENT TEMP.:
GRAVITY :
VAPOR PRES. :

COMPONENTS	NORM. MOLE%	GPM @ 14.65	GPM @ 14.73
HELIUM	0.00	-	-
HYDROGEN	0.00	-	-
OXYGEN/ARGON	2.15	-	-
NITROGEN	31.19	-	-
CO2	23.28	-	-
METHANE	43.38	-	-
ETHANE	0.00	0.000	0.000
PROPANE	0.00	0.000	0.000
ISOBUTANE	0.00	0.000	0.000
N-BUTANE	0.00	0.000	0.000
ISOPENTANE	0.00	0.000	0.000
N-PENTANE	0.00	0.000	0.000
HEXANES+	0.00	0.000	0.000
TOTAL	100.00	0.000	0.000

BTU @ 60 DEG F	14.65	14.73
GROSS DRY REAL =	437.6	440.0
GROSS WET REAL =	429.9	432.3

RELATIVE DENSITY (AIR=1 @14.696 PSIA 60F) : 0.9203

COMPRESSIBILITY FACTOR : 0.99817

NOTE: REFERENCE GPA 2261(ASTM D1945), 2145, & 2172 CURRENT PUBLICATIONS

EMPACT ANALYTICAL
SYSTEMS INC.
365 S. MAIN ST.
BRIGHTON, CO
80601
303-637-0150

NATURAL GAS ANALYSIS

PROJECT NO. : **0507104**
COMPANY NAME : **KLEINFELDER INC**
ACCOUNT NO. :
PRODUCER :
LEASE NO. :
NAME/DESCRIP : WATERMAN LANDFILL EVALUATION #59292
B-15 TAKEN @ 2:35

ANALYSIS NO. : 03
ANALYSIS DATE: JULY 22, 2005
SAMPLE DATE : JULY 20, 2005
TO:
CYLINDER NO. :

FIELD DATA
SAMPLED BY : RICKEY L JONES
SAMPLE PRES. :
SAMPLE TEMP. :
COMMENTS :

AMBIENT TEMP.:
GRAVITY :
VAPOR PRES. :

COMPONENTS	NORM. MOLE%	GPM @ 14.65	GPM @ 14.73
HELIUM	0.00	-	-
HYDROGEN	0.01	-	-
OXYGEN/ARGON	0.82	-	-
NITROGEN	28.05	-	-
CO2	22.35	-	-
METHANE	48.77	-	-
ETHANE	0.00	0.000	0.000
PROPANE	0.00	0.000	0.000
ISOBUTANE	0.00	0.000	0.000
N-BUTANE	0.00	0.000	0.000
ISOPENTANE	0.00	0.000	0.000
N-PENTANE	0.00	0.000	0.000
HEXANES+	0.00	0.000	0.000
TOTAL	100.00	0.000	0.000

BTU @ 60 DEG F	14.65	14.73
GROSS DRY REAL =	492.0	494.7
GROSS WET REAL =	483.4	486.1

RELATIVE DENSITY (AIR=1 @14.696 PSIA 60F) : 0.8909

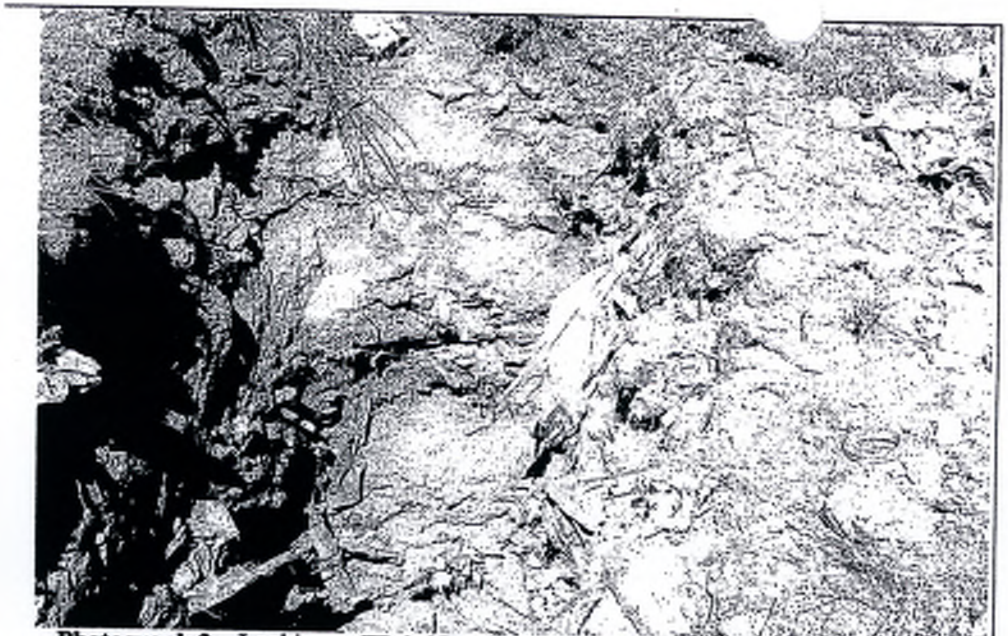
COMPRESSIBILITY FACTOR : 0.99811

NOTE: REFERENCE GPA 2261(ASTM D1945), 2145, & 2172 CURRENT PUBLICATIONS

APPENDIX D

Site Photographs

Photograph 1 – Looking at the debris pile from TP-2. Debris was observed throughout the fifteen-foot test pit.



Photograph 2 – Looking at TP-2. Note the large amounts of debris within the soil.

Photograph 3 – Looking at the debris pile from TP-2.

Photograph 4 – Looking at the debris pile from TP-3. Debris wa observed throughout the fifteen-foot test pit.

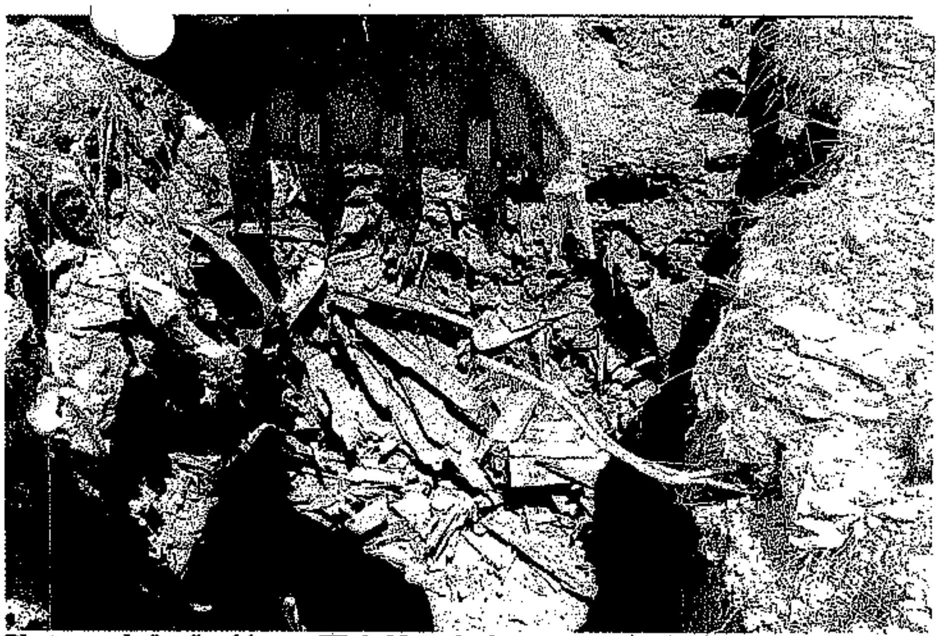
KLEINFELDER

Project Number 5929-1 Photos Taken August 1, 2005

Landfill Evaluation
South of West Van Buren
Colorado Springs, Colorado

Site Photographs

Appendix
D



Photograph 5 – Looking at TP-3. Note the large amounts of debris mixed within the soil.

Photograph 7 – Looking at TP-5. Note the large amounts of debris mixed within the soil.

Photograph 6 – Looking at the debris pile from TP-5. Debris was observed throughout the entire fifteen-foot test pit.

Appendix C

Soil Boring Investigation
November 2005

KLEINFELDER
An employee owned company

November 30, 2005

Kleinfelder File No. 63249

Mr. Ted Waterman, President
Waterman, Inc.
P.O. Box 27560
Albuquerque, New Mexico 87125

Subject: **Soil Boring Investigation**
Mesa Valley Springs Property
Colorado Springs, Colorado

Dear Mr. Waterman:

Kleinfelder is pleased to present the results of our soil boring investigation for the Mesa Valley Springs Property in Colorado Springs, Colorado (Subject Site). Our scope of work included the drilling and logging of three sets of soil borings, determining the depth to the top and bottom of the solid waste zone, performing groundwater measurements for each boring, recording the materials removed from the soil borings, and preparing a report presenting the results of the soil boring investigation.

SUMMARY

This investigation was conducted on a vacant parcel of land located at the Mesa Valley Springs Property in Colorado Springs, El Paso County, Colorado.

During this assessment the following tasks were completed:

1) The completion of three sets of soil borings. Set 1 included three borings that were equally spaced at 150-foot intervals between Borings 14 and 15. Set 2 included three borings that were installed in a straight line, spaced at 200-feet intervals, in the vicinity of Boring 1 and Boring 4. Set 3 included three borings placed at 200-foot intervals from Boring 15 to Boring 2. These borings were placed as shown on the drawing provided to Kleinfelder.
2) Each boring was drilled beyond the bottom of the landfill and extended to a depth of at least three feet below the bottom of the landfill. Depths were determined for the top and bottom of the solid waste zone. All measurements were taken from the ground surface. Additionally, the depth to groundwater was measured for each boring, if encountered, during drilling operations.
3) The materials removed from the soil borings were recorded. Solid waste that was encountered in each boring was classified as the following materials: (1) wood; (2) paper or paper products; (3) concrete; (4) metal; (5) lumber; (6) asphalt.

SCOPE

This soil boring investigation was conducted in general accordance with our proposal dated October 31, 2005. The purpose of this study was to conduct a soil boring investigation to record the depths of the existing landfill debris and to characterize the types of solid wastes observed. This study did not include investigating other environmental issues such as soil or groundwater contamination. This study included preparing a description of the materials observed in the borings based on visual observation only. No testing or other methods were utilized to describe the subsurface conditions.

SITE LOCATION & DESCRIPTION

The Subject Site is a vacant parcel encompassing approximately 48-acres of land, located south of West Van Buren Street in Colorado Springs, El Paso County, Colorado. The Subject Site is generally located within the northwest ¼ of the southeast ¼ of Section 1, Township 13 South, and Range 67 West of the 6th PM. The El Paso County Assessor's parcel number is 7401200002. The Subject Site is approximately 6,230 feet above mean sea level (MSL) at the northern property boundary, falling to approximately 6,130 feet above MSL at the southeastern property boundary. The topography of the Site and the surrounding area slopes down to the south towards the intermittent stream that borders the Subject Site. The topography of the site is irregular, but is dominated in the northeast by a prominent ridge, in the central portion by a valley, in the northwest by a system of ridges. A drainage forms the westerly and southerly side boundaries.

FIELD INVESTIGATION

Prior to the commencement of field activities at the Subject Site, Kleinfelder prepared a Site-Specific Health and Safety Plan as required by Occupational Safety and Health Administration ("OSHA"), to inform our personnel of the potential hazards that may be encountered and the required procedures to protect worker health and safety. Also, as required by law, Kleinfelder coordinated with utility companies to locate buried utilities in the vicinity of the Subject Site.

Subsurface Investigation

On November 22 and November 23, 2005, Kleinfelder mobilized to the Subject Site with a track-mounted drilling rig equipped with 4-inch continuous flight augers to drill nine (9) subsurface borings (Set-1, Set-2, and Set-3) to delineate the depth of solid wastes and also to evaluate what type of wastes were present. A map indicating the location of the borings is presented as Figure 1.

All borings were drilled beyond the bottom of the landfill extending to a depth of at least three feet below the bottom of the landfill. Landfill depths are indicted on the individual boring logs, which are included in Appendix A. Samples of the subsurface materials were collected at 5-foot intervals and observed in the field to record the type of solid waste present (e.g.: wood, paper or paper products, concrete, metal, lumber or asphalt). The types of wastes observed are documented on the boring logs. Waste material observed in the landfill included solid wastes ranging mainly from wood, to organics, plastic, glass, rubber, metal, aluminum, galvanized wire, cloth, newspaper, and cardboard. Kleinfelder returned to the site on November 28, 2005 to measure the static water level in each boring.

Table 1: Static Water Levels

Boring ID	Static Water Level (feet below grade)*
S1-1	24.5
S1-2	26.4
S1-3	27.6
S2-1	12.9
S2-2	14.7
S2-3	20.6
S3-1	16.5
S3-2	DRY
S3-3	DRY

*DRY: No free groundwater was encountered during or immediately after drilling activities. Water levels shown above were measured 6 days after drilling.

FINDINGS

Nine (9) subsurface borings were drilled to delineate the depth of solid wastes and also to evaluate what type of wastes were present within the landfill. Boring 1 through 3 of Set 1 was located along the southern boundary of the property. Boring 1 through 3 of Set 2 was located in the northern portion of the Subject Site. Boring 1 through 3 of Set was located in the central portion. The findings of drilling and sampling activities are presented below in Table 2.

Table 2: Findings

Boring	Top Depth of Solid Waste Zone (feet below grade)	Bottom Depth of Solid Waste Zone (feet below grade)	Type of Wastes Observed	Approximate Elevation (Ground Surface)	Northing/Easting (Based on Hand-Held GPS)
S1-1	21	29	Wood, Glass, Brick	6173'	1,376,182.713/ 3,187,162.646
S1-2	25	47	Glass, Wood, Asphalt, Plastic, Styrofoam	6190'	1,376,242.324/ 3,187,011.935
S1-3	20	32	Paper, Plastic, Metal, Glass, Wood	6187'	1,376,271.587/ 3,186,861.445
S2-1	0	17	Glass, Plastic, Metal, Concrete, Brick, wood	6217'	1,377,152.672/ 3,186,989.535
S2-2	0	20	Glass, Plastic, Wood, Metal	6214'	1,377,000.586/ 3,186,943.180
S2-3	3	20	Plastic, Wood, Galvanized Wire	6216'	1,376,838.383/ 3,186,896.896
S3-1	--	--	No Wastes	6202'	1,376,911.084/ 3,187,157.375
S3-2	2	9 ½	Wood, Glass	6214'	1,376,648.805/ 3,187,262.094
S3-3	2	7 ½	Glass, Wood, Plastic	6192'	1,376,395.670/ 3,187,232.289

*--: No solid wastes were encountered during drilling or sampling activities

LIMITATIONS

The limited sampling performed during this investigation was performed to provide a general indication of the depth and characterization of solid wastes. Limited assessments such as this are non-comprehensive by nature and will not identify all environmental problems or eliminate all risk, associated with environmental issues. The scope of work on this project was presented in our proposal and subsequently approved by our client. Please be aware our scope of work was limited to those items specifically identified in the proposal. Environmental issues not specifically addressed in the proposal or this report is beyond the scope of our work and not included in this evaluation.

Although risk can never be eliminated, more detailed and extensive investigations yield more information, which may help you understand and better manage your risks. Since such detailed services involve greater expense, we ask our clients to participate in identifying the level of service that will provide them with an acceptable level of risk. Please contact the signatories of this report if you would like to discuss this issue of risk further.

Land use, site conditions (both on-site and off-site) and other factors will change over time. Since site activities and regulations beyond our control could change at any time after the completion of this report, our observations, findings and opinions can be considered valid only as of the date of this report.

The property owner is solely responsible for notifying all governmental agencies, and the public at large, of the existence, release, treatment or disposal of any hazardous materials or conditions detected at the project site. Kleinfelder assumes no responsibility or liability whatsoever for any claim, loss of property value, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

If you have any questions regarding this letter or need additional information, please do not hesitate to call our office at (719) 632-3593.

Respectfully submitted,

KLEINFELDER, INC.

Rickey L. Jones

Rickey L. Jones
Environmental Scientist

Will J Barriere

William J. Barriere, P.E.
Area Manager

RLJ:WJB

Aerial Photograph: 1-01-2002

KLEINFELDER
An employee owned company

Checked By: R. Jones
Drafted By: R. Stump
Project Number: 63249-1
Date: 11/29/2005

BORING LOCATION PLAN

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

Figure

1

LEGEND OF SYMBOLS USED ON BORING LOGS

LOG SYMBOLS

☒	BULK / GRAB SAMPLE
■	MODIFIED CALIFORNIA SAMPLER (2.5 inch inside diameter)
◪	STANDARD PENETRATION SPLIT SPOON SAMPLER (2.0-inch O.D. X 1.4-inch I.D.)
▯	SHELBY TUBE (3 inch outside diameter)
▥	BDBGM SIZE CORE BARREL (1.65-inch I.D.)
▥	NX SIZE CORE BARREL (1.875-inch I.D.)
▥	HQ-3 SIZE CORE BARREL (2.4-inch I.D.)
▼	WATER LEVEL (level where first encountered)
▽	WATER LEVEL (level after completion)

	USCS SYMBOL	SOIL DESCRIPTIONS
▩	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
▩	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
▩	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
▨	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
▩	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
▩	SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
▩	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
▨	SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
▥	ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
▨	--	INTEBEDDED SANDSTONE/CLAYSTONE
▦	--	LIMESTONE
■	--	CLAYSTONE
■	--	SHALE
▨	--	SANDSTONE
▩	--	LANDFILL REFUSE
▩	--	FILL

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were based on visual classification in the field and were modified where appropriate by visual classifications in the office, and/or laboratory gradation and index property testing.
5. NV = No Value; NA = Not Analyzed; NP = No Plasticity
6. Exp = percent expansion under defined surcharge pressure.
7. Com = Percent compression under defined surcharge pressure.
8. 50/X indicates number of blows required to drive the identified sampler X inches with a 140 lb hammer falling 30 inches.

GEO LEGEND 63249-1.   rstump@kleinfelder.com 11/29/2005

KLEINFELDER

Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG LEGEND

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (▽): 24.5 feet 6 days after drilling.
Drilling Company: Spectrum Exploration Equipment: CME-55 ATV
Auger Diameter (in): 4 Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 35.5

			DESCRIPTION	FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	Appx. Surface Elevation (ft): 6173.0 Surface Condition: Heavily vegetated	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
			FILL: Sandy CLAY (CL), brown, moist, stiff.											
	1													
	2													
6170	3													
	4													
	5			◣	5 7 6	SPT								
	6													
	7													
6165	8													
	9													
	10			◣	5 7 8	SPT								
	11													
	12													
6160	13													
	14													
	15			◣	7 7 9	SPT								
	16													
	17													
6155	18													
	19													
	20			◣	4 6 6	SPT								
	21		LANDFILL REFUSE (wood, glass, brick) with silty SAND (SM), brown, moist, stiff.											
	22													
6150	23													
	24	▽												
	25			◣	3 5 8	SPT								
	26													
	27													
6145	28													
	29													
	30													

CSPRINGS_GEO_A 249-1.GPJ rstump@kleinfelder.com 11/29/2005

KLEINFELDER

Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S1-1

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	FIELD			LABORATORY							
				Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
		▨	CLAYSTONE BEDROCK: gray, moist to slightly moist, medium hard to very hard. *(continued)*		8 12 20	SPT								
	31	▨												
	32	▨												
6140	33	▨												
	34	▨												
	35	▨			50/3	SPT								
	36													
	37													
6135	38													
	39													
	40													
	41													
	42													
6130	43													
	44													
	45													
	46													
	47													
6125	48													
	49													
	50													
	51													
	52													
6120	53													
	54													
	55													
	56													
	57													
6115	58													
	59													
	60													
	61													
	62													
6110	63													
	64													

KLEINFELDER

Drafted By: R. Stump

Date: 11/29/2005

Project Number: 63249-1

BORING LOG

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING

S1-1

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (∇): 26.4 feet 6 days after drilling.
Drilling Company: Spectrum Exploration Equipment: CME-55 ATV
Auger Diameter (in): 4 Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 50.0

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6190.0 Surface Condition: Heavily vegetated	FIELD Sample Interval	Blow Counts per 6" Interval	Sample Type	LABORATORY USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
			FILL: Silty SAND (SM), fine to coarse grained, brown, moist, medium dense.											
	1													
	2													
	3													
	4													
6185	5			◣	7 7 7	SPT								
	6													
	7													
	8		FILL: Sandy CLAY (CL), brown, moist, stiff to very stiff.											
	9													
6180	10			◣	3 5 6	SPT								
	11													
	12													
	13													
	14													
6175	15			◣	3 7 9	SPT								
	16													
	17													
	18													
	19													
6170	20			◣	6 8 9	SPT								
	21													
	22													
	23													
	24													
6165	25		LANDFILL REFUSE (glass, wood, asphalt, plastic, styrofoam) with silty SAND (SM), brown, moist, loose to medium dense.	◣	4 6 6	SPT								
	26	∇												
	27													
	28													
	29													
6160	30													

CSPRINGS_GEO_AL 49-1.GPJ rstump@kleinfelder.com 11/29/2005

KLEINFELDER

Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG
Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S1-2

				FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
	31		LANDFILL REFUSE (glass, wood, asphalt, plastic, styrofoam) with silty SAND (SM), brown, moist, loose to medium dense. *(continued)*		1 2 3	SPT								
	32													
	33													
	34													
6155	35				2 2 4	SPT								
	36													
	37													
	38													
	39													
6150	40				3 4 5	SPT								
	41													
	42													
	43													
	44													
6145	45				11 13 17	SPT								
	46													
	47		FILL: Silty SAND (SM), brown, moist.											
	48													
	49													
6140	50													
	51													
	52													
	53													
	54													
6135	55													
	56													
	57													
	58													
	59													
6130	60													
	61													
	62													
	63													
	64													

CSPRINGS_GEO_A 249-1.GPJ rstump@kleinfelder.com 11/29/2005

KLEINFELDER

Drafted By:	R. Stump	Project Number:
Date:	11/29/2005	63249-1

BORING LOG
Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S1-2

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (▽): 27.6 feet 6 days after drilling.
Drilling Company: Spectrum Exploration
Equipment: CME-55 ATV
Auger Diameter (in): 4
Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 36.5

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6187.0 Surface Condition: Heavily vegetated	FIELD Sample Interval	 Blow Counts per 6" Interval	 Sample Type	LABORATORY USCS SYMBOL	 Dry Density (pcf)	 Moisture Content (%)	 Liquid Limit	 Plasticity Index	 Passing #4 Sieve (%)	 Passing #200 Sieve (%)	 Other Tests
	1		FILL: Silty SAND (SM), medium to coarse grained, brown, moist, medium dense.											
6185	2													
	3													
	4													
	5			◣	7 9 8	SPT								
	6													
6180	7													
	8													
	9													
	10			◣	4 5 6	SPT								
	11													
6175	12													
	13													
	14													
	15			◣	6 6 8	SPT								
	16													
6170	17													
	18													
	19													
	20		LANDFILL REFUSE (paper, plastic, metal, glass) with silty SAND (SM), brown, moist, loose.	◣	3 3 4	SPT								
	21													
6165	22													
	23													
	24													
	25			◣	3 3 5	SPT								
	26													
6160	27	▽												
	28													
	29													
	30													

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Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S1-3

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	FIELD			LABORATORY							
				Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
	31		LANDFILL REFUSE (paper, plastic, metal, glass) with silty SAND (SM), brown, moist, loose. *(continued)*		2 3 4	SPT								
6155	32		Sandy CLAY (CL), brown to gray, moist, very stiff.											
	33													
	34													
	35				7 10 18	SPT								
	36													
6150	37													
	38													
	39													
	40													
	41													
6145	42													
	43													
	44													
	45													
	46													
6140	47													
	48													
	49													
	50													
	51													
6135	52													
	53													
	54													
	55													
	56													
6130	57													
	58													
	59													
	60													
	61													
6125	62													
	63													
	64													

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Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S1-3

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (∇): 12.9 feet 6 days after drilling.
Drilling Company: Spectrum Exploration
Equipment: CME-55 ATV
Auger Diameter (in): 4
Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 26.5

				FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6217.0 Surface Condition: Heavily vegetated	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
			LANDFILL REFUSE (glass, plastic, metal, concrete, brick, wood) with silty SAND (SM), brown, moist, medium dense.											
	1													
6215	2													
	3													
	4													
	5			◣	7 5 6	SPT								
	6													
6210	7													
	8													
	9													
	10			◣	2 3 10	SPT								
	11													
6205	12													
	13	∇												
	14													
	15			◣	13 11 4	SPT								
	16													
6200	17		Sandy CLAY (CL), brown, moist, very stiff.											
	18													
	19													
	20			◣	17 13 12	SPT								
	21													
6195	22													
	23													
	24													
	25			◣	12 12 17	SPT								
	26													
6190	27													
	28													
	29													
	30													

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Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG
Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING

S2-1

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (▽): 14.7 feet 6 days after drilling.
Drilling Company: Spectrum Exploration Equipment: CME-55 ATV
Auger Diameter (in): 4 Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 26.5

				FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6214.0 Surface Condition: Heavily vegetated	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
	0	▨	LANDFILL REFUSE (glass, plastic, wood, metal) with silty SAND (SM), brown, moist, very loose to medium dense.											
	1	▨												
	2	▨												
	3	▨												
6210	4	▨												
	5	▨		◣	2 1 1	SPT								
	6	▨												
	7	▨												
	8	▨												
6205	9	▨												
	10	▨		◣	3 4 7	SPT								
	11	▨												
	12	▨												
	13	▨												
6200	14	▨	▽											
	15	▨		◣	1 3 4	SPT								
	16	▨												
	17	▨												
	18	▨												
6195	19	▨												
	20	▧	Sandy CLAY (CL), brown, moist, medium stiff to hard.	◣	4 3 3	SPT								
	21	▧												
	22	▧												
	23	▧												
6190	24	▧												
	25	▧		◣	12 28 35	SPT								
	26	▧												
	27													
	28													
6185	29													
	30													

KLEINFELDER

Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG
Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S2-2

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (▽): 20.6 feet 6 days after drilling.
Drilling Company: Spectrum Exploration Equipment: CME-55 ATV
Auger Diameter (in): 4 Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 26.5

Appx. Surface Elevation (ft): 6216.0
Surface Condition: Heavily vegetated

		DESCRIPTION	FIELD			LABORATORY							
Elevation (feet)	Depth (feet)		Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
		FILL: Silty SAND (SM), brown, moist.											
6215	1												
	2												
	3	LANDFILL REFUSE (plastic, wood, wire) with silty SAND (SM), brown, moist, loose to medium dense.											
	4												
	5		◣	7 7 8	SPT								
6210	6												
	7												
	8												
	9												
	10		◣	1 2 3	SPT								
6205	11												
	12												
	13												
	14												
	15		◣	7 4 4	SPT								
6200	16												
	17												
	18												
	19												
	20	▽ Sandy CLAY (CL), brown, moist, stiff to very stiff.	◣	2 4 4	SPT								
6195	21												
	22												
	23												
	24												
	25		◣	10 10 10	SPT								
6190	26												
	27												
	28												
	29												
	30												

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Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG
Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S2-3

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (∇): 16.5 feet 6 days after drilling.
Drilling Company: Spectrum Exploration Equipment: CME-55 ATV
Auger Diameter (in): 4 Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 21.5

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6202.0 Surface Condition: Heavily vegetated	FIELD Sample Interval	FIELD Blow Counts per 6" Interval	FIELD Sample Type	LABORATORY USCS SYMBOL	LABORATORY Dry Density (pcf)	LABORATORY Moisture Content (%)	LABORATORY Liquid Limit	LABORATORY Plasticity Index	LABORATORY Passing #4 Sieve (%)	LABORATORY Passing #200 Sieve (%)	LABORATORY Other Tests
		▩	FILL: Silty SAND (SM), brown, moist, medium dense.											
	1	▩												
6200	2	▩												
	3	▩												
	4	▩												
	5	▨	Sandy CLAY (CL), brown, moist, very stiff to hard.	◣	5 7 6	SPT								
	6	▨												
6195	7	▨												
	8	▨												
	9	▨												
	10	▨		◣	9 14 13	SPT								
	11	▨												
6190	12	▨												
	13	▨												
	14	▨												
	15	▨		◣	10 14 17	SPT								
	16	▨	∇											
6185	17	▨												
	18	▨												
	19	▨												
	20	▨		◣	11 12 14	SPT								
	21	▨												
6180	22													
	23													
	24													
	25													
	26													
6175	27													
	28													
	29													
	30													

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Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING
S3-1

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (▽): None feet 6 days after drilling.
Drilling Company: Spectrum Exploration Equipment: CME-55 ATV
Auger Diameter (in): 4 Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 16.0

			DESCRIPTION	FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	Appx. Surface Elevation (ft): 6214.0 Surface Condition: Heavily vegetated	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
	0		LANDFILL REFUSE (wood, glass, rubber) with silty SAND (SM), brown, moist, very loose.											
	1													
	2													
	3													
6210	4													
	5			◣	3 2 1	SPT								
	6													
	7													
	8													
6205	9													
	10		Sandy CLAY (CL), brown, moist, very stiff to hard.	◣	6 12 17	SPT								
	11													
	12													
	13													
6200	14													
	15			◣	50 11	SPT								
	16													
	17													
	18													
6195	19													
	20													
	21													
	22													
	23													
6190	24													
	25													
	26													
	27													
	28													
6185	29													
	30													

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Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

BORING

S3-2

Location: See Boring Location Plan
Groundwater (ft): None at Drilling /Final (▽): None feet 6 days after drilling.
Drilling Company: Spectrum Exploration Equipment: CME-55 ATV
Auger Diameter (in): 4 Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 11/22/2005
Date Completed: 11/22/2005
Logged By: R. Jones
Total Depth (ft): 15.0

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6192.0 Surface Condition: Heavily vegetated	FIELD Sample Interval	Blow Counts per 6" Interval	Sample Type	LABORATORY USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
		▩	LANDFILL REFUSE (glass, wood, plastic) with silty SAND (SM), brown, moist, medium dense.											
	1	▩												
6190	2	▩												
	3	▩												
	4	▩												
	5	▩		◣	7 7 9	SPT								
	6	▩												
6185	7	▩												
	8	▨	Sandy CLAY (CL), brown to gray, moist, very stiff to hard.											
	9	▨												
	10	▨		◣	12 17 21	SPT								
	11	▨												
6180	12	▨												
	13	▨												
	14	▨												
	15													
	16													
6175	17													
	18													
	19													
	20													
	21													
6170	22													
	23													
	24													
	25													
	26													
6165	27													
	28													
	29													
	30													

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Drafted By: R. Stump
Date: 11/29/2005
Project Number: 63249-1

BORING LOG

Soil Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

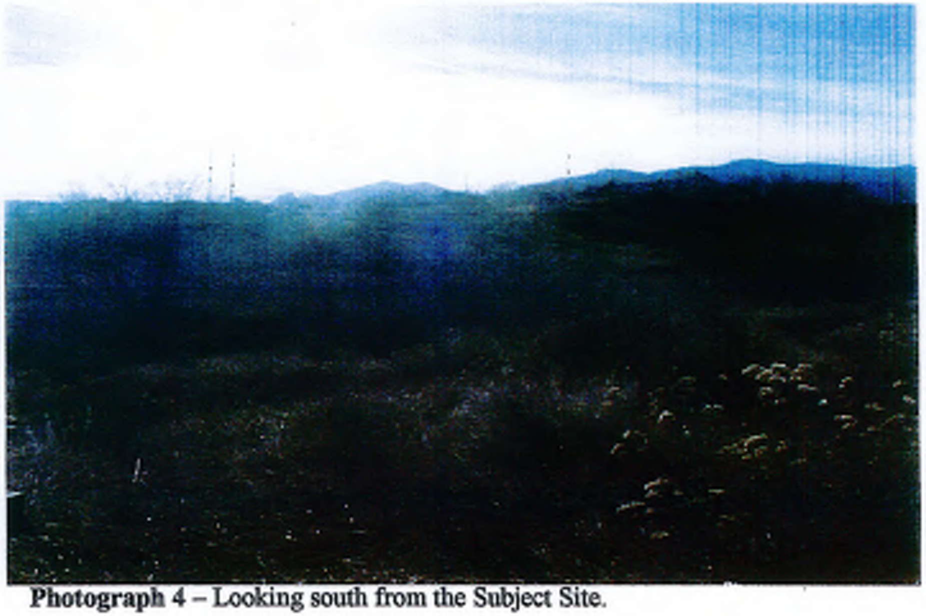
BORING

S3-3

Photograph 1 – Looking east from the Subject Site.

Photograph 2 – Looking north from the Subject Site.

Photograph 3 – Looking west from the Subject Site.



Photograph 4 – Looking south from the Subject Site.

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Project Number 63249

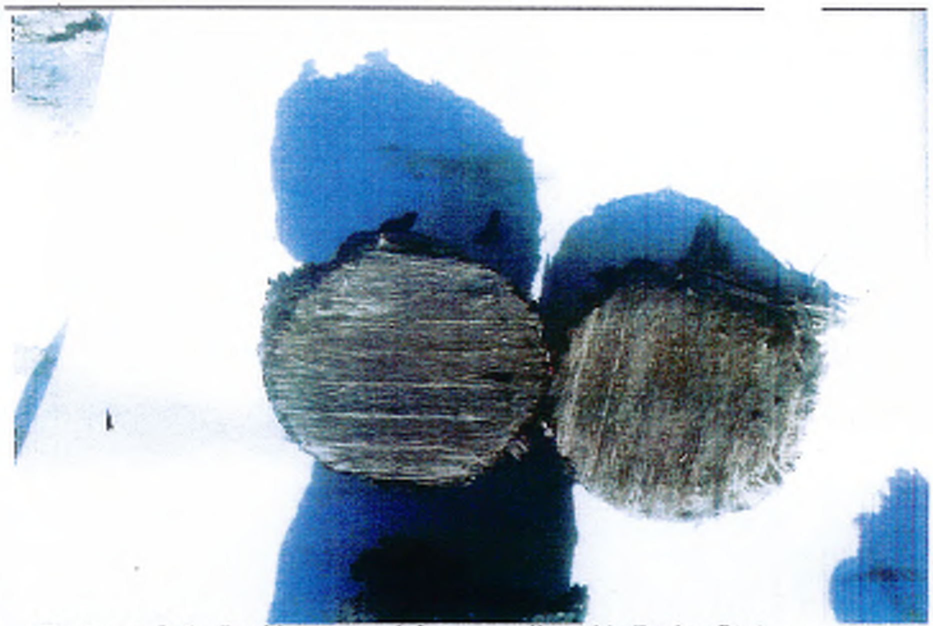
Photos Taken November 22 & 23, 2005

Soil Boring Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

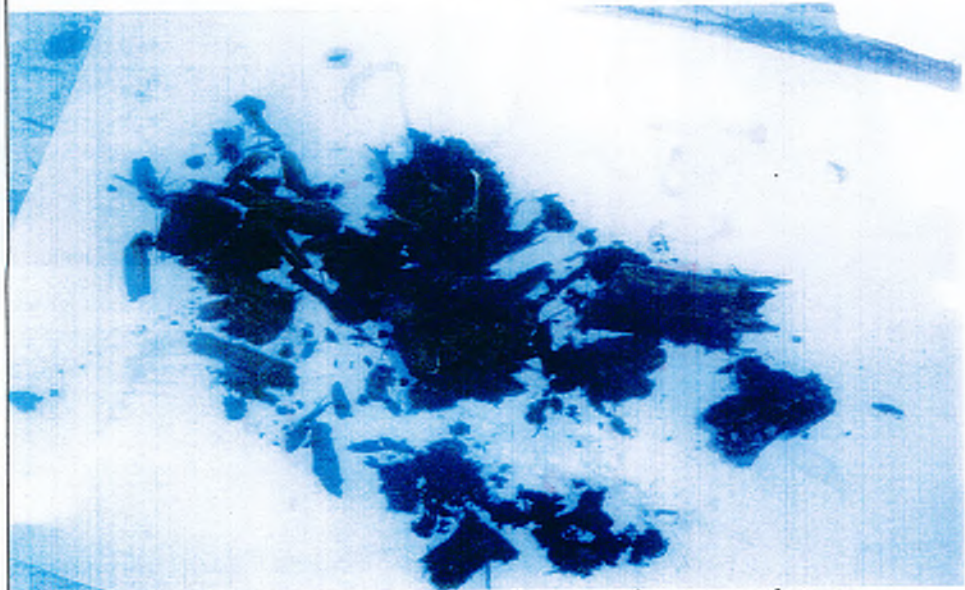
Site Photographs

Appendi
B

Photograph 5 – Looking at wood and glass that was collected in Boring S1-1.



Photograph 6 – Looking at wood that was collected in Boring S1-1.



Photograph 7 – Looking at wood and a small amount of newspaper that was collected from Boring S1-2.

Photograph 8 – Looking at the cuttings from Boring S1-2. The cuttings consisted of water and soil with various types of waste materials within (refer to boring logs).

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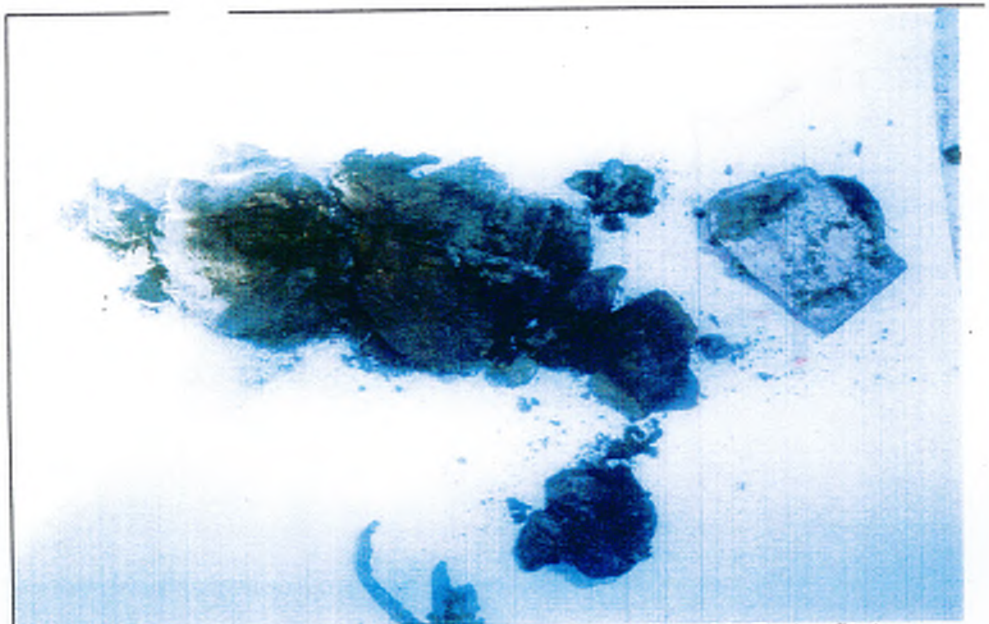
Project Number 63249 Photos Taken November 22 & 23, 2005

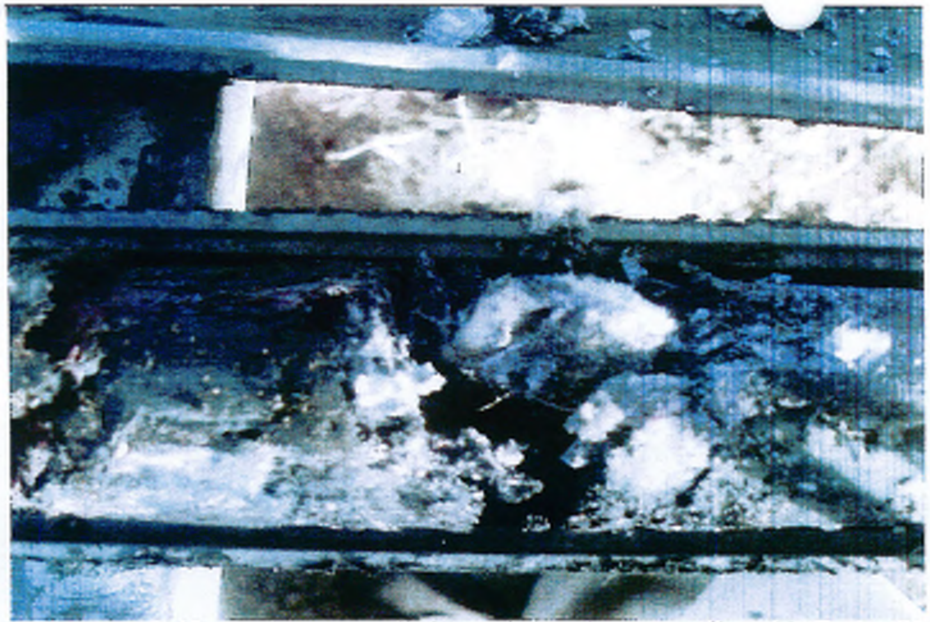
Soil Boring Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

Site Photographs

Appendi
B



Photograph 9 – Looking at wood and metal that were collected in Boring S1-3.



Photograph 10 – Looking at small pieces of glass that were collected in Boring S1

Photograph 11 – Looking at glass and metal that were collected in Boring S2-1.

Photograph 12 – Looking at wood and brick fragments that were collected in Bo S2-1.

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Project Number 63249 Photos Taken November 22 & 23, 2005

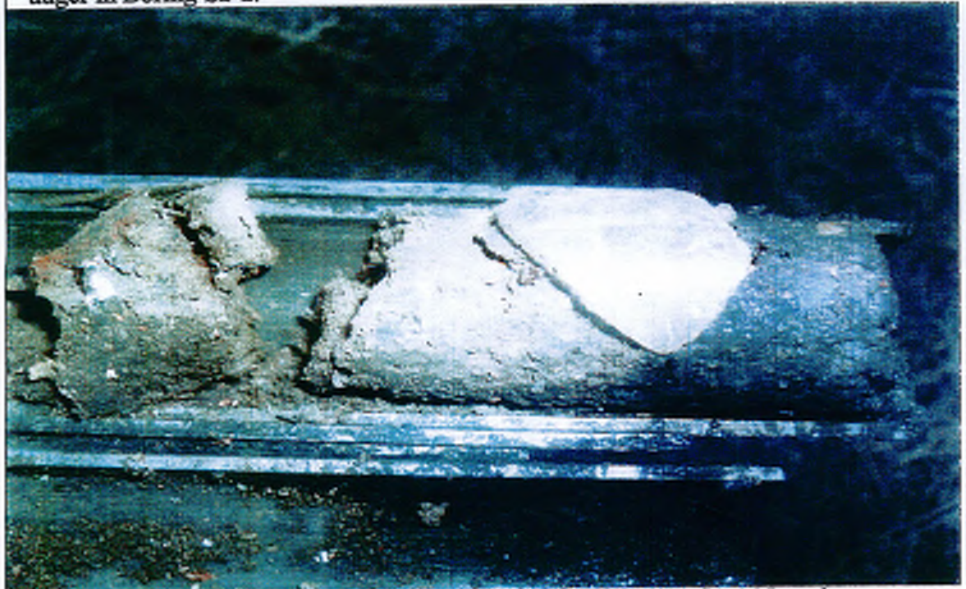
Soil Boring Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

Site Photographs

Appendi B

Photograph 13 – Looking at a large piece of cloth that was wrapped around the auger in Boring S2-2.

Photograph 14 – Looking at small pieces of glass, wood, and plastic that was collected in Boring S2-2.



Photograph 15 – Looking at soil that was collected in Boring S2-2.Note the black discoloration of the soil. The black soil was found within the landfill material.

Photograph 16 – Looking at a large piece of metal that was wrapped around the bit in Boring S2-2.

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Project Number 63249 Photos Taken November 22 & 23, 2005

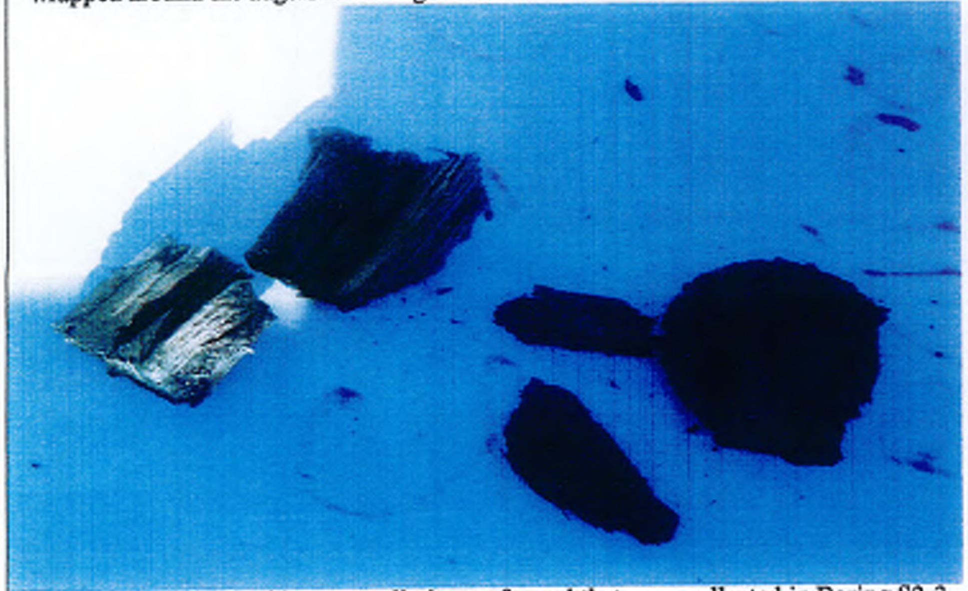
Soil Boring Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

Site Photographs

Appendi
B

Photograph 17 – Looking at a large amount of galvanized wire that was wrapped around the augers in Boring S2-3.

Photograph 18 – Looking at large amounts of plastic that were pulled out of Boring S2-3 during drilling.



Photograph 19 – Looking at small pieces of wood that were collected in Boring S2-3.

Photograph 20 – Looking at soil cuttings from Boring S3-1. Note that there wa waste material collected in this boring. The entire sampling format was clean.

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Project Number 63249

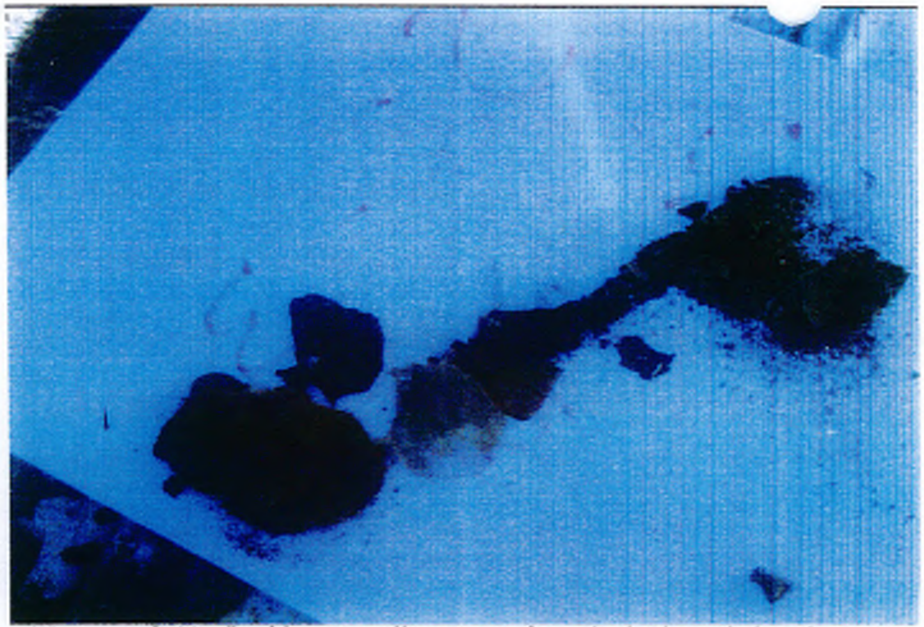
Photos Taken November 22 & 23, 2005

Soil Boring Investigation
Mesa Valley Springs Property
Colorado Springs, Colorado

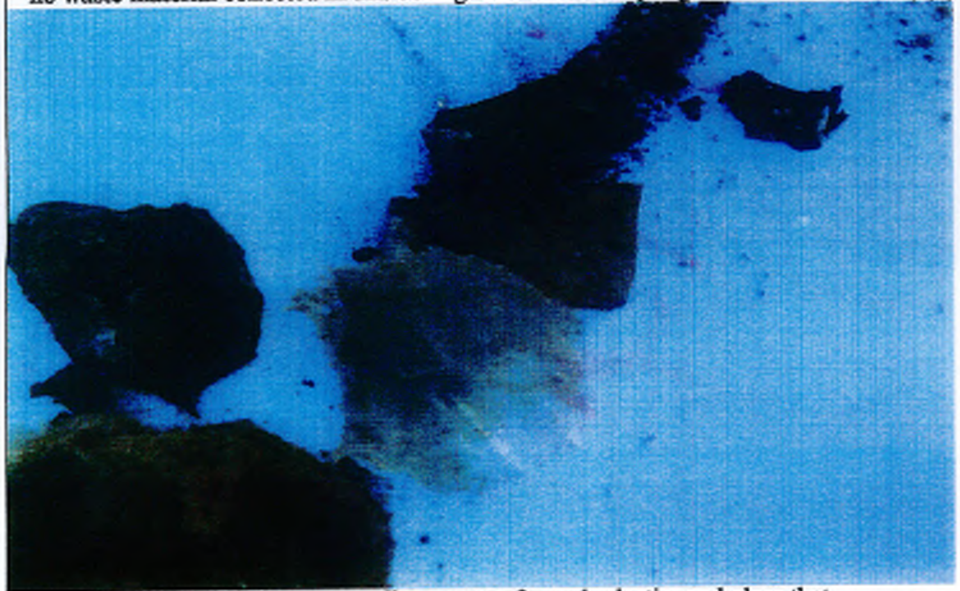
Site Photographs

Appendi
B

Photograph 21 –Looking at soil cuttings from Boring S3-2. Note that there was no waste material collected in this boring. The entire sampling format was clean.



Photograph 22 – Looking at small amounts of wood, plastic, and glass that were collected in Boring S3-3.



Photograph 23 –Looking at small amounts of wood, plastic, and glass that were collected in Boring S3-3.

Photograph 24 –Looking at large amounts of plastic that were collected in Boring S3-3.

Appendix D

Groundwater Sampling and Methane Monitoring Report April 2006

GROUNDWATER SAMPLING & METHANE GAS MONITORING
MESA VALLEY SPRINGS PROPERTY
WEST VAN BUREN STREET
COLORADO SPRINGS, COLORADO

3 April 2006

KLEINFELDER
An employee owned company

April 3, 2006

Kleinfelder File No. 66511-1

Mr. Ted Waterman, President
Waterman, Inc.
P.O. Box 27560
Albuquerque, New Mexico 87125

Subject: **Groundwater Sampling & Methane Gas Monitoring**
Mesa Valley Springs Property
West Van Buren Street
Colorado Springs, Colorado

Dear Mr. Waterman:

Kleinfelder is pleased to present the results of our groundwater sampling and methane monitoring investigation for the above referenced property located south of West Van Buren Street in Colorado Springs, Colorado (Figure 1). This report presents the results of our investigation including analytical data.

SUMMARY

This investigation was conducted on a vacant parcel of land located south of West Van Buren Street in Colorado Springs, El Paso County, Colorado.

During this assessment the following tasks were completed:

- Subsurface drilling;
- Installation of two groundwater monitoring wells;
- Laboratory Analysis of groundwater samples;
- Installation of four methane gas monitoring wells; and,
- Screening for methane gas.

SCOPE

This investigation was conducted in general accordance with our proposal dated February 20, 2006. The purpose of this investigation was to collect groundwater samples from two separate locations and have the samples analyzed to determine if groundwater is contaminated and to monitor methane levels from four separate locations to evaluate if the methane is migrating beyond the perimeter of the landfill at these locations. This study did not include investigating other environmental issues such as soil contamination.

SITE LOCATION & HISTORY

The Subject Site is a vacant parcel encompassing approximately 48-acres of land, located south of West Van Buren Street in Colorado Springs, El Paso County, Colorado. The site location is indicated on the Site Location Map (Figure 1).

The Subject Site is generally located within the northwest ¼ of the southeast ¼ of Section 1, Township 13 South, and Range 67 West of the 6th PM. The El Paso County Assessor's parcel number is 7401200002. The Subject Site is approximately 6,230 feet above mean sea level (MSL) at the northern property boundary, falling to approximately 6,130 feet above MSL at the southeastern property boundary. The topography of the Site and the surrounding area slopes down to the south towards the intermittent stream that borders the Subject Site. The topography of the site is irregular, but is dominated in the northeast by a prominent ridge, in the central portion by a valley, in the northwest by a system of ridges. A drainage forms the westerly and southerly side boundaries.

FIELD INVESTIGATION

Prior to the commencement of field activities at the Subject Site, Kleinfelder prepared a Site-Specific Health and Safety Plan as required by Occupational Safety and Health Administration ("OSHA"), to inform our personnel of the potential hazards that may be encountered and the required procedures to protect worker health and safety. Also, as required by law, Kleinfelder coordinated with utility companies to locate buried utilities in the vicinity of the Subject Site.

Groundwater Assessment

On February 22, 2006, Kleinfelder mobilized to the Subject Site with a track-mounted drilling rig equipped with 4-inch continuous flight augers to install two (2) groundwater-monitoring wells and to install four (4) methane monitoring wells. A map indicating the location of the monitoring wells is presented as Figure 2.

The groundwater monitoring wells were drilled to an approximate depth of 30 feet. Groundwater wells were constructed using factory cleaned 2-inch diameter, PVC well casing with 20 feet of 0.010-inch slotted screen and sufficient riser to reach the ground surface. The slotted screen PVC was surrounded with 10/20 silica sand that prevents entry of soil into the well. A 2 to 3-foot bentonite annular seal was placed at the top of the well, near the ground surface. Well construction specifications are indicated on the logs, which are included in Appendix A.

One groundwater sample from each of the two monitoring wells was submitted via Federal Express to ACZ Laboratories in Steamboat Springs, Colorado for chemical analysis. The samples were analyzed for cations/anions and 47 volatile organics as listed in Appendix IA and IB of the *Regulations Pertaining to Solid Waste Disposal Sites* *and Facilities* set forth by the Colorado Department of Public Health and Environment. Laboratory analysis of the groundwater samples were performed using appropriate methods described in EPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* Table 1 summarizes the metals analysis of the groundwater wells. Wet chemistry and volatile organics results are summarized in Appendix B.

TABLE 1 –GROUNDWATER SAMPLE RESULTS

Sample ID	**GW-1**	**GW-2**	Applicable Standards
Sample Date and Time	**2/23/06 1:30**	**2/23/06 2:30**	
Sample Interval	**10-13 ft (screen)**	**10-13 ft (screen)**	
Matrix	**Groundwater**	**Groundwater**	Groundwater
Units	**(mg/l)**	**(mg/l)**	(mg/l)
Antimony	0.008	No Detect	0.006
Arsenic	0.0215	0.0071	0.01
Barium	0.963	0.056	2.0
Beryllium	No Detect	No Detect	0.004
Cadmium	No Detect	No Detect	0.005
Calcium, dissolved	145	338	N/A
Chromium	0.05	0.01	0.1
Cobalt	0.03	0.02	N/A
Copper	0.05	No Detect	1.0
Iron	0.64	No Detect	0.3
Lead	0.14	No Detect	0.05
Magnesium, dissolved	106	593	N/A
Manganese, dissolved	0.40	1.45	N/A
Nickel	0.03	0.03	0.1
Potassium, dissolved	53.1	21	N/A
Selenium	No Detect	No Detect	0.05
Silver	No Detect	No Detect	0.05
Sodium, dissolved	408	3380	N/A
Thallium	0.0009	0.0003	0.002
Vanadium	0.083	0.013	0.1
Zinc	0.34	0.04	5.0

References:

-Applicable standards are obtained from the CDPHE Regulation No. 41, Basic Standards for Groundwater, Human Health Standards, 2001.

-Maximum Contaminant Levels promulgated under the Safe Drinking Water Act, EPA 816-F-02-013, July 2002 (Arsenic standard effective 01/23/06).

-Applicable standards are obtained from the CDPHE Regulation No. 41, Basic Standards for Groundwater, Ground Water Organic Chemical Standards, 2001.

Methane Gas Assessment

On February 22, 2006, Kleinfelder mobilized to the Subject Site with a track-mounted drilling rig equipped with 4-inch continuous flight augers to install four (4) methane gas monitoring wells outside the existing landfill perimeter, at the locations indicated on Figure 2. Monitoring well installation records (including depth and materials used) for each methane well, MW-1 through MW-4, are included in Appendix A.

Methane wells were constructed using factory cleaned 1-inch diameter, PVC well casing with 10 feet of 0.010-inch slotted screen and sufficient riser to reach the ground surface. The slotted screen PVC was surrounded with 10/20 silica sand that prevents entry of soil into the well. A 2 to 3-foot bentonite annular seal was placed at the top of the well, near the ground surface.

On February 27 and February 28, 2006, Kleinfelder performed gas monitoring at the four (4) methane wells installed on the Subject Site. The gas in each well was analyzed using a GasTech Portable Gas Monitor. The meter is designed to measure concentrations of methane (CH_4), hydrogen sulfide (H_2S) and oxygen (O_2). Table 2 summarizes the gases detected in the methane wells.

TABLE 2 –SUMMARY OF METHANE GAS MONITORING

Monitoring Location	February 27, 2006				February 28, 2006			
	CH_4 (%LEL)	CH_4 (%GAS)	H_2S (ppm)	O_2 (%)	CH_4 (%LEL)	CH_4 (%GAS)	H_2S (ppm)	O_2 (%)
MW-1	0.0	0.0	3.0	20.2	0.0	0.0	0.0	20.1
MW-2	0.0	0.0	0.0	20.1	0.0	0.0	0.0	19.7
MW-3	1.0	0.0	0.0	17.2	2.0	0.0	0.0	13.3
MW-4	1.0	0.0	0.0	20.4	0.0	0.0	0.0	20.6

Notes: CH_4 (% LEL) = Methane % of the lower explosive limit (LEL)
CH_4 (% Gas) = % Methane Gas by volume
H_2S = Hydrogen Sulfide parts per million by volume
O_2 = Oxygen % by volume

CONCLUSIONS

Groundwater Hazards

Laboratory analysis indicated that groundwater quality has been impacted by historic activity at the Subject Site based on the limited data collected to date. For the analyses listed above, there were four confirmed regulatory exceedances of analytes that indicate an environmental concern. Antimony, Iron, Lead and Thallium all exceeded the regulatory standards for groundwater.

Methane Hazards

Methane gas field monitoring provided the following information. No measurable methane concentrations were found within the four monitoring wells and methane gas is not migrating beyond the perimeter of the landfill. It is not likely that the site is subject to CDPHE explosive gas requirements for solid waste disposal sites. These regulations, found in Title 6 of the Code of Colorado Regulations (CCR), Section 1007-2, Part 1, state that "The concentration of explosive gases generated by the facility for solid waste disposal shall not exceed: At the boundary, the lower explosive limit which is five percent (5%) by volume in air for methane." Considering this rule, it is unlikely that any future development of the Subject Site that is outside the perimeter of the landfill would not need to consider monitoring of any structure developed on the Site.

RECOMMENDATIONS

Kleinfelder recommends that the Colorado Department of Public Health and Environment (CDPHE) be contacted to review the conclusions of this investigation and to further evaluate the results of the groundwater and methane analysis.

LIMITATIONS

Limited assessments such as this are non-comprehensive by nature and will not identify all environmental problems or eliminate all risk, associated with environmental issues. The scope of work on this project was presented in our proposal and subsequently approved by our client. Please be aware our scope of work was limited to those items specifically identified in the proposal. Environmental issues not specifically addressed in the proposal or this report is beyond the scope of our work and not included in this evaluation.

Although risk can never be eliminated, more detailed and extensive investigations yield more information, which may help you understand and better manage your risks. Since such detailed services involve greater expense, we ask our clients to participate in identifying the level of service that will provide them with an acceptable level of risk. Please contact the signatories of this report if you would like to discuss this issue of risk further.

Land use, site conditions (both on-site and off-site) and other factors will change over time. Since site activities and regulations beyond our control could change at any time after the completion of this report, our observations, findings and opinions can be considered valid only as of the date of this report.

The property owner is solely responsible for notifying all governmental agencies, and the public at large, of the existence, release, treatment or disposal of any hazardous materials or conditions detected at the project site. Kleinfelder assumes no responsibility or liability whatsoever for any claim, loss of property value, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

If you have any questions regarding this letter or need additional information, please do not hesitate to call our office at (719) 632-3593.

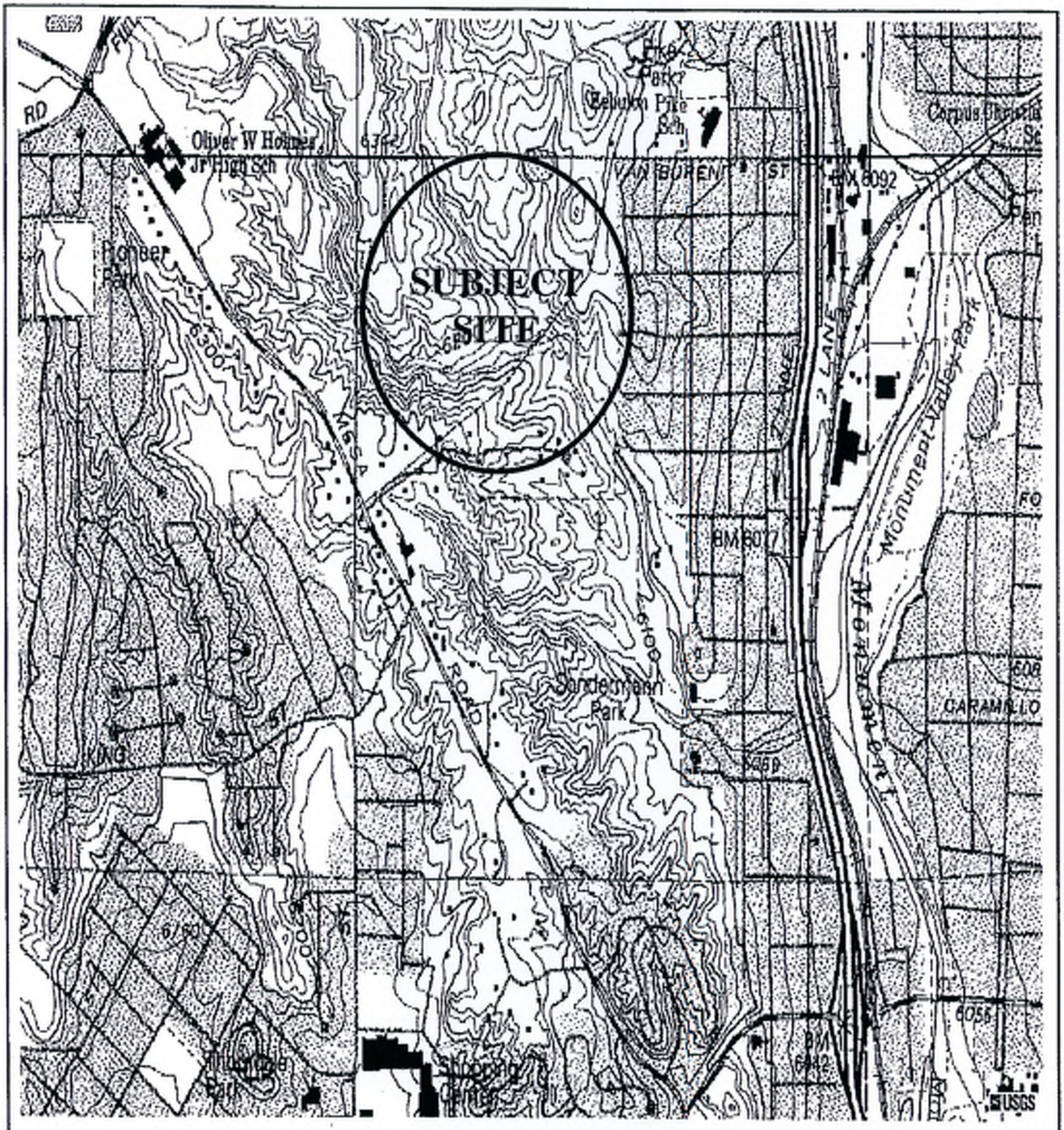
Respectfully submitted,

KLEINFELDER, INC.

Rickey L. Jones
Environmental Scientist

for William J. Barreire, P.E.
Area Manager

RLJ:WJB:ss



0' 1000' 2000'

SCALE 1:24,000
1" = 2000'
BASE MAP:PIKEVIEW, COLORADO
CONTOUR INTERVAL 20 FEET
USGS 7.5 MINUTE QUADRANGLE,1994

N
W E
S

KLEINFELDER
4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

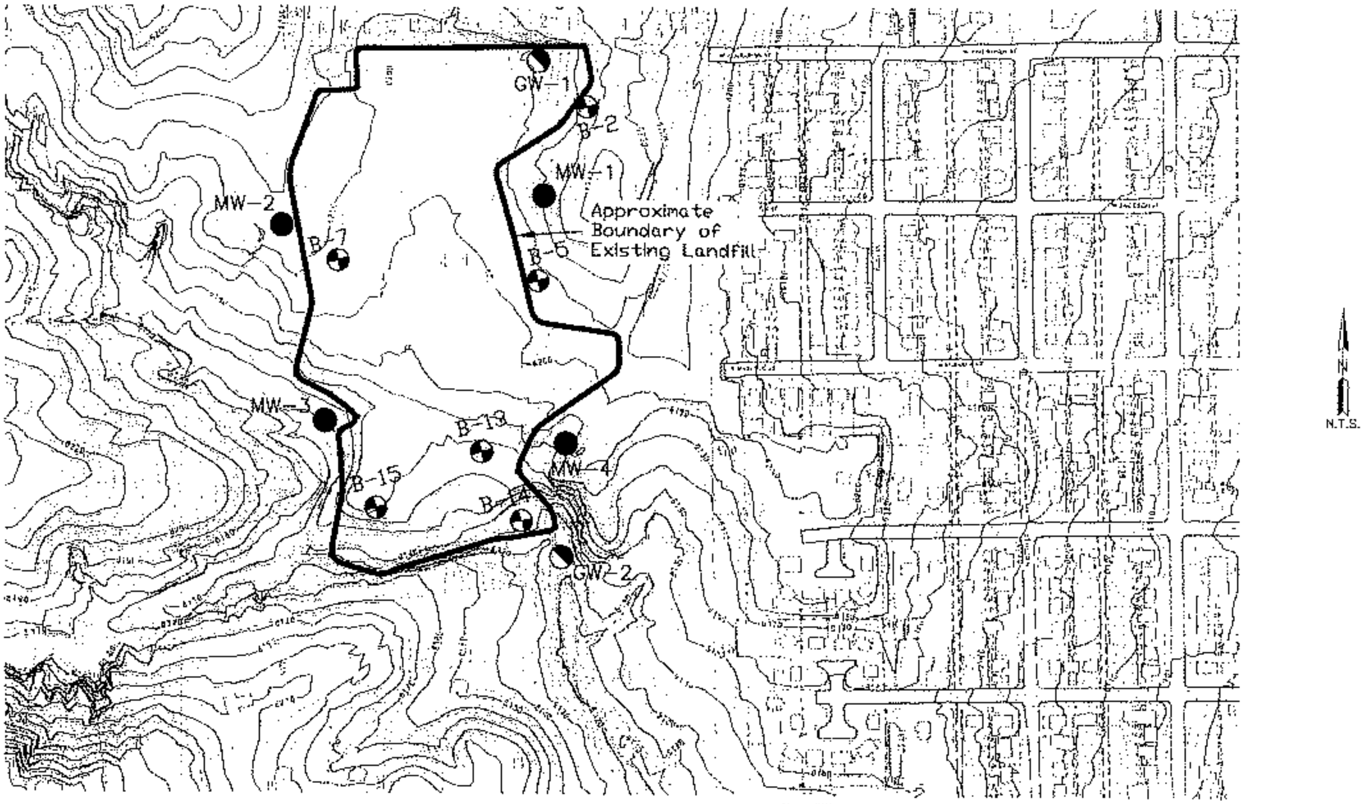
DOCUMENT NO. CSP6R020	FN: VICINITY
PROJECT NO. 66511	DATE: 03/13/06

SITE LOCATION MAP

MESA VALLEY SPRINGS SAMPLING
WEST VAN BUREN ST.
COLORADO SPRINGS, COLORADO

FIGURE

1



● = Approximate Location of Methane Monitoring Wells

◑ = Approximate Location of Groundwater Monitoring Wells

KLEINFELDER
An employee owned company

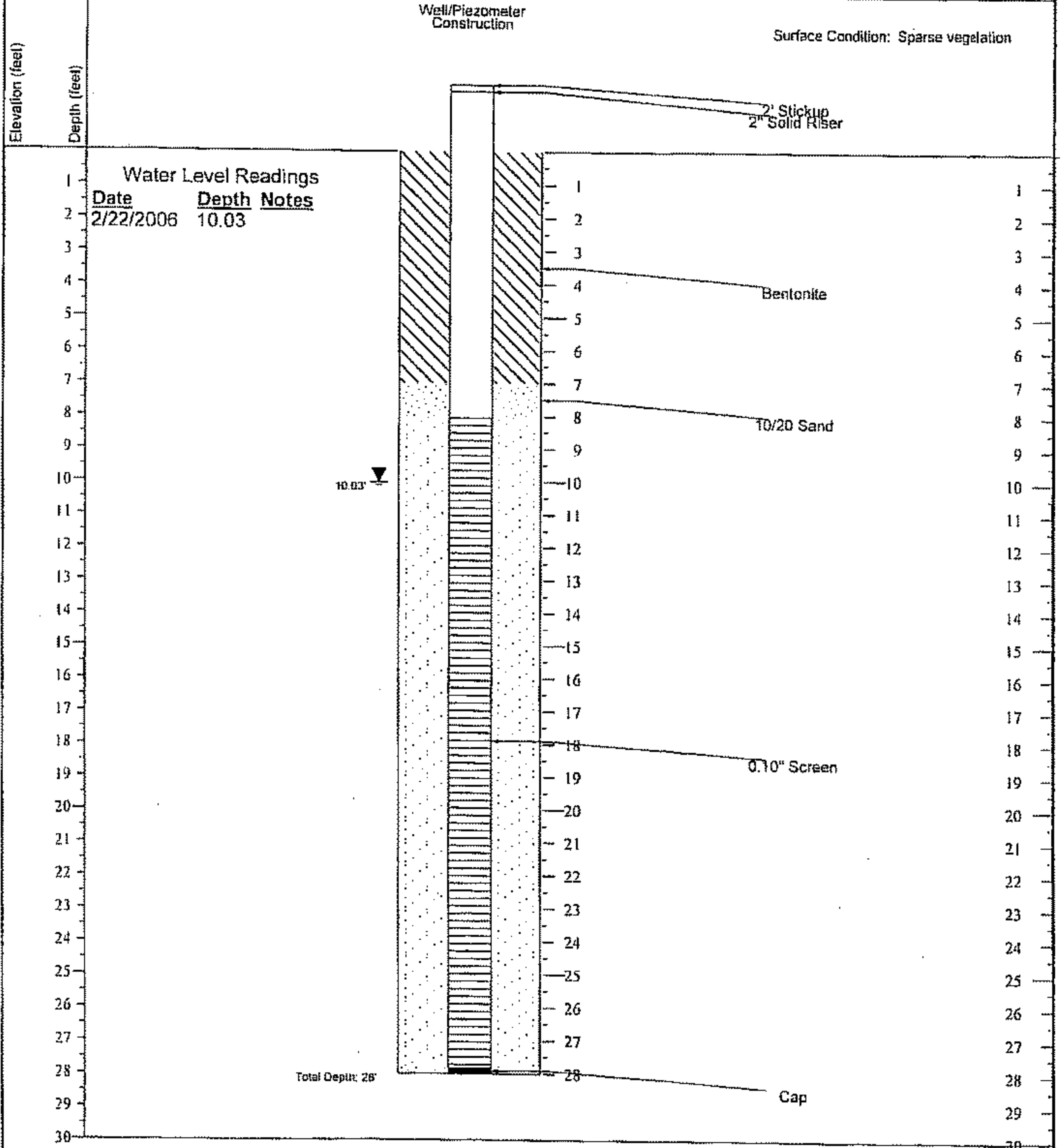
Checked By: R. Jones
Drafted By: S. Hyskell
Project Number: 66511-1
Date: March 13, 2006

BORING / WELL
LOCATION PLAN
Mesa Valley Springs Sampling
West Van Buren St.
Colorado Springs, Colorado

Figure
2

Location: North of Existing B-2 (See Boring/Well Location Plan)
Date Installed: 2/22/2006
Date Completed: 2/22/2006
Drilling Company: Spectrum Exploration
Equipment: Boart Longyear Track
Logged By: R. Jones
Hole Diameter (in): 6
Drilling Method: Hollow Stem Auger
Total Depth (ft): 28.0

Surface Condition: Sparse vegetation



Water Level Readings

Date	Depth	Notes
2/22/2006	10.03	

2006CSP_ENV_WELL_CONSTRUCTION 66511.GPJ rstump@kleinfelder.com 3/13/2006

KLEINFELDER

Drafted By: R. Stump
Date: 3/10/2006
Project Number: 66511

WELL CONSTRUCTION SCHEMATIC

Mesa Valley Springs Sampling
West Van Buren Street
Colorado Springs, Colorado

BORING
GW-1

Location: Southeast of Existing B-14 (See Boring/Well Location Plan)

Date Installed: 2/22/2006

Date Completed: 2/22/2006

Drilling Company: Spectrum Exploration

Equipment: Boart Longyear Track

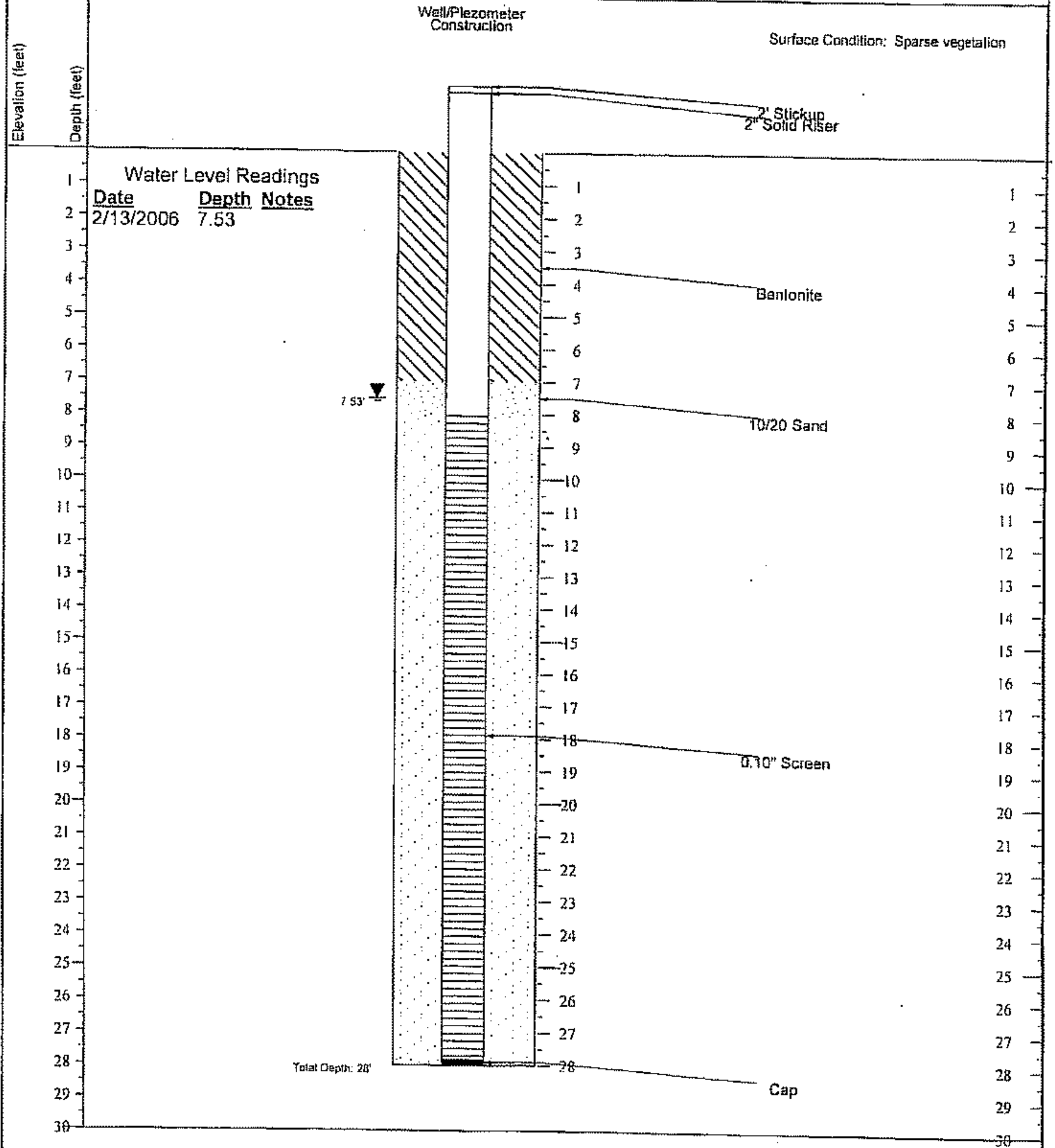
Logged By: R. Jones

Hole Diameter (in): 4

Drilling Method: Hollow Stem Auger

Total Depth (ft): 28.0

Surface Condition: Sparse vegetation



Water Level Readings

Date	Depth	Notes
2/13/2006	7.53	

2006CSP_ENV_WELL_CONSTRUCTION 66511.GPJ rslump@kleinfelder.com 3/13/2006

KLEINFELDER

WELL CONSTRUCTION SCHEMATIC

Mesa Valley Springs Sampling
West Van Buren Street
Colorado Springs, Colorado

BORING

GW-2

Drafted By: R. Slump

Date: 3/10/2006

Project Number: 66511

Page 1 of 1

Location: North of Existing B-5 (See Boring/Well Location Plan)

Date Installed: 2/22/2006

Date Completed: 2/22/2006

Drilling Company: Spectrum Exploration

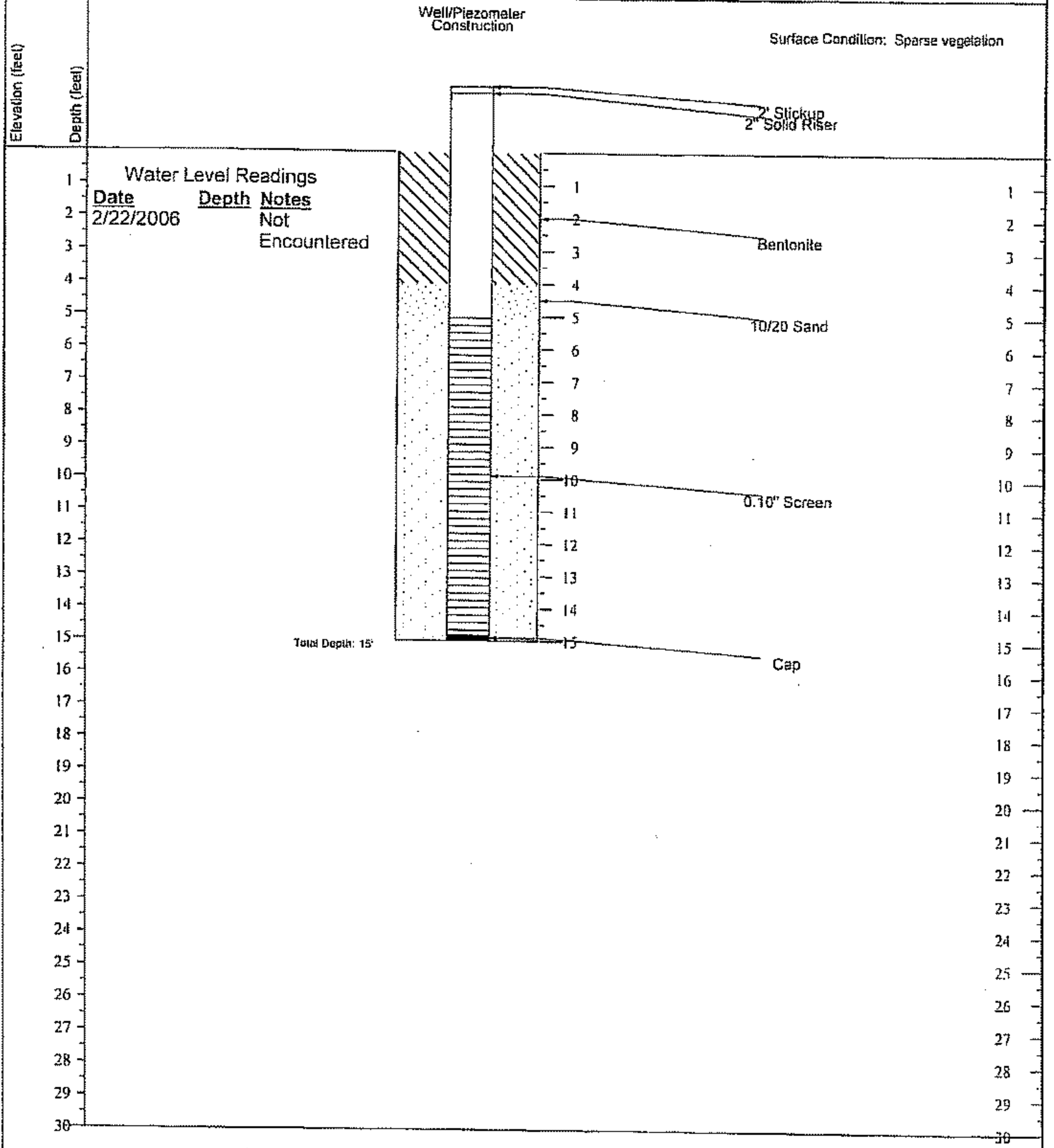
Equipment: Boart Longyear Track

Logged By: R. Jones

Hole Diameter (in): 4

Drilling Method: Hollow Stem Auger

Total Depth (ft): 15.0



Water Level Readings

Date	Depth	Notes
2/22/2006		Not Encountered

KLEINFELDER

Drafted By: R. Stump

Date: 3/10/2006

Project Number: 66511

WELL CONSTRUCTION SCHEMATIC

Mesa Valley Springs Sampling
West Van Buren Street
Colorado Springs, Colorado

BORING

MW-1

Location: Northwest of Existing B-7 (See Boring/Well Location Plan)

Date Installed: 2/22/2006

Date Completed: 2/22/2006

Drilling Company: Spectrum Exploration

Equipment: Boart Longyear Track

Logged By: R. Jones

Hole Diameter (in): 4

Drilling Method: Hollow Stem Auger

Total Depth (ft): 15.0

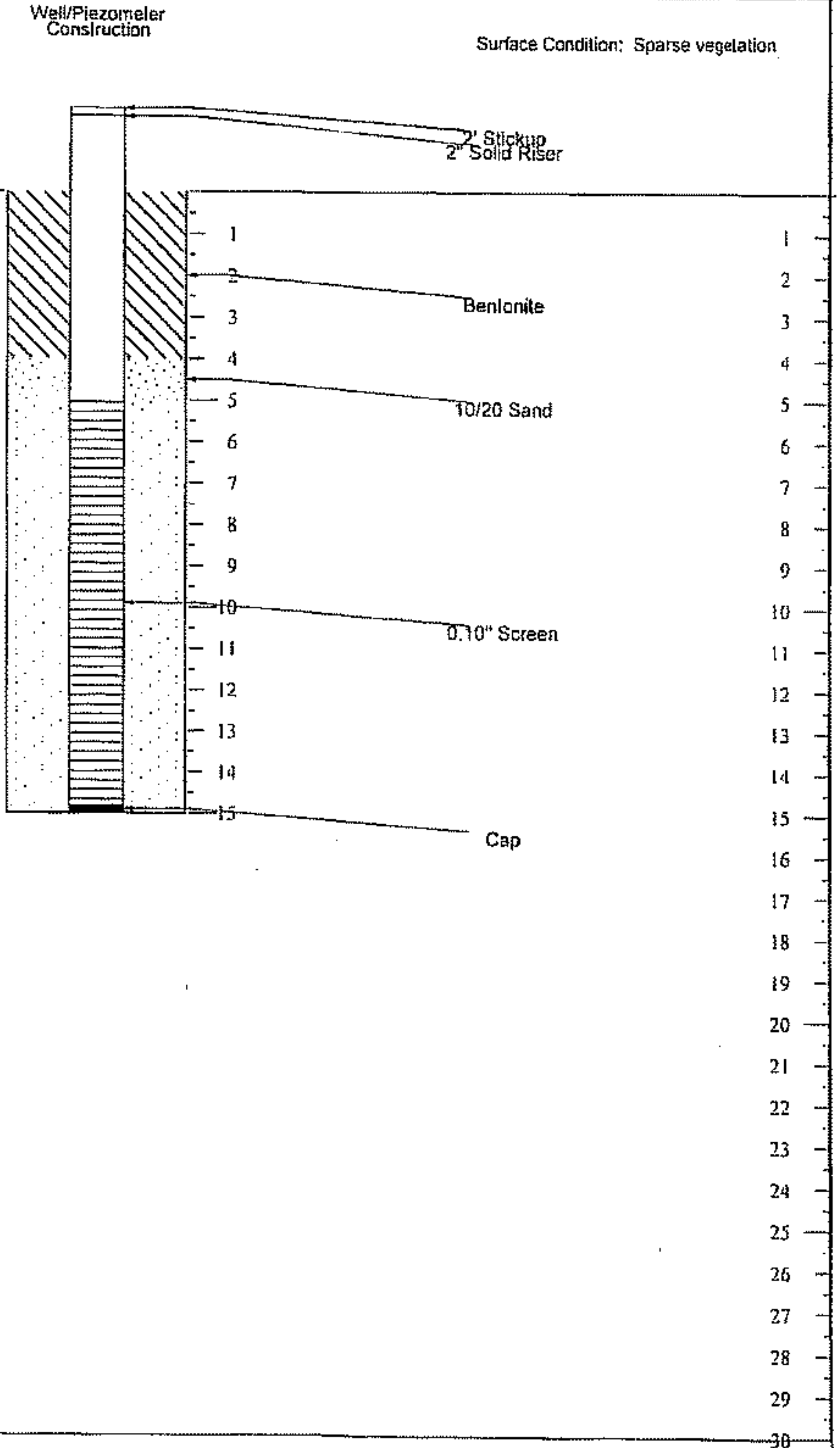
Surface Condition: Sparse vegetation

Elevation (feet)

Depth (feet)

Water Level Readings

Date	Depth	Notes
2/22/2006		Not Encounterd



KLEINFELDER

WELL CONSTRUCTION SCHEMATIC

Mesa Valley Springs Sampling
West Van Buren Street
Colorado Springs, Colorado

BORING

MW-2

Drafted By: R. Stump

Date: 3/10/2006

Project Number: 66511

2005CSP_ENV_WELL_CONSTRUCTION 66511.GPJ rstump@kleinfelder.com 3/13/2006

Location: Northwest of Existing B-15 (See Boring/Well Location Plan)

Date Installed: 2/22/2006

Date Completed: 2/22/2006

Drilling Company: Spectrum Exploration

Equipment: Boart Longyear Track

Logged By: R. Jones

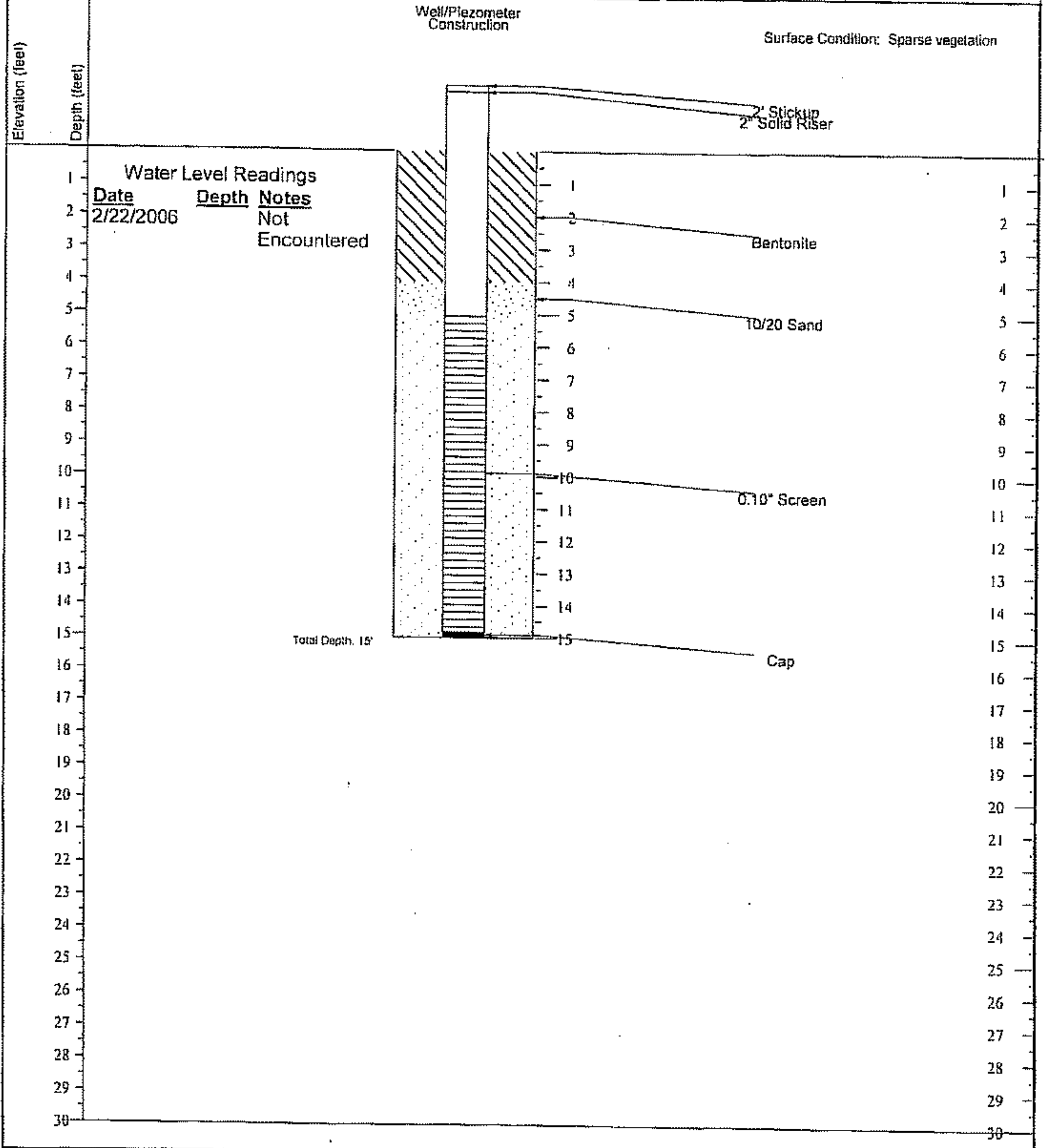
Hole Diameter (in): 4

Drilling Method: Hollow Stem Auger

Total Depth (ft): 15.0

Well/Piezometer Construction

Surface Condition: Sparse vegetation



Water Level Readings

Date	Depth	Notes
2/22/2006		Not Encountered

KLEINFELDER

Drafted By: R. Stump

Date: 3/10/2006

Project Number: 66511

WELL CONSTRUCTION SCHEMATIC

Mesa Valley Springs Sampling
West Van Buren Street
Colorado Springs, Colorado

BORING

MW-3

Page 1 of 1

2006CSP_ENV_WELL_CONSTRUCTION 66511.GPJ rstump@kleinfelder.com 3/13/2006

Location: East of Existing B-13 (See Boring/Well Location Plan)

Date Installed: 2/22/2006

Date Completed: 2/22/2006

Drilling Company: Spectrum Exploration

Equipment: Boart Longyear Track

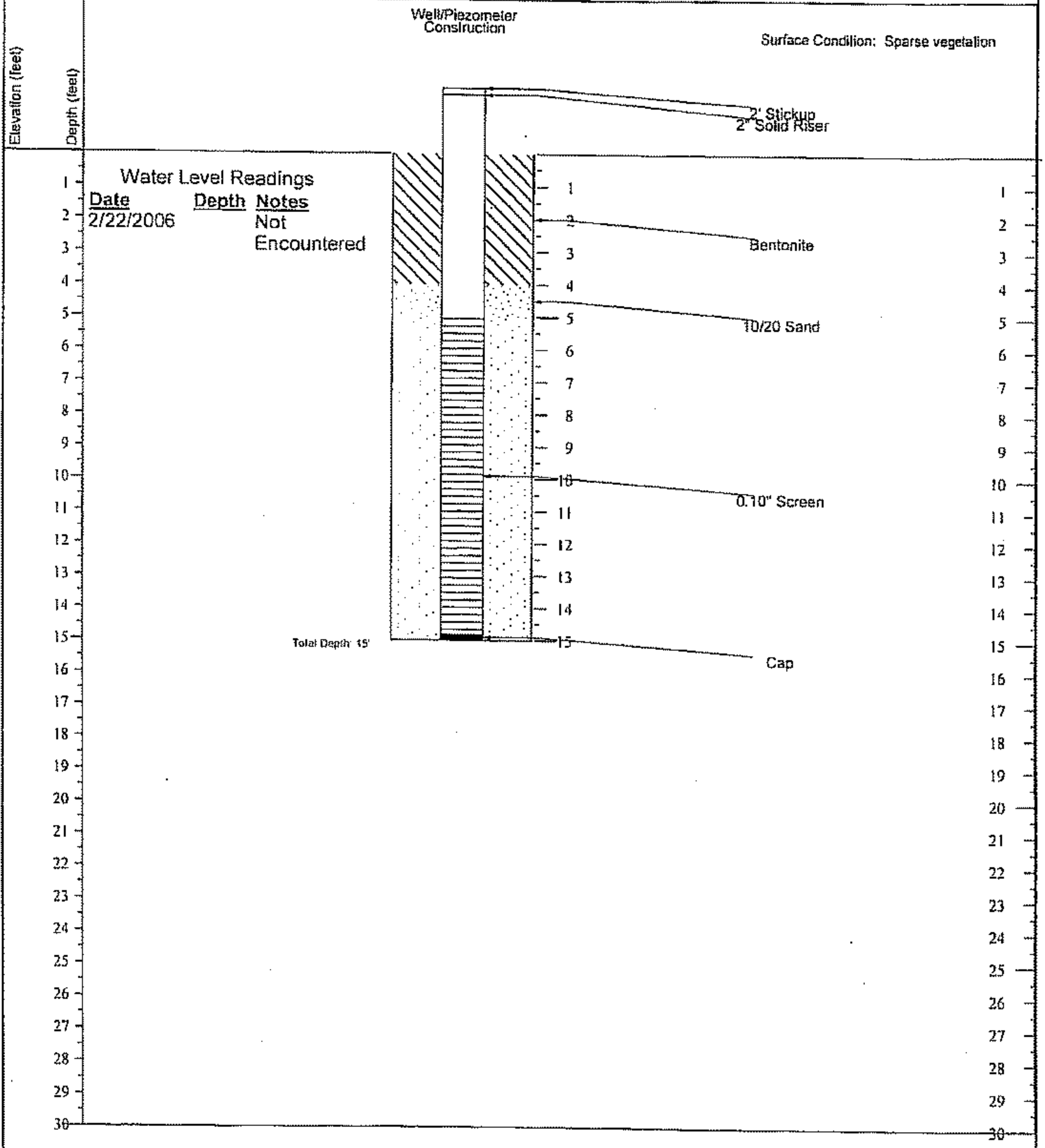
Logged By: R. Jones

Hole Diameter (in): 4

Drilling Method: Hollow Stem Auger

Total Depth (ft): 15.0

Surface Condition: Sparse vegetation



Water Level Readings

Date	Depth	Notes
2/22/2006		Not Encountered

KLEINFELDER

Drafted By: R. Stump

Date: 3/10/2006

Project Number: 66511

WELL CONSTRUCTION SCHEMATIC

Mesa Valley Springs Sampling
West Van Buren Street
Colorado Springs, Colorado

BORING

MW-4

2006CSP_ENV_WELL_CONSTRUCTION 66511.GPJ rstump@kleinfelder.com 3/13/2006

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

[redacted]

March 28, 2006

Report to:
Ricky Jones
Kleinfelder, Inc.
4815 List Drive, Unit 115
Colorado Springs, CO 80919

Bill to:
Brenda Anthony
Kleinfelder, Inc.
4815 List Drive, Unit 115
Colorado Springs, CO 80919

Project ID: 66511
ACZ Project ID: L55388

Ricky Jones:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on February 24, 2006. This project has been assigned to ACZ's project number, L55388. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 11.0. The enclosed results relate only to the samples received under L55388. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after April 28, 2006. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

Sue Webber 28/Mar/06

Sue Webber, Project Manager, has reviewed and approved this report in its entirety.

ACCREDITED IN ACCORDANCE WITH nelac

ACIL

Kleinfelder, Inc.

March 28, 2008

Project ID: 66511
ACZ Project ID: L55388

ACZ Laboratories, Inc. (ACZ) received 3 ground water samples from Kleinfelder, Inc. on February 24, 2006. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L55388. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

All analyses except those qualified with an ACZ 'H' flag were performed within EPA recommended holding times.

These samples were analyzed for inorganic and organic parameters. The individual methods are referenced on both the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. Suspect analytes were reanalyzed to confirm Cation/Anion Balance.

2. For the Volatile Organic surrogate Toluene d-8 value flagged with an "S1", the recovery was above laboratory control limits, but within method acceptance limits.

3. For the Volatile Organic surrogate Bromofluorobenzene value flagged with an "N1", the recoveries were low but all other internal standards and surrogates were within control limits.

4. For Volatile Organic compounds (other than bromofluorobenzene) flagged with an "N1", the response for these analytes was below 0.1 in the calibration. While this is still within method criteria, the data may not be reliable near the PQL as a result. Samples were rerun to confirm.

Kleinfelder, Inc.

Project ID:	66511
Sample ID:	GW-1

ACZ Sample ID:	*L55388-01*
Date Sampled:	*02/23/06 00:00*
Date Received:	*02/24/06*
Sample Matrix:	*Ground Water*

Metals Analysis

Antimony, total	M6020 ICP-MS	0.0008	B	*	mg/L	0.0004	0.002	03/01/06 20:53	jjr
Arsenic, total	M6020 ICP-MS	0.0215			mg/L	0.0005	0.003	03/01/06 20:53	jjr
Barium, total	M6010B ICP	0.963			mg/L	0.003	0.01	02/28/06 6:15	jjc
Beryllium, total	M6010B ICP		U		mg/L	0.002	0.01	02/28/06 6:15	jjc
Cadmium, total	M6010B ICP		U		mg/L	0.005	0.02	02/28/06 6:15	jjc
Calcium, dissolved	M6010B ICP	145			mg/L	0.4	2	03/07/06 13:19	jjc
Chromium, total	M6010B ICP	0.05			mg/L	0.01	0.05	02/28/06 6:15	jjc
Cobalt, total	M6010B ICP	0.03	B		mg/L	0.01	0.05	02/28/06 6:15	jjc
Copper, total	M6010B ICP	0.05			mg/L	0.01	0.05	02/28/06 6:15	jjc
Iron, dissolved	M6010B ICP	0.64		*	mg/L	0.04	0.1	03/07/06 13:19	jjc
Lead, total	M6010B ICP	0.14	B		mg/L	0.04	0.2	02/28/06 6:15	jjc
Magnesium, dissolved	M6010B ICP	106			mg/L	0.4	2	03/07/06 13:19	jjc
Manganese, dissolved	M6010B ICP	0.40			mg/L	0.01	0.05	03/07/06 13:19	jjc
Nickel, total	M6010B ICP	0.03	B		mg/L	0.01	0.05	02/28/06 6:15	jjc
Potassium, dissolved	M6010B ICP	53.1			mg/L	0.6	2	03/07/06 13:19	jjc
Selenium, total	SM 3114 B, AA-Hydride		U		mg/L	0.001	0.005	02/28/06 15:36	djt-pre
Silver, total	M6010B ICP		U		mg/L	0.01	0.03	02/28/06 6:15	jjc
Sodium, dissolved	M6010B ICP	408			mg/L	0.6	2	03/07/06 13:19	jjc
Thallium, total	M6020 ICP-MS	0.0009		*	mg/L	0.0001	0.0005	03/01/06 20:53	jjr
Vanadium, total	M6010B ICP	0.083			mg/L	0.005	0.03	02/28/06 6:15	jjc
Zinc, total	M6010B ICP	0.34		*	mg/L	0.01	0.05	02/28/06 6:15	jjc

Metals Prep

Total Hot Plate Digestion	M3010 ICP	02/27/06 18:36	djt
Total Hot Plate Digestion	M3010 ICP-MS	02/28/06 13:36	jjr

* *Please refer to Extended Qualifier Report for detail.*

[redacted]

Kleinfelder, Inc.
Project ID: 66511
Sample ID: GW-1

ACZ Sample ID: *L55388-01*
Date Sampled: *02/23/06 00:00*
Date Received: *02/24/06*
Sample Matrix: *Ground Water*

Wet Chemistry

Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		1510	H		mg/L	2	20	03/25/06 0:00	jlf
Carbonate as CaCO3			UH		mg/L	2	20	03/25/06 0:00	jlf
Hydroxide as CaCO3			UH		mg/L	2	20	03/25/06 0:00	jlf
Total Alkalinity		1510	H	*	mg/L	2	20	03/25/06 0:00	jlf
Carbon, total organic (TOC)	M415.1 Combustion/IR	105			mg/L	5	30	02/28/06 10:03	erf
Cation-Anion Balance	Calculation								
Cation-Anion Balance		-9.6			%			03/27/06 0:00	calc
Sum of Anions		42.8			meq/L	0.1	0.5	03/27/06 0:00	calc
Sum of Cations		35.3			meq/L	0.1	0.5	03/27/06 0:00	calc
Chloride	M325.2 - Colorimetric	270	H	*	mg/L	10	50	03/24/06 17:31	pjb
Conductivity @25C	M9050 - Meter	3600			umhos/cm	1	10	02/27/06 13:16	tam
Hardness as CaCO3	SM2340B - Calculation	798			mg/L	1	7	03/27/06 0:00	calc
Lab Filtration	SM 3030 B			*				02/24/06 14:54	jll
Lab Filtration & Acidification	SM 3030 B			*				03/01/06 17:13	djl
Nitrate as N, dissolved	Calculation: NO3NO2 minus NO2	0.49			mg/L	0.02	0.1	03/27/06 0:00	calc
Nitrate/Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	0.50		*	mg/L	0.02	0.1	02/24/06 17:53	pjb
Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	0.01	B	*	mg/L	0.01	0.05	02/24/06 17:53	pjb
pH (lab)	M9045C/M9040B								
pH		7.6	H		units	0.1	0.1	02/27/06 0:00	tam
pH measured at		23.0			C	0.1	0.1	02/27/06 0:00	tam
Residue, Filterable (TDS) @180C	M160.1 - Gravimetric	2170			mg/L	10	20	02/28/06 15:30	tam
Sodium Absorption Ratio in Water	USGS - I1738-78	6.36				0.03	0.15	03/27/06 0:00	calc
Sulfate	SM4500 SO4-D	240		*	mg/L	10	50	03/23/06 17:17	tam
TDS (calculated)	Calculation	2130			mg/L	10	50	03/27/06 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.02						03/27/06 0:00	calc

* *Please refer to Extended Qualifier Report for detail.*

[redacted]

Kleinfelder, Inc.

Project ID: 66511
Sample ID: GW-2

ACZ Sample ID: *L55388-02*
Date Sampled: *02/23/06 00:00*
Date Received: *02/24/06*
Sample Matrix: *Ground Water*

Metals Analysis

Antimony, total	M6020 ICP-MS		U	*	mg/L	0.0004	0.002	03/01/06 21:05	jjr
Arsenic, total	M6020 ICP-MS	0.0071			mg/L	0.0005	0.003	03/01/06 21:05	jjr
Barium, total	M6010B ICP	0.056			mg/L	0.003	0.01	02/28/06 6:19	jjc
Beryllium, total	M6010B ICP		U		mg/L	0.002	0.01	02/28/06 6:19	jjc
Cadmium, total	M6010B ICP		U		mg/L	0.005	0.02	02/28/06 6:19	jjc
Calcium, dissolved	M6010B ICP	338			mg/L	2	10	03/07/06 13:29	jjc
Chromium, total	M6010B ICP	0.01	B		mg/L	0.01	0.05	02/28/06 6:19	jjc
Cobalt, total	M6010B ICP	0.02	B		mg/L	0.01	0.05	02/28/06 6:19	jjc
Copper, total	M6010B ICP		U		mg/L	0.01	0.05	02/28/06 6:19	jjc
Iron, dissolved	M6010B ICP		U	*	mg/L	0.2	0.5	03/07/06 13:29	jjc
Lead, total	M6010B ICP		U		mg/L	0.04	0.2	02/28/06 6:19	jjc
Magnesium, dissolved	M6010B ICP	593			mg/L	2	10	03/07/06 13:29	jjc
Manganese, dissolved	M6010B ICP	1.45			mg/L	0.05	0.3	03/07/06 13:29	jjc
Nickel, total	M6010B ICP	0.03	B		mg/L	0.01	0.05	02/28/06 6:19	jjc
Potassium, dissolved	M6010B ICP	21			mg/L	3	10	03/07/06 13:29	jjc
Selenium, total	SM 3114 B, AA-Hydride		U		mg/L	0.001	0.005	02/28/06 15:38	djl-pre
Silver, total	M6010B ICP		U		mg/L	0.01	0.03	02/28/06 6:19	jjc
Sodium, dissolved	M6010B ICP	3380			mg/L	3	10	03/07/06 13:29	jjc
Thallium, total	M6020 ICP-MS	0.0003	B	*	mg/L	0.0001	0.0005	03/01/06 21:05	jjr
Vanadium, total	M6010B ICP	0.013	B		mg/L	0.005	0.03	02/28/06 6:19	jjc
Zinc, total	M6010B ICP	0.04	B	*	mg/L	0.01	0.05	02/28/06 6:19	jjc

Metals Prep

Total Hot Plate Digestion	M3010 ICP	02/27/06 19:00	djl
Total Hot Plate Digestion	M3010 ICP-MS	02/28/06 14:24	jjr

* *Please refer to Extended Qualifier Report for detail.*

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Kleinfelder, Inc.

Project ID: 66511
Sample ID: GW-2

ACZ Sample ID: *L55388-02*
Date Sampled: *02/23/06 00:00*
Date Received: *02/24/06*
Sample Matrix: *Ground Water*

Wet Chemistry

Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		1310			mg/L	2	20	02/27/06 0:00	lam
Carbonate as CaCO3			U		mg/L	2	20	02/27/06 0:00	lam
Hydroxide as CaCO3			U		mg/L	2	20	02/27/06 0:00	lam
Total Alkalinity		1310			mg/L	2	20	02/27/06 0:00	lam
Carbon, total organic (TOC)	M415.1 Combustion/IR	47			mg/L	5	30	02/28/06 11:59	erf
Cation-Anion Balance	Calculation								
Cation-Anion Balance		1.7			%			03/27/06 0:00	calc
Sum of Anions		208			meq/L	0.1	0.5	03/27/06 0:00	calc
Sum of Cations		215			meq/L	0.1	0.5	03/27/06 0:00	calc
Chloride	M325.2 - Colorimetric	480			mg/L	10	50	03/02/06 11:45	jag
Conductivity @25C	M9050 - Meter	15700			umhos/cm	1	10	02/27/06 13:30	tam
Hardness as CaCO3	SM2340B - Calculation	3280			mg/L	1	7	03/27/06 0:00	calc
Lab Filtration	SM 3030 B			*				02/24/06 14:55	jlt
Lab Filtration & Acidification	SM 3030 B			*				03/01/06 17:14	djt
Nitrate as N, dissolved	Calculation: NO3NO2 minus NO2	0.10			mg/L	0.02	0.1	03/27/06 0:00	calc
Nitrate/Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	0.10		*	mg/L	0.02	0.1	02/24/06 17:55	pjb
Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction		U	*	mg/L	0.01	0.05	02/24/06 17:55	pjb
pH (lab)	M9045C/M9040B								
pH		7.8	H		units	0.1	0.1	02/27/06 0:00	lam
pH measured at		23.0			C	0.1	0.1	02/27/06 0:00	lam
Residue, Filterable (TDS) @180C	M160.1 - Gravimetric	15400		*	mg/L	10	20	02/28/06 15:33	tam
Sodium Absorption Ratio In Water	USGS - I1738-78	26.00				0.03	0.15	03/27/06 0:00	calc
Sulfate	SM4500 SO4-D	8030		*	mg/L	50	300	03/01/06 12:03	jlr
TDS (calculated)	Calculation	13600			mg/L	10	50	03/27/06 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.13						03/27/06 0:00	calc

* *Please refer to Extended Qualifier Report for detail.*

[illegible]

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of Interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of Interest

[illegible]

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calivation Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

[illegible]

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

[illegible]

B	Analyte concentration detected at a value between MDL and PQL.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
R	Poor spike recovery accepted because the other spike in the set fell within the given limits.
T	High Relative Percent Difference (RPD) accepted because sample concentrations are less than 10x the MDL.
U	Analyte was analyzed for but not detected at the indicated MDL
V	High blank data accepted because sample concentration is 10 times higher than blank concentration
W	Poor recovery for Silver quality control is accepted because Silver often precipitates with Chloride.
X	Quality control sample is out of control.
Z	Poor spike recovery is accepted because sample concentration is four times greater than spike concentration.

[illegible]

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995.

[illegible]

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

Kleinfelder, Inc.
Project ID: 66511

ACZ Project ID: *L55388*

Alkalinity as CaCO3 SM2320B - Titration

WG202932

WG202932LCSW2	LCSW	02/27/06 12:03	WC060210-3	820.0001		888.6	mg/L	108.4	80	120			
L55388-02DUP	DUP	02/27/06 13:44			1310	1308.9	mg/L				0.1	20	
WG202932LCSW5	LCSW	02/27/06 14:46	WC060210-3	820.0001		966.7	mg/L	117.9	80	120			
WG202932LCSW8	LCSW	02/27/06 17:26	WC060210-3	820.0001		885.1	mg/L	107.9	80	120			

WG204008

WG204008LCSW2	LCSW	03/25/06 9:42	WC060210-3	820.0001		844.2	mg/L	103	80	120			
L55759-03DUP	DUP	03/25/06 11:10			146	145.6	mg/L				0.3	20	
WG204008LCSW5	LCSW	03/25/06 12:50	WC060210-3	820.0001		858	mg/L	104.6	80	120			
WG204008LCSW8	LCSW	03/25/06 16:34	WC060210-3	820.0001		870.5	mg/L	106.2	80	120			

Antimony, total M6020 ICP-MS

WG203104

WG203104ICV	ICV	03/01/06 18:56	MS060215-2	.02008		.01979	mg/L	98.6	90	110			
WG203104ICB	ICB	03/01/06 19:02				U	mg/L		-0.0012	0.0012			
WG203017PBW	PBW	03/01/06 20:42				U	mg/L		-0.0012	0.0012			
WG203017LCSW	LCSW	03/01/06 20:48	MS060215-2	.02008		.02105	mg/L	104.8	80	120			
L55388-02MS	MS	03/01/06 21:11	MS060116-3	.00625	U	.00462	mg/L	73.9	75	125			M2
L55388-02MSD	MSD	03/01/06 21:17	MS060116-3	.00625	U	.0045	mg/L	72	75	125	2.63	20	M2

Arsenic, total M6020 ICP-MS

WG203104

WG203104ICV	ICV	03/01/06 18:56	MS060215-2	.05		.0513	mg/L	102.6	90	110			
WG203104ICB	ICB	03/01/06 19:02				U	mg/L		-0.0015	0.0015			
WG203017PBW	PBW	03/01/06 20:42				U	mg/L		-0.0015	0.0015			
WG203017LCSW	LCSW	03/01/06 20:48	MS060215-2	.05		.05274	mg/L	105.5	80	120			
L55388-02MS	MS	03/01/06 21:11	MS060116-3	.05	.0071	.06594	mg/L	117.7	75	125			
L55388-02MSD	MSD	03/01/06 21:17	MS060116-3	.05	.0071	.06368	mg/L	113.2	75	125	3.49	20	

Barium, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.9896	mg/L	99.5	90	110			
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.009	0.009			
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.009	0.009			
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		1.0072	mg/L	100.7	80	120			
L55279-11MS	MS	02/28/06 5:06	II10XWATE	5	2.23	6.886	mg/L	93.1	75	125			
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	2.23	6.873	mg/L	92.9	75	125	0.19	20	

[redacted]

Kleinfelder, Inc.
Project ID: 66511

ACZ Project ID: *L55388*

Beryllium, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.9051	mg/L	95.3	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.006	0.006		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.006	0.006		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		1.0092	mg/L	100.9	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	U	4.915	mg/L	98.3	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	U	4.861	mg/L	97.2	75	125	1.1	20

Cadmium, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.86	mg/L	93	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.015	0.015		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.015	0.015		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		.9822	mg/L	98.2	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	U	4.849	mg/L	97	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	U	4.819	mg/L	96.4	75	125	0.62	20

Calcium, dissolved M6010B ICP

WG203294

WG203294ICV	ICV	03/07/06 12:41	II060302-5	100		97.29	mg/L	97.3	90	110		
WG203294ICB	ICB	03/07/06 12:45				U	mg/L		-0.6	0.6		
L55360-01AS	AS	03/07/06 13:05	II060304-5	67.92102	152	213.53	mg/L	90.6	75	125		
L55360-01ASD	ASD	03/07/06 13:09	II060304-5	67.92102	152	213.6	mg/L	90.7	75	125	0.03	20

Carbon, total organic (TOC) M415.1 Combustion/IR

WG202959

WG202959ICV	ICV	02/27/06 15:47	WI060216-5	75		73.2	mg/L	97.6	90	110		
WG202959ICB	ICB	02/27/06 16:44				U	mg/L		-3	3		
WG202959LFB	LFB	02/27/06 17:42	WI060216-3	50		47.6	mg/L	95.2	90	110		
L55388-01DUP	DUP	02/28/06 11:01			105	97.3	mg/L				7.6	20
L55388-02AS	AS	02/28/06 12:56	WI060216-3	250	47	274.4	mg/L	91	90	110		

Kleinfelder, Inc.
Project ID: 66511

ACZ Project ID: *L55388*

Chloride M325.2 - Colorimetric

WG203129												
WG203129ICV	ICV	03/02/06 11:14	WI060207-2	55		53.8	mg/L	97.8	90	110		
WG203129ICB	ICB	03/02/06 11:15				U	mg/L		-3	3		
WG203129LFB	LFB	03/02/06 11:16	WI051219-3	30		30	mg/L	100	90	110		
L55388-01AS	AS	03/02/06 11:44	WI051219-3	300	270	575	mg/L	101.7	90	110		
L55388-02DUP	DUP	03/02/06 11:45			480	480	mg/L				0	20
WG204002												
WG204002ICV	ICV	03/24/06 17:02	WI060207-2	55		55.3	mg/L	100.5	90	110		
WG204002ICB	ICB	03/24/06 17:03				U	mg/L		-3	3		
WG204002LFB	LFB	03/24/06 17:04	WI060321-4	30		30.7	mg/L	102.3	90	110		
L55673-01DUP	DUP	03/24/06 17:08			99	98.9	mg/L				0.1	20
L55388-01AS	AS	03/24/06 17:32	WI060321-4	300	270	585	mg/L	105	90	110		

Chromium, total M6010B ICP

WG202973												
WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.904	mg/L	95.2	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.03	0.03		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.03	0.03		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		.994	mg/L	99.4	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	U	4.96	mg/L	99.2	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	U	4.92	mg/L	98.4	75	125	0.81	20

Cobalt, total M6010B ICP

WG202973												
WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.828	mg/L	91.4	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.03	0.03		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.03	0.03		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		.982	mg/L	98.2	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	U	4.79	mg/L	95.8	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	U	4.76	mg/L	95.2	75	125	0.63	20

Conductivity @25C M9050 - Meter

WG202932												
WG202932PBW1	PBW	02/27/06 11:52				1.7	umhos/cn		-10	10		
WG202932LCSW1	LCSW	02/27/06 11:54	PCN23833	1409		1374	umhos/cn	97.5	80	120		
L55388-02DUP	DUP	02/27/06 13:44			15700	15540	umhos/cn				1	20
WG202932PBW2	PBW	02/27/06 14:34				1.5	umhos/cn		-10	10		
WG202932LCSW4	LCSW	02/27/06 14:35	PCN23833	1409		1386	umhos/cn	98.4	80	120		
WG202932LCSW7	LCSW	02/27/06 17:16	PCN23833	1409		1382	umhos/cn	98.1	80	120		

Kleinfelder, Inc. ACZ Project ID: *L55388*
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Copper, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.895	mg/L	94.8	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.03	0.03		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.03	0.03		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		.979	mg/L	97.9	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	U	4.85	mg/L	97	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	U	4.81	mg/L	96.2	75	125	0.83	20

Iron, dissolved M6010B ICP

WG203294

WG203294ICV	ICV	03/07/06 12:41	II060302-5	2		1.92	mg/L	96	90	110		
WG203294ICB	ICB	03/07/06 12:45				U	mg/L		-0.06	0.06		
L55360-01AS	AS	03/07/06 13:05	II060304-5	1	.06	1.067	mg/L	100.7	75	125		
L55360-01ASD	ASD	03/07/06 13:09	II060304-5	1	.06	1.069	mg/L	100.9	75	125	0.19	20

Lead, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	4		3.777	mg/L	94.4	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.12	0.12		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.12	0.12		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		.978	mg/L	97.8	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	10	U	9.78	mg/L	97.8	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	10	U	9.63	mg/L	96.3	75	125	1.55	20

Magnesium, dissolved M6010B ICP

WG203294

WG203294ICV	ICV	03/07/06 12:41	II060302-5	100		97.53	mg/L	97.5	90	110		
WG203294ICB	ICB	03/07/06 12:45				U	mg/L		-0.6	0.6		
L55360-01AS	AS	03/07/06 13:05	II060304-5	54.92926	46.3	99.95	mg/L	97.7	75	125		
L55360-01ASD	ASD	03/07/06 13:09	II060304-5	54.92926	46.3	99.7	mg/L	97.2	75	125	0.25	20

Manganese, dissolved M6010B ICP

WG203294

WG203294ICV	ICV	03/07/06 12:41	II060302-5	2		1.9046	mg/L	95.2	90	110		
WG203294ICB	ICB	03/07/06 12:45				U	mg/L		-0.015	0.015		
L55360-01AS	AS	03/07/06 13:05	II060304-5	.5	.017	.52	mg/L	100.6	75	125		
L55360-01ASD	ASD	03/07/06 13:09	II060304-5	.5	.017	.5206	mg/L	100.7	75	125	0.12	20

Kleinfelder, Inc.
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Nickel, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.863	mg/L	93.2	90	110			
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.03	0.03			
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.03	0.03			
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		.996	mg/L	99.6	80	120			
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	.1	4.87	mg/L	95.4	75	125			
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	.1	4.81	mg/L	94.2	75	125	1.24	20	

Nitrate/Nitrite as N, dissolved M353.2 - Automated Cadmium Reduction

WG202913

WG202913ICV	ICV	02/24/06 17:47	WI051201-1	2.4083		2.388	mg/L	99.2	90	110			
WG202913ICB	ICB	02/24/06 17:48				U	mg/L		-0.06	0.06			
WG202913LFB	LFB	02/24/06 17:52	WI050914-3	2		2.006	mg/L	100.3	90	110			
L55388-01AS	AS	02/24/06 17:54	WI050914-3	2	.5	2.519	mg/L	101	90	110			
L55388-02DUP	DUP	02/24/06 17:56			.1	.117	mg/L				15.7	20	RA

Nitrite as N, dissolved M353.2 - Automated Cadmium Reduction

WG202913

WG202913ICV	ICV	02/24/06 17:47	WI051201-1	.6092		.599	mg/L	98.3	90	110			
WG202913ICB	ICB	02/24/06 17:48				U	mg/L		-0.03	0.03			
WG202913LFB	LFB	02/24/06 17:52	WI050914-3	1		1.003	mg/L	100.3	90	110			
L55388-01AS	AS	02/24/06 17:54	WI050914-3	1	.01	1.021	mg/L	101.1	90	110			
L55388-02DUP	DUP	02/24/06 17:56			U	U	mg/L				0	20	RA

Ph M9045C/M9040B

WG202932

WG202932LCSW3	LCSW	02/27/06 12:06	PCN23504	6		6.08	units	101.3	90	110			
L55388-02DUP	DUP	02/27/06 13:44			7.8	7.82	units				0.3	20	
WG202932LCSW6	LCSW	02/27/06 14:50	PCN23504	6		6.09	units	101.5	90	110			
WG202932LCSW9	LCSW	02/27/06 17:29	PCN23504	6		6.1	units	101.7	90	110			

Potassium, dissolved M6010B ICP

WG203294

WG203294ICV	ICV	03/07/06 12:41	II060302-5	20		19.76	mg/L	98.8	90	110			
WG203294ICB	ICB	03/07/06 12:45				U	mg/L		-0.9	0.9			
L55360-01AS	AS	03/07/06 13:05	II060304-5	100.1604	1.6	109.4	mg/L	107.6	75	125			
L55360-01ASD	ASD	03/07/06 13:09	II060304-5	100.1604	1.6	108.37	mg/L	106.6	75	125	0.95	20	

Kleinfelder, Inc. ACZ Project ID: *L55388*
Project ID: 66511

Residue, Filterable (TDS) @180C M160.1 - Gravimetric

WG203036

WG203036PBW	PBW	02/28/06 15:20				U	mg/L		-20	20			
WG203036LCSW	LCSW	02/28/06 15:22	PCN23926	260		268	mg/L	103.1	192	325			
L55426-02DUP	DUP	02/28/06 15:51			1090	1086	mg/L				0.4	20	

Selenium, total SM 3114 B, AA-Hydride

WG202938

WG202938LRB	LRB	02/28/06 15:11				U	mg/L		-0.003	0.003			
WG202938LFB	LFB	02/28/06 15:13	II060217-3	.02		.0195	mg/L	97.5	85	115			
L55326-10LFM	LFM	02/28/06 15:18	II060217-3	.02	U	.0198	mg/L	99	85	115			
L55326-10LFMD	LFMD	02/28/06 15:20	II060217-3	.02	U	.0197	mg/L	98.5	85	115	0.51	20	

Silver, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	1		.938	mg/L	93.8	90	110			
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.03	0.03			
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.03	0.03			
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	.25		.248	mg/L	99.2	80	120			
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	U	4.84	mg/L	96.8	75	125			
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	U	4.85	mg/L	97	75	125	0.21	20	

Sodium, dissolved M6010B ICP

WG203294

WG203294ICV	ICV	03/07/06 12:41	II060302-5	100		100.5	mg/L	100.5	90	110			
WG203294ICB	ICB	03/07/06 12:45				U	mg/L		-0.9	0.9			
L55360-01AS	AS	03/07/06 13:05	II060304-5	99.34137	19.7	119.64	mg/L	100.6	75	125			
L55360-01ASD	ASD	03/07/06 13:09	II060304-5	99.34137	19.7	118.86	mg/L	99.8	75	125	0.65	20	

Sulfate SM4500 SO4-D

WG203074

WG203074PBW	PBW	03/01/06 12:00				U	mg/L		-30	30			
WG203074LCSW	LCSW	03/01/06 12:01	WC060112-3	100		104	mg/L	104	80	120			
L55404-01DUP	DUP	03/01/06 12:15			U	U	mg/L				0	20	RA

WG203953

WG203953PBW	PBW	03/23/06 17:14				U	mg/L		-30	30			
WG203953LCSW	LCSW	03/23/06 17:15	WC060112-3	100		95	mg/L	95	80	120			
L55667-01DUP	DUP	03/23/06 17:34			U	12	mg/L				200	20	RA

Kleinfelder, Inc. ACZ Project ID: *L55388*
Project ID: 66511

Thallium, total M6020 ICP-MS

WG203104

WG203104ICV	ICV	03/01/06 18:56	MS060215-2	.0546		.05592	mg/L	102.4	90	110		
WG203104ICB	ICB	03/01/06 19:02				U	mg/L		-0.0003	0.0003		
WG203017PBW	PBW	03/01/06 20:42				U	mg/L		-0.0003	0.0003		
WG203017LCSW	LCSW	03/01/06 20:48	MS060215-2	.0546		.05603	mg/L	102.6	80	120		
L55388-02MS	MS	03/01/06 21:11	MS060116-3	.05	.0003	.05978	mg/L	119	75	125		
L55388-02MSD	MSD	03/01/06 21:17	MS060116-3	.05	.0003	.05946	mg/L	118.4	75	125	0.5	20

Vanadium, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.9081	mg/L	95.4	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.015	0.015		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.015	0.015		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		.9934	mg/L	99.3	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	.18	5.089	mg/L	98.2	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	.18	5.049	mg/L	97.4	75	125	0.79	20

Zinc, total M6010B ICP

WG202973

WG202973ICV	ICV	02/28/06 4:26	II060119-4	2		1.901	mg/L	95.1	90	110		
WG202973ICB	ICB	02/28/06 4:30				U	mg/L		-0.03	0.03		
WG202924PBW	PBW	02/28/06 4:47				U	mg/L		-0.03	0.03		
WG202924LCSW	LCSW	02/28/06 4:51	II060118-1	1		1.003	mg/L	100.3	80	120		
L55279-11MS	MS	02/28/06 5:08	II10XWATE	5	.3	5.22	mg/L	98.4	75	125		
L55279-11MSD	MSD	02/28/06 5:12	II10XWATE	5	.3	5.18	mg/L	97.6	75	125	0.77	20

L55388-01	WG203104	Antimony, total	M6020 ICP-MS	M2	Matrix spike recovery was low, the method control sample recovery was acceptable.
	WG203294	Iron, dissolved	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
	WG203104	Thallium, total	M6020 ICP-MS	ZB	The ICP-MS Serial Dilution was not used for data validation because the sample concentration was less than 100 times the MDL.
	WG202973	Zinc, total	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
	WG204002	Chloride	M325.2 - Colorimetric	C4	Confirmatory analysis was past holding time.
	WG202913	Nitrate/Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG203953	Sulfate	SM4500 SO4-D	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG204008	Total Alkalinity	SM2320B - Titration	C4	Confirmatory analysis was past holding time.
L55388-02	WG203104	Antimony, total	M6020 ICP-MS	M2	Matrix spike recovery was low, the method control sample recovery was acceptable.
	WG203294	Iron, dissolved	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
	WG203104	Thallium, total	M6020 ICP-MS	ZB	The ICP-MS Serial Dilution was not used for data validation because the sample concentration was less than 100 times the MDL.
	WG202973	Zinc, total	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
	WG202913	Nitrate/Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG203038	Residue, Filterable (TDS) @180C	M160.1 - Gravimetric	ZO	TDS concentration is based on a final residue greater than 200 mg.
	WG203074	Sulfate	SM4500 SO4-D	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Kleinfelder, Inc.

Project ID:	66511
Sample ID:	GW-1
Locator:	

ACZ Sample ID:	*L55388-01*
Date Sampled:	*02/23/06 0:00*
Date Received:	*02/24/06*
Sample Matrix:	*Ground Water*

[redacted]

Analysis Method:	**M8260B GC/MS**
Extract Method:	**Method**

Analyst:	*jj*
Extract Date:	*03/08/06 23:06*
Analysis Date:	*03/08/06 23:06*
Dilution Factor:	*1*

Compound

[redacted]

1,1,1,2-Tetrachloroethane	000630-20-6		U	*	ug/L	0.5	1
1,1,1-Trichloroethane	000071-55-6		U	*	ug/L	0.5	2
1,1,2,2-Tetrachloroethane	000079-34-5		U	*	ug/L	0.5	1
1,1,2-Trichloroethane	000079-00-5		U	*	ug/L	0.5	1
1,1-Dichloroethane	000075-34-3		U	*	ug/L	0.5	1
1,1-Dichloroethene	000075-35-4		U	*	ug/L	0.5	1
1,2,3-Trichloropropane	000096-18-4		U	*	ug/L	0.5	1
1,2-Dibromo-3-chloropropane	000096-12-8		U	*	ug/L	0.5	1
1,2-Dibromoethane	000106-93-4		U	*	ug/L	0.5	1
1,2-Dichlorobenzene	000095-50-1		U	*	ug/L	0.5	1
1,2-Dichloroethane	000107-06-2		U	*	ug/L	0.5	1
1,2-Dichloropropane	000078-87-5		U	*	ug/L	0.5	1
1,3-Dichlorobenzene	000541-73-1		U	*	ug/L	0.5	1
1,4-Dichlorobenzene	000106-46-7		U	*	ug/L	0.5	1
2-Butanone	000078-93-3		U	*	ug/L	0.5	2
2-Hexanone	000591-78-6		U	*	ug/L	0.5	2
4-Methyl-2-Pentanone	000108-10-1		U	*	ug/L	0.5	2
Acetone	000067-64-1		U	*	ug/L	0.5	2
Acrylonitrile	000107-13-1		U	*	ug/L	0.5	2
Benzene	000071-43-2	4.3		*	ug/L	0.5	1
Bromochloromethane	000074-97-5		U	*	ug/L	0.5	1
Bromodichloromethane	000075-27-4		U	*	ug/L	0.5	1
Bromoform	000075-25-2		U	*	ug/L	0.5	1
Bromomethane	000074-83-9		U	*	ug/L	0.5	2
Carbon Disulfide	000075-15-0		U	*	ug/L	0.5	1
Carbon Tetrachloride	000056-23-5		U	*	ug/L	0.5	1
Chlorobenzene	000108-90-7		U	*	ug/L	0.5	1
Chloroethane	000075-00-3		U	*	ug/L	0.5	2
Chloroform	000067-66-3		U	*	ug/L	0.5	1
Chloromethane	000074-87-3		U	*	ug/L	0.5	1
cis-1,2-Dichloroethene	000156-59-2	17.5		*	ug/L	0.5	1
cis-1,3-Dichloropropene	010061-01-5		U	*	ug/L	0.5	1
Dibromochloromethane	000124-48-1		U	*	ug/L	0.5	1
Dibromomethane	000074-95-3		U	*	ug/L	0.5	1
Dichlorodifluoromethane	000075-71-8		U	*	ug/L	0.5	1

* *Please refer to Extended Qualifier Report for details.*

Kleinfelder, Inc.
Project ID: 66511
Sample ID: GW-1
Locator:

ACZ Sample ID: *L55388-01*
Date Sampled: *02/23/06 0:00*
Date Received: *02/24/06*
Sample Matrix: *Ground Water*

Ethylbenzene	000100-41-4	12.3		*	ug/L	0.5	1
Iodomethane	000074-88-4		U	*	ug/L	0.5	1
m,p-Xylene	001330 20 7		U	*	ug/L	0.5	1
Methylene Chloride	000075-09-2		U	*	ug/L	0.5	1
o-Xylene	000095-47-6		U	*	ug/L	0.5	1
Styrene	000100-42-5		U	*	ug/L	0.5	1
Tetrachloroethene	000127-18-4		U	*	ug/L	0.5	1
Toluene	000108-88-3		U	*	ug/L	0.5	1
trans-1,2-Dichloroethene	000156-60-5		U	*	ug/L	0.5	1
trans-1,3-Dichloropropene	010061-02-6		U	*	ug/L	0.5	1
trans-1,4-Dichloro-2-butene	000110-57-6		U	*	ug/L	0.5	1
Trichloroethene	000079-01-6	8.1		*	ug/L	0.5	1
Trichlorofluoromethane	000075-69-4		U	*	ug/L	0.5	1
Vinyl Acetate	000108-05-4		U	*	ug/L	0.5	2
Vinyl Chloride	000075-01-4	4.3		*	ug/L	0.5	2

Surrogate Recoveries

Bromofluorobenzene	000460-00-4	111.3	*	%	86	115
Dibromofluoromethane	001868-53-7	86.4	*	%	86	118
Toluene-d8	002037-26-5	104.6	*	%	88	110

* *Please refer to Extended Qualifier Report for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Kleinfelder, Inc.
Project ID: 66511
Sample ID: GW-2
Locator:

ACZ Sample ID: *L55388-02*
Date Sampled: *02/23/06 0:00*
Date Received: *02/24/06*
Sample Matrix: *Ground Water*

Analysis Method: **M8260B GC/MS**
Extract Method: **Method**

Analyst: *jj*
Extract Date: *03/08/06 22:22*
Analysis Date: *03/08/06 22:22*
Dilution Factor: *1*

Compound							
1,1,1,2-Tetrachloroethane	000630-20-6		U	*	ug/L	0.5	1
1,1,1-Trichloroethane	000071-55-6		U	*	ug/L	0.5	2
1,1,2,2-Tetrachloroethane	000079-34-5		U	*	ug/L	0.5	1
1,1,2-Trichloroethane	000079-00-5		U	*	ug/L	0.5	1
1,1-Dichloroethane	000075-34-3		U	*	ug/L	0.5	1
1,1-Dichloroethene	000075-35-4		U	*	ug/L	0.5	1
1,2,3-Trichloropropane	000096-18-4		U	*	ug/L	0.5	1
1,2-Dibromo-3-chloropropane	000096-12-8		U	*	ug/L	0.5	1
1,2-Dibromoethane	000106-93-4		U	*	ug/L	0.5	1
1,2-Dichlorobenzene	000095-50-1		U	*	ug/L	0.5	1
1,2-Dichloroethane	000107-06-2		U	*	ug/L	0.5	1
1,2-Dichloropropane	000078-87-5		U	*	ug/L	0.5	1
1,3-Dichlorobenzene	000541-73-1		U	*	ug/L	0.5	1
1,4-Dichlorobenzene	000106-46-7		U	*	ug/L	0.5	1
2-Butanone	000078-93-3		U	*	ug/L	0.5	2
2-Hexanone	000591-78-6		U	*	ug/L	0.5	2
4-Methyl-2-Pentanone	000108-10-1		U	*	ug/L	0.5	2
Acetone	000067-64-1		U	*	ug/L	0.5	2
Acrylonitrile	000107-13-1		U	*	ug/L	0.5	2
Benzene	000071-43-2		U	*	ug/L	0.5	1
Bromochloromethane	000074-97-5		U	*	ug/L	0.5	1
Bromodichloromethane	000075-27-4		U	*	ug/L	0.5	1
Bromoform	000075-25-2		U	*	ug/L	0.5	1
Bromomethane	000074-83-9		U	*	ug/L	0.5	2
Carbon Disulfide	000075-15-0		U	*	ug/L	0.5	1
Carbon Tetrachloride	000056-23-5		U	*	ug/L	0.5	1
Chlorobenzene	000108-90-7		U	*	ug/L	0.5	1
Chloroethane	000075-00-3		U	*	ug/L	0.5	2
Chloroform	000067-66-3		U	*	ug/L	0.5	1
Chloromethane	000074-87-3		U	*	ug/L	0.5	1
cis-1,2-Dichloroethene	000156-59-2	29.8		*	ug/L	0.5	1
cis-1,3-Dichloropropene	010061-01-5		U	*	ug/L	0.5	1
Dibromochloromethane	000124-48-1		U	*	ug/L	0.5	1
Dibromomethane	000074-95-3		U	*	ug/L	0.5	1
Dichlorodifluoromethane	000075-71-8		U	*	ug/L	0.5	1

* *Please refer to Extended Qualifier Report for details.*

Kleinfelder, Inc.
Project ID: 66511
Sample ID: GW-2
Locator:

ACZ Sample ID: ***L55388-02***
Date Sampled: *02/23/06 0:00*
Date Received: *02/24/06*
Sample Matrix: *Ground Water*

Ethylbenzene	000100-41-4		U	*	ug/L	0.5	1
Iodomethane	000074-88-4		U	*	ug/L	0.5	1
m,p-Xylene	001330 20 7		U	*	ug/L	0.5	1
Methylene Chloride	000075-09-2		U	*	ug/L	0.5	1
o-Xylene	000095-47-6		U	*	ug/L	0.5	1
Styrene	000100-42-5		U	*	ug/L	0.5	1
Tetrachloroethene	000127-18-4		U	*	ug/L	0.5	1
Toluene	000108-88-3		U	*	ug/L	0.5	1
trans-1,2-Dichloroethene	000156-60-5		U	*	ug/L	0.5	1
trans-1,3-Dichloropropene	010061-02-6		U	*	ug/L	0.5	1
trans-1,4-Dichloro-2-butene	000110-57-6		U	*	ug/L	0.5	1
Trichloroethene	000079-01-6	12		*	ug/L	0.5	1
Trichlorofluoromethane	000075-69-4		U	*	ug/L	0.5	1
Vinyl Acetate	000108-05-4		U	*	ug/L	0.5	2
Vinyl Chloride	000075-01-4		U	*	ug/L	0.5	2

Surrogate Recoveries

[redacted]

Bromofluorobenzene	000460-00-4	64.4		*	%	86	115
Dibromofluoromethane	001868-53-7	104.2		*	%	86	118
Toluene-d8	002037-26-5	103.7		*	%	88	110

* *Please refer to Extended Qualifier Report for details.*

[redacted]

Kleinfelder, Inc.
Project ID: 66511
Sample ID: TB022106-02
Locator:

ACZ Sample ID: *L55388-03*
Date Sampled: *02/23/06 0:00*
Date Received: *02/24/06*
Sample Matrix: *Ground Water*

[redacted]

Analyst: *jj*
Extract Date: *03/08/06 21:38*
Analysis Date: *03/08/06 21:38*
Dilution Factor: *1*

Analysis Method: **M8260B GC/MS**
Extract Method: **Method**

[redacted]

Compound						
1,1,1,2-Tetrachloroethane	000630-20-6	U	*	ug/L	0.5	1
1,1,1-Trichloroethane	000071-55-6	U	*	ug/L	0.5	2
1,1,2,2-Tetrachloroethane	000079-34-5	U	*	ug/L	0.5	1
1,1,2-Trichloroethane	000079-00-5	U	*	ug/L	0.5	1
1,1-Dichloroethane	000075-34-3	U	*	ug/L	0.5	1
1,1-Dichloroethene	000075-35-4	U	*	ug/L	0.5	1
1,2,3-Trichloropropane	000096-18-4	U	*	ug/L	0.5	1
1,2-Dibromo-3-chloropropane	000096-12-8	U	*	ug/L	0.5	1
1,2-Dibromoethane	000106-93-4	U	*	ug/L	0.5	1
1,2-Dichlorobenzene	000095-50-1	U	*	ug/L	0.5	1
1,2-Dichloroethane	000107-06-2	U	*	ug/L	0.5	1
1,2-Dichloropropane	000078-87-5	U	*	ug/L	0.5	1
1,3-Dichlorobenzene	000541-73-1	U	*	ug/L	0.5	1
1,4-Dichlorobenzene	000106-46-7	U	*	ug/L	0.5	1
2-Butanone	000078-93-3	U	*	ug/L	0.5	2
2-Hexanone	000591-78-6	U	*	ug/L	0.5	2
4-Methyl-2-Pentanone	000108-10-1	U	*	ug/L	0.5	2
Acetone	000067-64-1	U	*	ug/L	0.5	2
Acrylonitrile	000107-13-1	U	*	ug/L	0.5	2
Benzene	000071-43-2	U	*	ug/L	0.5	1
Bromochloromethane	000074-97-5	U	*	ug/L	0.5	1
Bromodichloromethane	000075-27-4	U	*	ug/L	0.5	1
Bromoform	000075-25-2	U	*	ug/L	0.5	1
Bromomethane	000074-83-9	U	*	ug/L	0.5	2
Carbon Disulfide	000075-15-0	U	*	ug/L	0.5	1
Carbon Tetrachloride	000056-23-5	U	*	ug/L	0.5	1
Chlorobenzene	000108-90-7	U	*	ug/L	0.5	1
Chloroethane	000075-00-3	U	*	ug/L	0.5	2
Chloroform	000067-66-3	U	*	ug/L	0.5	1
Chloromethane	000074-87-3	U	*	ug/L	0.5	1
cis-1,2-Dichloroethene	000156-59-2	U	*	ug/L	0.5	1
cis-1,3-Dichloropropene	010061-01-5	U	*	ug/L	0.5	1
Dibromochloromethane	000124-48-1	U	*	ug/L	0.5	1
Dibromomethane	000074-95-3	U	*	ug/L	0.5	1
Dichlorodifluoromethane	000075-71-8	U	*	ug/L	0.5	1

* Please refer to Extended Qualifier Report for details.

Kleinfelder, Inc.

Project ID:	66511	ACZ Sample ID:	*L55388-03*
Sample ID:	TB022106-02	Date Sampled:	*02/23/06 0:00*
Locator:		Date Received:	*02/24/06*
		Sample Matrix:	*Ground Water*

Ethylbenzene	000100-41-4		U	*	ug/L	0.5	1
Iodomethane	000074-88-4		U	*	ug/L	0.5	1
m,p-Xylene	001330 20 7		U	*	ug/L	0.5	1
Methylene Chloride	000075-09-2	4.6		*	ug/L	0.5	1
o-Xylene	000095-47-6		U	*	ug/L	0.5	1
Styrene	000100-42-5		U	*	ug/L	0.5	1
Tetrachloroethene	000127-18-4		U	*	ug/L	0.5	1
Toluene	000108-88-3		U	*	ug/L	0.5	1
trans-1,2-Dichloroethene	000156-60-5		U	*	ug/L	0.5	1
trans-1,3-Dichloropropene	010061-02-6		U	*	ug/L	0.5	1
trans-1,4-Dichloro-2-butene	000110-57-6		U	*	ug/L	0.5	1
Trichloroethene	000079-01-6		U	*	ug/L	0.5	1
Trichlorofluoromethane	000075-69-4		U	*	ug/L	0.5	1
Vinyl Acetate	000108-05-4		U	*	ug/L	0.5	2
Vinyl Chloride	000075-01-4		U	*	ug/L	0.5	2

Surrogate Recoveries

Bromofluorobenzene	000460-00-4	62.5		*	%	86	115
Dibromofluoromethane	001868-53-7	97.1		*	%	86	118
Toluene-d8	002037-26-5	107.1		*	%	88	110

* *Please refer to Extended Qualifier Report for details.*

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
LCL	Lower Control Limit
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
UCL	Upper Control Limit
Sample	Value of the Sample of Interest

SURR	Surrogate	*LFM*	Laboratory Fortified Matrix
INTS	Internal Standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
LCSS	Laboratory Control Sample - Soil	*MS/MSD*	Matrix Spike/Matrix Spike Duplicate
LCSW	Laboratory Control Sample - Water	*PBS*	Prep Blank - Soil
LFB	Laboratory Fortified Blank	*PBW*	Prep Blank - Water

Blanks	Verifies that there is no or minimal contamination in the prep method procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.

B	Analyte detected in daily blank
H	Analysis exceeded method hold time.
J	Analyte concentration detected at a value between MDL and PQL
R	Poor spike recovery accepted because the other spike in the set fell within the given limits.
T	High Relative Percent Difference (RPD) accepted because sample concentrations are less than 10x the MDL.
U	Analyte was analyzed for but not detected at the indicated MDL
V	High blank data accepted because sample concentration is 10 times higher than blank concentration
W	Poor recovery for Silver quality control is accepted because Silver often precipitates with Chloride.
X	Quality contreol sample is out of control.
Z	Poor spike recovery is accepted because sample concentration is four times greater than spike concentration.
P	Analyte concentration differs from second detector by more than 40%.
E	Analyte concentration is estimated due to result exceeding calibration range.
M	Analyte concentration is estimated due to matrix interferences.

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/4-90/020. Methods for the Determination of Organic Compounds in Drinking Water (I), July 1990.
(3)	EPA 600/R-92/129. Methods for the Determination of Organic Compounds in Drinking Water (II), July 1990.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December, 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995.

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Organic analyses are reported on an "as received" basis.

REPIN03.11.00.01

Kleinfelder, Inc.

Project ID: 66511

ACZ Project ID: *L55388*

Volatile Organics by GC/MS
WG203412

M8260B GC/MS

LCSW **Sample ID: WG203412LCSW** **PCN/SCN: SCN0002165** **Analyzed: 03/08/06 20:10**

[redacted]

1,1,1-TRICHLOROETHANE	8	8.78	ug/L	109.8	70	130	
1,1,2,2-TETRACHLOROETHANE	8	8.71	ug/L	108.9	70	130	
1,1,2-TRICHLOROETHANE	8	8.62	ug/L	107.8	70	130	
1,1-DICHLOROETHANE	8	7.66	ug/L	95.8	70	130	
1,2-DICHLOROBENZENE	8	8.08	ug/L	101.0	70	130	
1,2-DICHLOROETHANE	8	7.57	ug/L	94.6	70	130	
1,2-DICHLOROPROPANE	8	7.97	ug/L	99.6	70	130	
1,3-DICHLOROBENZENE	8	7.63	ug/L	95.4	70	130	
1,4-DICHLOROBENZENE	8	7.63	ug/L	95.4	70	130	
BROMODICHLOROMETHANE	8	8.53	ug/L	106.6	70	130	
BROMOFORM	8	7.05	ug/L	88.1	70	130	
CARBON TETRACHLORIDE	8	8.1	ug/L	101.3	70	130	
CHLOROBENZENE	8	8.66	ug/L	108.3	91	121	
CHLOROFORM	8	7.15	ug/L	89.4	70	130	
CIS-1,3-DICHLOROPROPENE	8	7.66	ug/L	95.8	70	130	
DIBROMOCHLOROMETHANE	8	8.5	ug/L	106.3	70	130	
METHYLENE CHLORIDE	8	7.22	ug/L	90.3	70	130	
TETRACHLOROETHENE	8	8.25	ug/L	103.1	70	130	
TRANS-1,2-DICHLOROETHENE	8	7.48	ug/L	93.5	70	130	
TRANS-1,3-DICHLOROPROPENE	8	7.16	ug/L	89.5	70	130	
TRICHLOROETHENE	8	7.92	ug/L	99.0	87	135	
BROMOFLUOROBENZENE (surr)			%	58.3	87	113	N1
DIBROMOFLUOROMETHANE (surr)			%	92.6	89	108	
TOLUENE-D8 (surr)			%	110.1	92	107	S1

LCSWD **Sample ID: WG203412LCSWD** **PCN/SCN: SCN0002165** **Analyzed: 03/08/06 20:54**

[redacted]

1,1,1-TRICHLOROETHANE	8	8.33	ug/L	104.1	70	130	5.3	30
1,1,2,2-TETRACHLOROETHANE	8	7.8	ug/L	97.5	70	130	11	30
1,1,2-TRICHLOROETHANE	8	8.32	ug/L	104.0	70	130	3.5	30
1,1-DICHLOROETHANE	8	7.32	ug/L	91.5	70	130	4.5	30
1,2-DICHLOROBENZENE	8	7.83	ug/L	97.9	70	130	3.1	30
1,2-DICHLOROETHANE	8	7.76	ug/L	97.0	70	130	2.5	30
1,2-DICHLOROPROPANE	8	8.26	ug/L	103.3	70	130	3.6	30
1,3-DICHLOROBENZENE	8	7.35	ug/L	91.9	70	130	3.7	30
1,4-DICHLOROBENZENE	8	7.35	ug/L	91.9	70	130	3.7	30
BROMODICHLOROMETHANE	8	9.41	ug/L	117.6	70	130	9.8	30
BROMOFORM	8	7.86	ug/L	98.3	70	130	10.9	30
CARBON TETRACHLORIDE	8	8.17	ug/L	102.1	70	130	0.9	30
CHLOROBENZENE	8	8.53	ug/L	106.6	91	121	1.5	3
CHLOROFORM	8	7.03	ug/L	87.9	70	130	1.7	30
CIS-1,3-DICHLOROPROPENE	8	8.12	ug/L	101.5	70	130	5.8	30
DIBROMOCHLOROMETHANE	8	8.77	ug/L	109.6	70	130	3.1	30
METHYLENE CHLORIDE	8	7.37	ug/L	92.1	70	130	2.1	30

TETRACHLOROETHENE	8	8.61	ug/L	107.6	70	130	4.3	30	
TRANS-1,2-DICHLOROETHENE	8	7.3	ug/L	91.3	70	130	2.4	30	
TRANS-1,3-DICHLOROPROPENE	8	6.8	ug/L	85.0	70	130	5.2	30	
TRICHLOROETHENE	8	8.65	ug/L	108.1	87	135	8.8	3	RJ
BROMOFLUOROBENZENE (surr)			%	60.4	87	113			N1
DIBROMOFLUOROMETHANE (surr)			%	92.0	89	108			
TOLUENE-D8 (surr)			%	115.5	92	107			S1

PBW **Sample ID: WG203412PBW** **Analyzed: 03/08/06 19:10**

1,1,1,2-TETRACHLOROETHANE		U	ug/L		-1	1			
1,1,1-TRICHLOROETHANE		U	ug/L		-2	2			
1,1,2,2-TETRACHLOROETHANE		U	ug/L		-1	1			
1,1,2-TRICHLOROETHANE		U	ug/L		-1	1			
1,1-DICHLOROETHANE		U	ug/L		-1	1			
1,1-DICHLOROETHENE		U	ug/L		-1	1			
1,2,3-TRICHLOROPROPANE		U	ug/L		-1	1			
1,2-DIBROMO-3-CHLOROPROPANE		U	ug/L		-1	1			
1,2-DIBROMOETHANE		U	ug/L		-1	1			
1,2-DICHLOROBENZENE		U	ug/L		-1	1			
1,2-DICHLOROETHANE		U	ug/L		-1	1			
1,2-DICHLOROPROPANE		U	ug/L		-1	1			
1,3-DICHLOROBENZENE		U	ug/L		-1	1			
1,4-DICHLOROBENZENE		U	ug/L		-1	1			
2-BUTANONE		U	ug/L		-2	2			
2-HEXANONE		U	ug/L		-2	2			
4-METHYL-2-PENTANONE		U	ug/L		-2	2			
ACETONE		U	ug/L		-2	2			
ACRYLONITRILE		U	ug/L		-2	2			
BENZENE		U	ug/L		-1	1			
BROMOCHLOROMETHANE		U	ug/L		-1	1			
BROMODICHLOROMETHANE		U	ug/L		-1	1			
BROMOFORM		U	ug/L		-1	1			
BROMOMETHANE		U	ug/L		-2	2			
CARBON DISULFIDE		U	ug/L		-1	1			
CARBON TETRACHLORIDE		U	ug/L		-1	1			
CHLOROBENZENE		U	ug/L		-1	1			
CHLOROETHANE		U	ug/L		-2	2			
CHLOROFORM		U	ug/L		-1	1			
CHLOROMETHANE		U	ug/L		-1	1			
CIS-1,2-DICHLOROETHENE		U	ug/L		-1	1			
CIS-1,3-DICHLOROPROPENE		U	ug/L		-1	1			
DIBROMOCHLOROMETHANE		U	ug/L		-1	1			
DIBROMOMETHANE		U	ug/L		-1	1			
DICHLORODIFLUOROMETHANE		U	ug/L		-1	1			
ETHYL BENZENE		U	ug/L		-1	1			
IODOMETHANE		U	ug/L		-1	1			
M,P-XYLENE		U	ug/L		-1	1			
METHYLENE CHLORIDE		U	ug/L		-1	1			

Kleinfelder, Inc.

Project ID: 66511

ACZ Project ID: *L55388*

O-XYLENE	U	ug/L		-1	1	
STYRENE	U	ug/L		-1	1	
TETRACHLOROETHENE	U	ug/L		-1	1	
TOLUENE	U	ug/L		-1	1	
TRANS-1,2-DICHLOROETHENE	U	ug/L		-1	1	
TRANS-1,3-DICHLOROPROPENE	U	ug/L		-1	1	
TRANS-1,4-DICHLORO-2-BUTENE	U	ug/L		-1	1	
TRICHLOROETHENE	U	ug/L		-1	1	
TRICHLOROFLUOROMETHANE	U	ug/L		-1	1	
VINYL ACETATE	U	ug/L		-2	2	
VINYL CHLORIDE	U	ug/L		-2	2	
BROMOFLUOROBENZENE (surr)		%	65.5	86	115	N1
DIBROMOFLUOROMETHANE (surr)		%	101.8	86	118	
TOLUENE-D8 (surr)		%	105.4	88	110	

Kleinfelder, Inc.

ACZ Project ID: *L55388*

L55388-01	WG203412	1,1,2,2-Tetrachloroethane	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		1,1-Dichloroethane	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		1,2,3-Trichloropropane	M8260B GC/MS	N1	See Case Narrative.
		1,2-Dibromo-3-chloropropane	M8260B GC/MS	N1	See Case Narrative.
		2-Butanone	M8260B GC/MS	N1	See Case Narrative.
		2-Hexanone	M8260B GC/MS	N1	See Case Narrative.
			M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		4-Methyl-2-Pentanone	M8260B GC/MS	N1	See Case Narrative.
		Acetone	M8260B GC/MS	N1	See Case Narrative.
			M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		Acrylonitrile	M8260B GC/MS	N1	See Case Narrative.
		Carbon Disulfide	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		m,p-Xylene	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		Methylene Chloride	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		o-Xylene	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		trans-1,4-Dichloro-2-butene	M8260B GC/MS	N1	See Case Narrative.
		Trichloroethene	M8260B GC/MS	RJ	LCS/LCSD RPD exceeded the method or laboratory control limit. Recovery met method acceptance criteria.

[redacted]

Kleinfelder, Inc.

ACZ Project ID: *L55388*

[redacted]

L55388-02	WG203412	1,1,2,2-Tetrachloroethane	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		1,1-Dichloroethane	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		1,2,3-Trichloropropane	M8260B GC/MS	N1	See Case Narrative.
		1,2-Dibromo-3-chloropropane	M8260B GC/MS	N1	See Case Narrative.
		2-Butanone	M8260B GC/MS	N1	See Case Narrative.
		2-Hexanone	M8260B GC/MS	N1	See Case Narrative.
			M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		4-Methyl-2-Pentanone	M8260B GC/MS	N1	See Case Narrative.
		Acetone	M8260B GC/MS	N1	See Case Narrative.
			M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		Acrylonitrile	M8260B GC/MS	N1	See Case Narrative.
		Bromofluorobenzene	M8260B GC/MS	N1	See Case Narrative.
		Carbon Disulfide	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		m,p-Xylene	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		Methylene Chloride	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		o-Xylene	M8260B GC/MS	W1	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.
		trans-1,4-Dichloro-2-butene	M8260B GC/MS	N1	See Case Narrative.
		Trichloroethene	M8260B GC/MS	RJ	LCS/LCSD RPD exceeded the method or laboratory control limit. Recovery met method acceptance criteria.

Appendix E

Subsurface Investigation for Mesa Valley Springs

January 2007

KLEINFELDER
An employee owned company

January 17, 2007
Kleinfelder Project Number: 77810

Engineering Solutions & Design, Inc.
4848 Tramway Ridge, NE, Suite 222
Albuquerque, New Mexico 87111

Attention: Mr. Jack Chappelle

Subject: Subsurface Investigation for
Mesa Valley Springs Property
Existing Landfill Consolidation Project
Colorado Springs, Colorado

Mr. Chappelle:

This letter transmits 3 copies of our subsurface investigation for the above referenced property. Our services consisted of a subsurface exploration, laboratory testing, and preparation of the attached report.

We appreciate this opportunity to be of service to you, and look forward to future endeavors. If you have any questions regarding this report or need additional information or services, please contact our office.

Respectfully submitted,

KLEINFELDER, INC.

John E. Hunyadi, E.I.T.
Staff Geotechnical Engineer

William J. Barreire, P.E.
Senior Geotechnical Engineer

JEH/JMS/hg

Enclosures

KLEINFELDER
EXPECT MORE®

SUBSURFACE INVESTIGATION FOR MESA VALLEY SPRINGS PROPERTY
EXISTING LANDFILL CONSOLIDATION PROJECT
COLORADO SPRINGS, COLORADO

John E. Hunyadi, E.I.T.
Staff Geotechnical Engineer

WILLIAM J. BARRERE
32045
1-16-07

William J. Barreire, P.E.
Senior Geotechnical Engineer

January 17, 2007

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APPENDICES

1 INTRODUCTION

1.1 GENERAL

This report presents the results of Kleinfelder's subsurface investigation performed at the Mesa Valley Springs Property in Colorado Springs, Colorado. An attached Vicinity Map (Figure A-1) shows the general location of the subject site.

In addition to presenting the results of our subsurface investigation, this report includes our preliminary opinions relating to the geotechnical aspects of project design and construction. The preliminary opinions stated in this report are based on the subsurface conditions found at the locations of our exploratory borings at the time our exploration was performed for this and the previous investigation. They also are subject to the provisions stated in the report sections titled Additional Services and Limitations. Our findings, and preliminary opinions should not be extrapolated to other areas or used for other projects without our prior review. Furthermore, they should not be used if the site has been altered, or if a prolonged period has elapsed since the date of the report, without Kleinfelder's prior review to determine if they remain valid.

1.2 PROJECT DESCRIPTION

Based on conversations with Engineering Solutions & Design, Inc. (ESD) representatives, we understand that the existing landfill must be consolidated to allow more area for future development. The exact type and layout of future development is not explicitly known at this time, but we understand that it will involve residential housing, roadway, and general infrastructure construction.

1.3 PURPOSE AND SCOPE

The purpose of our services was two-fold:

1) To evaluate on-site materials for suitability for support and containment of the landfill consolidation project. Specifically, we performed subsurface explorations to evaluate on-site soil/bedrock type and condition, and performed on-site/downhole permeability tests on in-situ materials as well as laboratory permeability testing of remolded on-site materials.

Our opinion as to the suitability of the on-site materials to physically support the loads of the landfill are provided herein. The results of our permeability testing are provided as well. This information is provided solely for the purpose of aiding others in the design of the landfill consolidation project.

2) To provide preliminary opinions related to development of the site including:
    a. Geotechnical/Geologic Issues
        i. Expansive clay soils.
        ii. Slope stability issues (to be addressed under a separate geologic hazard evaluation).
    b. Preliminary opinions related to design and construction of various features of the development as follows:
        i. Design/construction of structure foundations.
        ii. Design/construction of roadway pavements.
        iii. Considerations related to earthwork operations.
        iv. Providing results of limited corrosion testing performed on the on-site subgrade materials.

Kleinfelder's scope of services included:

- A review of selected published geologic and geotechnical data pertinent to the project site;
- A visual reconnaissance to observe surface and geologic conditions at the project sites and to locate the exploratory borings;
- Identification of utilities in the public right-of-way through the one-call Utility Notification Center of Colorado (UNCC);
- Drilling of ten (10) exploratory borings at the proposed site;
- Laboratory testing of selected samples obtained during the field exploration to evaluate relevant physical and engineering properties of the soil;
- Evaluation and engineering analysis of the field and laboratory data collected to develop our preliminary opinions related to site soils;
- Preparation of this report, which includes:

- A vicinity map and site plan showing the approximate location of the site and borings.
- Logs of the test borings.
- Results of the laboratory tests.
- Preliminary opinions pertaining to feasibility of the proposed development, including impacts of geotechnical and geologic features on the proposed project.

2 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

We performed our field investigation in two phases. The first phase was performed on November 30, 2006 and included drilling a total of six (6) exploratory borings at various locations throughout the proposed site. The second phase was performed on January 3 and 4, 2007 and included drilling a total of four (4) borings. The second phase involved down-hole pressure meter testing to obtain permeability values of in-place soil/bedrock units. The locations of all exploratory borings are indicated in the Boring Location Plan (Figure A-2).

Phase I borings were advanced to depths ranging from approximately 20 to 35 feet below the existing ground surface using a truck-mounted CME-55 drill rig equipped with a 3-inch outside-diameter, continuous-flight, solid-stem auger. Phase II borings were advanced to similar depths using a track-mounted CME-55 drill rig equipped with both a mud-rotary bit and a continuous-flight, solid-stem auger. Drive samples were taken with a standard split-spoon sampler and a modified California sampler. The number of blows of a 140 pound hammer falling 30 inches were recorded for each drive sample. Boring elevations were estimated from the topographic map provided by ESD.

Appendix B to this report includes the individual boring logs describing the subsurface conditions encountered within our borings at the site. A legend to the boring logs summarizing the notes and the Unified Soil Classification System (USCS) used to describe the soils is located at the beginning of Appendix B. The lines defining boundaries between soil and rock types on the logs are based upon drill behavior and interpolation between samples, and are therefore approximate. Therefore, the transition between soil and rock types may be abrupt or may be gradual.

2.2 LABORATORY TESTING

Laboratory tests were performed on selected soil samples to estimate their relative engineering properties. The following tests were performed in general accordance with the standards set forth by the American Society for Testing and Materials (ASTM):

- Description and Identification of Soils (Visual-Manual Procedure);

- Classification of Soils for Engineering Purposes;
- Particle-Size Analysis of Soils;
- Liquid Limit, Plastic Limit, and Plasticity Index of Soils;
- In-place moisture content and unit weight determination;
- One-Dimensional Swell or Settlement Potential of Cohesive Soils;
- R-Value of Compacted Soils;
- Maximum Laboratory Density (Proctor);
- Permeability of remolded soils;
- Corrosion Testing.

Results of the laboratory tests are included in Appendix C of this report. Selected test results are also shown on the boring logs included in Appendix B.

3 SITE CONDITIONS

3.1 SURFACE

The Mesa Valley Springs Property has highly varied topography with hills and valleys separated by as much as approximately 130 feet in elevation. The general surface drainage pattern is to the south. Additionally there is a large streambed near the southern and western edges of the property boundary. The streambed was running several inches deep at the time of our investigation. The surface is covered in prairie grass and some trees, with foliage becoming denser near the streambed.

3.2 GEOLOGY

Prior to drilling, the geology of the site was evaluated by reviewing geologic maps, including the Geologic Map of the Colorado Springs Quadrangle, El Paso County, Colorado (Carroll & Crawford, 2000). The mapping indicates the soils underlying the proposed site consist of colluvial materials deposited during the middle Pleistocene to late Pleistocene. The colluvial materials are comprised of gravelly to silty sand. Pierre shale deposited during the Upper Cretaceous was encountered. Additionally, landfill material and mapped landslides are shown in the mapping.

3.3 SUBSURFACE

The subsurface profile encountered in our borings generally consisted of a thin layer of topsoil overlying weathered claystone overlying Pierre Shale Bedrock, as described in more detail below:

Weathered Claystone

The top of the weathered claystone was encountered below the thin layer of topsoil, between approximately 1 and 2 feet below existing ground surface. The weathered claystone bedrock was generally sandy, light brown to brown, slightly moist, and medium hard to hard in consistency. Ferric staining and fracturing were also encountered in this zone.

Pierre Shale Bedrock

The top of the bedrock (Pierre Shale Formation) was encountered below the weathered claystone or topsoil at depths between approximately 1 and 20 feet below the ground surface and extended to the maximum boring depths. The Pierre Shale Formation in this location consists of a sandy claystone. The bedrock encountered was very hard, dry to slightly moist, fissile, and dark gray in color.

The boring logs, contained in Appendix B, should be reviewed for more detailed descriptions of the subsurface conditions encountered at each of the boring locations explored.

3.3.1 GROUNDWATER

No free groundwater was encountered during our subsurface investigation. Based on our experience in this general area and similar geologic conditions, it is not uncommon to find groundwater seepage through fractures and joints in the bedrock at random locations and elevations within the strata.

Soil moisture levels and groundwater levels commonly vary over time and space depending on seasonal precipitation, irrigation practices, land use, and runoff conditions. These conditions and the variations that they create often are not apparent at the time of the field investigation. Accordingly, the soil moisture and groundwater data in this report pertain only to the locations and times at which exploration was performed. They can be extrapolated to other locations and times only with caution.

4 RESULTS OF INVESTIGATION

4.1 LANDFILL CONSOLIDATION PROJECT

4.1.1 SUPPORT CAPABILITY OF ON-SITE MATERIALS

The undisturbed weathered claystone and Pierre Shale bedrock units are medium hard to very hard in consistency and will be able to support the weight of the consolidated landfill provided no additional construction is planned on the landfill itself. Similarly, properly moisture conditioned and compacted fill consisting of on-site materials that can be broken down into a soil-like mass will provide suitable support for the landfill materials.

4.1.2 RESULTS OF PERMEABILITY TESTING

Processed soil samples were remolded to 95% density of a standard Proctor density and +3% of optimum moisture content and run in a triaxial compression permeability machine. Downhole tests were performed using a packer type pressure meter system in the representative native soil/bedrock units to quantify flow through potential fractures and joints in the formations. The results of the permeability tests are as follows:

Soil Type & Test Conditions	Location & Depth [feet]	Dry Density [pcf] & Moisture Content [%] of Processed Samples	Percent Passing No. 200 and Plasticity Index (PI)	Permeability [cm/s]
Sandy Claystone – Downhole/In-Situ	B-2 @ 15 – 21'	----	----	Head Pressure 30 psi = 1.18×10^{-6} Head Pressure 25 psi = 3.83×10^{-7}
Sandy Claystone - Processed	B-1 & B-5 Combined @ 10'	96.2 pcf @ 26.2%	-200 = 64.7% PI = 32	4.3×10^{-8}
Pierre Shale – Downhole/In-Situ	B-2 @ 21 - 30'	----	----	Formation did not take any water to accuracy of test method
Pierre Shale - Processed	B-1, B-8, & B-9 Combined @ 20'	101.9 pcf @ 21.3%	-200 = 81% PI = 35	2.2×10^{-7}

4.2 PRELIMINARY GEOLOGIC/GEOTECHNICAL CONSIDERATIONS

Potential geologic impacts to the proposed development will vary depending upon which portion of the site is selected for development and the type of development proposed. We believe the following geologic constraints may impact the proposed development:

- The existence of relatively shallow expansive bedrock;
- Poor long-term pavement subgrade support.
- Slope stability issues related to steep topography. The City of Colorado Springs Zoning Map indicates that the subject site is part of the hillside overlay zone. Additionally, several mapped landslides exist in the vicinity of the subject site. Placement of earth fills during overlot grading, construction of parking lots, and other improvements located near the steeper slopes on the site will likely require measures to preserve the stability of the improvements. Slope stability issues should be addressed once a preliminary layout of the facility is available. A Geologic Hazard Study will be required by the City of Colorado Springs to address these issues and will be performed as a separate study and presented under separate cover.
- Possible groundwater seepage within fractures and seams of the bedrock, although no free groundwater was encountered in our borings.
- Seasonal perched groundwater at the bedrock/soil interface.

While some of the above geologic constraints will ultimately depend on final site development plans and proposed site grading, expansive soil/bedrock or potentially expansive bedrock will be present regardless of development/grading plans. Mitigation of expansive soil/bedrock and groundwater may be accomplished through standard construction techniques to some degree.

Further discussion concerning geotechnical related issues are provided in the following sections of this report.

4.2.1 STRUCTURE FOUNDATIONS

Due to the presence of moderately to highly expansive clay soil and claystone bedrock at relatively shallow depths at this site, mitigation to limit damaging differential movement to the structures will be required. A common foundation system that is used locally to mitigate such issues includes a drilled pier and grade beam foundation system. The drilled piers would extend through the weathered claystone material, and would anchor in the underlying Pierre Shale bedrock. The piers may also need to be designed to impose minimum deadload pressures in order to resist potential uplift forces of expansive bedrock zones. As an alternative, removal of the problematic soils and replacement with more suitable material that would result in supporting foundations on a significant mat of non-expansive structural fill is a possibility. Depending on the nature of the actual materials encountered, removal and replacement of 3 to 10 feet of material below foundations is common, depending on the magnitude of potential swell and swell pressures.

4.2.2 FLOOR SYSTEMS

Similar to foundations on this site, expansive soils will likely be encountered at or near slab elevations. With these types of conditions, it is common practice to over-excavate the problematic soils to depths on the order of 3 to 5 feet and replace this material with an appropriate structural fill. If highly expansive soils are identified, over-excavation and replacement of up to 10 feet is possible to properly mitigate potential movement. As an alternative, and generally considered to be the more reliable alternative, to the deeper over-excavation/replacement option, construction of a structural floor system (crawlspace type system) may be considered. This is particularly common when a drilled pier/grade beam foundation system is utilized as overexcavation of the problematic soils beneath slabs and replacement with non or low expansive soils is eliminated.

4.2.3 ANTICIPATED PAVEMENT SUBGRADE MATERIAL

A total of three (3) borings (designated B-4, B-5, and B-6) were performed in the proposed southern extension of Centennial Boulevard to evaluate potential pavement subgrade conditions. The pavement subgrade soil at this site is anticipated to consist mainly of sandy claystone. An Hveem stabilometer test (R-Value) was performed on a bulk soil sample comprising the average upper 10 feet of soil obtained in borings B-4, B-5, and B-6. The resulting R-value was less than 5. Therefore, a resilient modulus (M_R) of less than 3,025 psi was calculated from the appropriate AASHTO R-Value conversion formula. These subgrade support values would be used in pavement thickness calculations. The low R-value of the on-site soils indicates that mitigation will be required to provide proper subgrade support for the planned roadway. This typically involves scarifying, moisture conditioning, and recompacting the subgrade. Thicker units of both base course and asphalt concrete pavement will be required for pavement subgrades that consist of these types of soil and bedrock.

Pavement design should be performed based on the City of Colorado Springs Standards Specifications for the above material and the anticipated traffic load.

4.2.4 DRAINAGE

The collection and diversion of surface drainage away from all pavement areas is extremely important to the satisfactory performance of pavement. Drainage design should provide for the removal of water and snow from paved areas and prevent the wetting of the subgrade soils. Possible water sources include but are not limited to storm runoff, irrigation of landscaping adjacent to the pavement, snow melt, and localized groundwater seepage. Landscaping adjacent to the pavements requiring supplemental watering should be avoided.

4.2.5 EARTHWORK OPERATIONS

It is likely that heavy-duty earth-moving equipment may be desired during grading, excavation, or trenching operations in areas where shallow, very hard bedrock is encountered. While we do not expect significant problems related to groundwater during construction, it is possible that some groundwater seepage may be encountered in isolated areas depending on the final grading planned. If groundwater seepage is encountered during earthwork operations, our office should be notified to evaluate the situation and provide any necessary recommendations.

Use of on-site soils and weathered claystone as overlot grading fills will require special consideration. Generally speaking, these types of materials will require the addition of a significant amount of water to facilitate compaction and reduce long-term swell potential. Typical recommendations for target moisture contents of compacted fills will range from –1 to +4% of optimum depending on the application.

Due to the nature of these materials, significant mixing will be required to obtain uniform moisture conditioning. Use of equipment to properly scarify, moisture condition, and mix water into these materials will be important. Use of an agricultural disc is common to aid in the mixing process. Moisture conditioning will also result in slick conditions that can be problematic for conventional earth moving equipment. Therefore, consideration should be given to use of low ground pressure and tracked equipment where feasible.

4.2.6 CORROSION TESTING RESULTS

The results of these analytical laboratory testing are presented in Appendix C of this report and are summarized below:

pH value and Resistivity Tests Results

Sample Location and Depth (Feet)	pH Value	Resistivity (uOhms)
B-4 @ 4' (Sandy Claystone)	8.4	410
B-8 @ 0-25' (Pierre Shale)	7.4	790

Water Soluble Sulfate Test Results

Sample Location and Depth (Feet)	Water Soluble Sulfates (percent)
B-4 @ 4' (Sandy Claystone)	0.129
B-8 @ 0-25' (Pierre Shale)	0.162

The concentrations of water-soluble sulfates measured on subsurface soils submitted for testing ranges from 0.129 to 0.162 percent. In accordance with ACI Building Code 318, the requirements for concrete exposed to sulfate – containing solutions are presented in following table.

Requirements For Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water soluble sulfate (SO_4) in soil, percent by weight	Cement Type
Negligible	0.00 to 0.10	------
Moderate	0.10 to 0.20	II, IP(MS), IS(MS), P(MS),I(PM)(MS), I(SM)(MS)
Severe	0.20 to 2.00	V
Very Severe	Over 2.00	V plus pozzolan

The concentration of water-soluble sulfates measured on subsurface soils submitted for testing represents a moderate degree of sulfate attack on concrete exposed to the native soils. As our experience in this type of geologic unit would indicate highly variable sulfate contents, we recommend a final geotechnical study include additional testing prior to recommending concrete type.

5 LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil conditions could vary between or beyond the points explored. If soil conditions are encountered during construction that differ from those described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, our recommendations should also be reviewed.

We recommend that a final geotechnical investigation be performed for this project once the final site selection has been performed, and the development/construction plans have been prepared to better refine the following conclusions and opinions and to provide "design-level" geotechnical recommendations. A "design-level" report would require additional borings and laboratory testing once the final site layout, final grading plans (cut and fill depths), type of building construction, and estimated building loads, etc., are known.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty, either express or implied, is made. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by Kleinfelder during the construction phase in order to evaluate compliance with our recommendations. Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the author of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference", as that latter term is used relative to contracts or other matters of law.

This report may be used only by the Client and only for the purposes stated within a reasonable time from its issuance, but in no event later than one (1) year from the date of the report.

Land or facility use, on and off-site conditions, regulations, or other factors may change over time, and additional work may be required with the passage of time. Based on the intended use of the report, Kleinfelder may recommend that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by Client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and Client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Kleinfelder has conducted subsurface exploration and provided recommendations for this project. We recommend that Kleinfelder be given the opportunity to provide final design for this project, if required. In the event Kleinfelder is not, at a minimum, retained to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted, we will assume no responsibility for misinterpretation of our recommendations.

We recommend that all earthwork during construction be monitored by a representative from Kleinfelder, including site preparation, installation of piles, and placement of structural fill and trench backfill. The purpose of these services would be to provide Kleinfelder the opportunity to observe the actual soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

APPENDIX A

Vicinity Map and Boring Location Plan

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Checked By:	B. Barreire	Drafted By:	J. Hunyadi
Project Number:	77810	Date:	January, 2007

Vicinity Map
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure

A-1

Topographic Map provided by ES&D. (December, 2006)

APPENDIX B

Boring Logs

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Custom Auger
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Solid Stem Auger
Hammer Type: Cathead

Date Started: 11/30/2006
Date Completed: 11/30/2006
Logged By: J. Hunyadi

Appx. Surface Elevation (ft): 6223.0
Surface Condition: Grass & Weeds, Snow

Elevation (feet)	Depth (feet)	DESCRIPTION	FIELD: Blow Counts per 6" Interval	FIELD: Sample Type	LABORATORY: USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
		2' Topsoil.										
	1											
	2	SANDY CLAYSTONE, light brown, slightly moist, hard, some ferric staining present.		SHELBY								
6220	3											
	4		17 27 32	SPT	CL			45	27	100	71	
	5											
	6											
	7											
6215	8											
	9		32 50/3	MCAL		121.8	14.9					
	10											
	11											
	12											
6210	13											
	14		22 50	SPT								
	15											
	16											
	17											
6205	18											
	19		50/5	MCAL		125.3	14.8					
	20	PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.										
	21											
	22											
6200	23											
	24											
	25											
	26											
	27											
6195	28											
	29		50/3	MCAL		131.2	13.6					
	30											
	31											
	32											
6190	33											
	34											
	35											

Boring terminated at approximately 29.5 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 11/30/2006.

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-1

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Spectrum Exploration
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Mud Rotary
Hammer Type: Automatic

Date Started: 1/4/2007
Date Completed: 1/4/2007
Logged By: J. Hunyadi

			DESCRIPTION	FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	Appx. Surface Elevation (ft): 6178.0 Surface Condition: Grass & Weeds, Snow	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
	1		SANDY CLAYSTONE, light brown to gray brown, slightly moist,weathered to medium hard. Vertical fractures present. Ferric staining in fractures.											
	2													
6175	3													
	4													
	5													
	6													
	7													
6170	8													
	9													
	10				6 7 8	SPT								
	11													
	12													
6165	13													
	14													
	15													
	16													
	17				17 16 14	SPT								
6160	18													
	19		PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile. Upper 18" slightly weathered.											
	20													
	21													
	22													
6155	23													
	24				50/4.5	SPT								
	25													
	26													
	27													
6150	28													
	29													
	30													
	31													
	32													
6145	33													
	34													
	35													

Boring terminated at approximately 24.5 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 1/4/2007.

CSPRINGS_GEO_ASTM 77810_GINT.GPJ jhunyadi@kleinfelder.com 1/18/2007

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-2

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Spectrum Exploration
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Mud Rotary
Hammer Type: Automatic
Date Started: 1/4/2007
Date Completed: 1/4/2007
Logged By: J. Hunyadi

Appx. Surface Elevation (ft): 6190.0
Surface Condition: Grass & Weeds, Snow

				FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
	1	▨	SANDY CLAYSTONE, light brown to gray brown, slightly moist, medium hard, some ferric staining present.											
	2	▨												
	3	▨												
	4	▨												
6185	5	▨		◣	11 12 14	SPT								
	6	▨												
	7	▨												
	8	▨												
	9	▨												
6180	10	▨												
	11	▨												
	12	▨												
	13	▨												
	14	▨												
6175	15	■	PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.	◣	18 23 38	SPT								
	16	■												
	17	■												
	18	■												
	19	■												
6170	20	■												
	21	■												
	22	■												
	23	■												
	24	■		◣	50/4	SPT								
6165	25													
	26													
	27													
	28													
	29													
6160	30													
	31													
	32													
	33													
	34													
6155	35													

Boring terminated at approximately 24.5 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 1/4/2007.

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING

B-3

Page 1 of 1

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Custom Auger
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Solid Stem Auger
Hammer Type: Cathead

Date Started: 11/30/2006
Date Completed: 11/30/2006
Logged By: J. Hunyadi

Appx. Surface Elevation (ft): 6215.0
Surface Condition: Grass & Weeds, Snow

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Sample Type	LABORATORY: USCS SYMBOL	LABORATORY: Dry Density (pcf)	LABORATORY: Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests
		░	2' Topsoil.											
	1													
	2	▓	SANDY CLAYSTONE, light brown, slightly moist, hard, some ferric staining present.	■	18 50/4	MCAL		117.5	19.1					
	3													
	4			◣	16 21 24	SPT								
6210	5													
	6													
	7													
	8													
	9			■	25 50/5	MCAL		111.9	18.5					
6205	10													
	11													
	12													
	13													
	14			◣	20 24 30	SPT								
6200	15													
	16													
	17													
	18													
	19	■	PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.	■	50/4	MCAL								
6195	20													
	21													
	22													
	23													
	24													
6190	25													
	26													
	27													
	28													
	29													
6185	30													
	31													
	32													
	33													
	34													
6180	35													

Boring terminated at approximately 19.5 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 11/30/2006.

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-4

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Custom Auger
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Solid Stem Auger
Hammer Type: Cathead
Date Started: 11/30/2006
Date Completed: 11/30/2006
Logged By: J. Hunyadi

Appx. Surface Elevation (ft): 6206.0
Surface Condition: Grass & Weeds, Snow

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	FIELD			LABORATORY							
				Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
			1' Topsoil.											
6205	1		SANDY CLAYSTONE, light brown, slightly moist, hard, some ferric staining present.											
	2				31 36	MCAL								
	3													
	4				25 35 50/5	SPT								
	5													
6200	6													
	7													
	8													
	9				29 50/4	MCAL		119.9	15.3					
	10													
6195	11													
	12													
	13		PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.											
	14				10 30 50/5	SPT								
	15													
6190	16													
	17													
	18													
	19				50/4	MCAL								
	20													
6185	21													
	22													
	23													
	24													
	25													
6180	26													
	27													
	28													
	29				50/5	SPT								
	30													
6175	31													
	32													
	33													
	34													
	35													

Boring terminated at approximately 29.5 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 11/30/2006.

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING B-5

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Spectrum Exploration
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 1/3/2007
Date Completed: 1/3/2007
Logged By: J. Hunyadi

Appx. Surface Elevation (ft): 6158.0
Surface Condition: Grass & Weeds, Snow

				FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
	1	▨	Sandy Lean CLAY (CL), light brown, moist, stiff.											
	2													
6155	3													
	4			◣	6 6 6	SPT								
	5													
	6	▓	SANDY CLAYSTONE, light brown, slightly moist to moist, weathered to medium hard, some ferric staining and gypsum present.											
	7													
6150	8													
	9			◣	6 6 7	SPT								
	10													
	11													
	12													
6145	13													
	14			◣	10 11 14	SPT								
	15													
	16													
	17													
6140	18	■	PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.											
	19			◣	50/2	SPT								
	20													
	21													
	22													
6135	23													
	24													
	25													
	26													
	27													
6130	28													
	29				50/1	SPT								
	30													
	31													
	32													
6125	33													
	34													
	35													

Boring terminated at approximately 29 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 1/3/2007.

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-6

CSPRINGS_GEO_ASTM 77810_GINT.GPJ jhunyadi@kleinfelder.com 1/18/2007

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Custom Auger
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Solid Stem Auger
Hammer Type: Cathead
Date Started: 11/30/2006
Date Completed: 11/30/2006
Logged By: J. Hunyadi

Appx. Surface Elevation (ft): 6226.0
Surface Condition: Grass & Weeds, Snow

				FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
			1' Topsoil.											
6225	1		SANDY CLAYSTONE, light brown, slightly moist, hard, some ferric staining present.											
	2													
	3				25 35	MCAL								
	4													
	5				16 18 24	SPT	CL			42	26		75	
6220	6													
	7													
	8													
	9													
	10				30 50	MCAL								
6215	11													
	12													
	13													
	14													
	15				14 20 24	SPT								
6210	16													
	17													
	18													
	19		PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.											
	20													
6205	21													
	22													
	23													
	24				50/4	MCAL		124	13.9					
	25													
6200	26													
	27													
	28													
	29													
	30													
6195	31													
	32													
	33													
	34				50/2	SPT								
	35													
6190	36													
	37													
	38													
	39													
	40													

Boring terminated at approximately 34 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 11/30/2006.

CSPRINGS_GEO_ASTM 77810_GINT.GPJ jhunyadi@kleinfelder.com 1/18/2007

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-7

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Custom Auger
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Solid Stem Auger
Hammer Type: Calhead

Date Started: 11/30/2006
Date Completed: 11/30/2006
Logged By: J. Hunyadi

				FIELD			LABORATORY							
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6239.0 Surface Condition: Grass & Weeds, Snow	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
			1' Topsoil.											
	1		PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.											
	2				50/6	MCAL								
	3													
6235	4				34 50	SPT								
	5						CL			47	30	99	76	
	6													
	7													
	8													
6230	9				50/3	MCAL								
	10													
	11													
	12													
	13													
6225	14				50/3	SPT								
	15													
	16													
	17													
	18													
6220	19													
	20													
	21													
	22													
	23													
6215	24				50/2	MCAL								
	25													
	26													
	27													
	28													
6210	29													
	30													
	31													
	32													
	33													
6205	34													
	35													

Boring terminated at approximately 24 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 11/30/2006.

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-8

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Custom Auger
Equipment: CME-55
Auger Diameter (in): 3"
Drilling Method: Solid Stem Auger
Hammer Type: Cathead

Date Started: 11/30/2006
Date Completed: 11/30/2006
Logged By: J. Hunyadi

Appx. Surface Elevation (ft): 6206.0
Surface Condition: Grass & Weeds, Snow

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	FIELD Sample Interval	FIELD Blow Counts per 6" interval	FIELD Sample Type	LABORATORY USCS SYMBOL	LABORATORY Dry Density (pcf)	LABORATORY Moisture Content (%)	LABORATORY Liquid Limit	LABORATORY Plasticity Index	LABORATORY Passing #4 Sieve (%)	LABORATORY Passing #200 Sieve (%)	LABORATORY Other Tests
			1' Topsoil.											
6205	1		SANDY CLAYSTONE, light brown, slightly moist, hard, some ferric staining present.											
	2				10 11 16	SPT								
	3													
	4				14 28	MCAL		107.1	20.3					
	5													
6200	6													
	7													
	8													
	9				12 17 30	SPT								
	10													
6195	11		PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.											
	12													
	13													
	14				50/3	MCAL								
	15													
6190	16													
	17													
	18													
	19				50/3	SPT								
	20													
6185	21													
	22													
	23													
	24													
	25													
6180	26													
	27													
	28													
	29				50/3	MCAL								
	30													
6175	31													
	32													
	33													
	34													
	35													

Boring terminated at approximately 29.5 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 11/30/2006.

KLEINFELDER

Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-9

Location: See Boring Location Plan
Groundwater (ft): None at Drilling
Drilling Company: Spectrum Exploration Equipment: CME-55
Auger Diameter (in): 3" Drilling Method: Solid Stem Auger
Hammer Type: Automatic

Date Started: 1/3/2007
Date Completed: 1/3/2007
Logged By: J. Hunyadi

				FIELD			LABORATORY								
Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION Appx. Surface Elevation (ft): 6194.0 Surface Condition: Grass & Weeds, Snow	Sample Interval	Blow Counts per 6" Interval	Sample Type	USCS SYMBOL	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests
		░	1' Topsoil.											
	1	▓	SANDY CLAYSTONE, light brown, slightly moist, hard, some ferric staining present.											
	2	▓												
	3	▓												
6190	4	▓		◣	20 20 18	SPT								
	5	▓												
	6	▓												
	7	▓												
	8	▓												
6185	9	▓		◣	20 20 20	SPT								
	10	▓												
	11	▓												
	12	▓												
	13	▓												
6180	14	▓		◣	31 40 50/4	SPT								
	15	▓												
	16	▓												
	17	▓												
	18	▓												
6175	19	▓		◣	28 25 32	SPT								
	20	▓												
	21	▓												
	22	▓												
	23	▓												
6170	24	▓												
	25	▓												
	26	█	PIERRE SHALE BEDROCK, dark gray, dry to slightly moist, very hard, fissile.											
	27	█												
	28	█												
6165	29	█		◣	50/4	SPT								
	30													
	31													
	32													
	33													
6160	34													
	35													

Boring terminated at approximately 29.5 feet below ground surface.
Groundwater was not encountered during drilling.
Boring was backfilled with auger cuttings on 1/3/2007.

KLEINFELDER

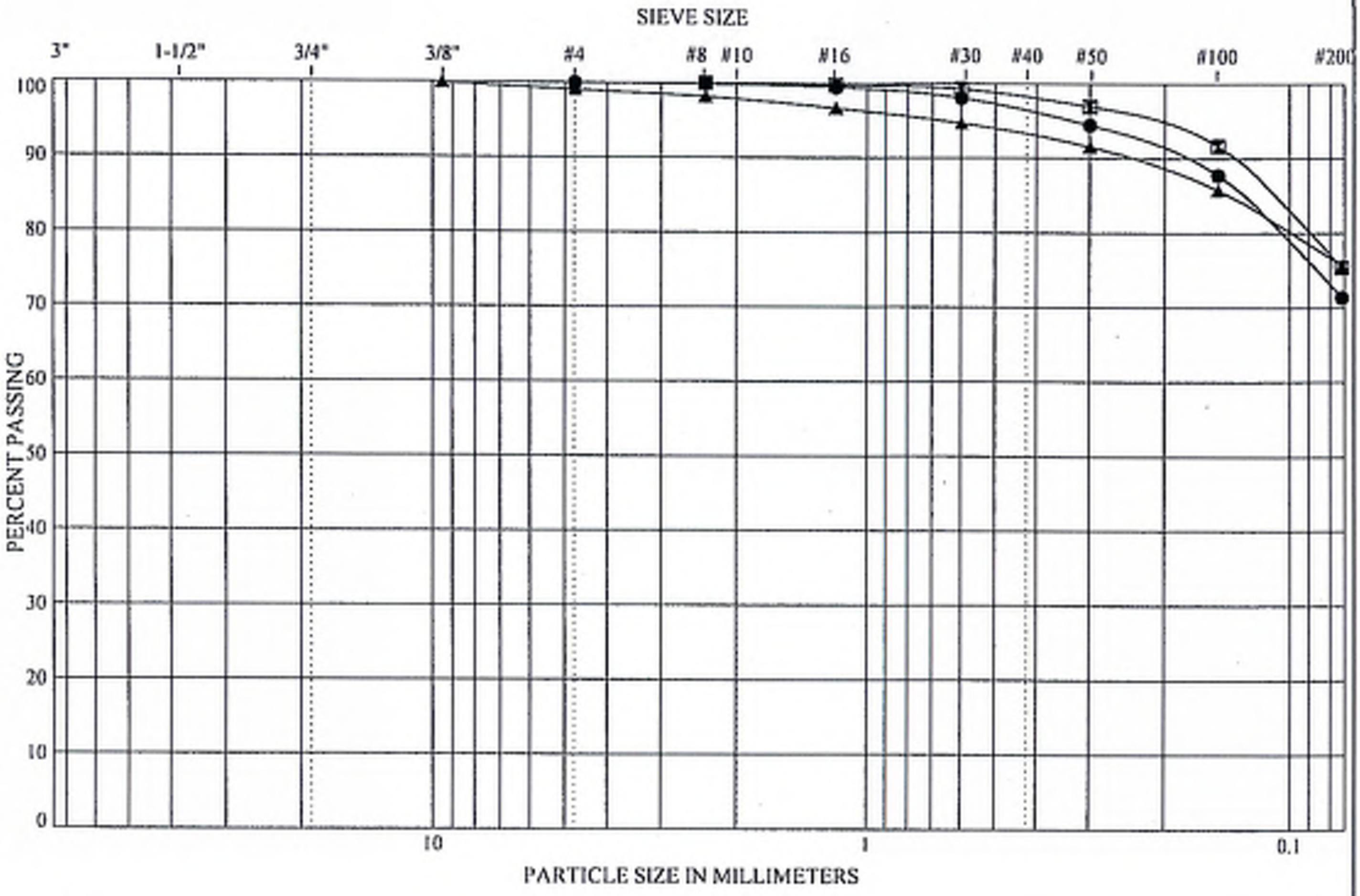
Drafted By: J. Hunyadi
Date: January, 2007
Project Number: 77810

BORING LOG
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

BORING
B-10

APPENDIX C

Laboratory Test Results



GRAVEL		SAND		
Coarse	Fine	Coarse	Medium	Fine

LEGEND	SOURCE	DEPTH (ft)	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)	DESCRIPTION
●	B-1	4.0	0.0	28.6	71.4	45	27	SANDY CLAYSTONE (CL)
⊠	B-7	4.0	0.0	24.6	75.4	42	26	SANDY CLAYSTONE (CL)
▲	B-8	4.0	0.9	23.4	75.7	47	30	PIERRE SHALE BEDROCK (CL)

CSPLABSIEVE_ASTM 77810_GINT.GPJ [hunyadi@kleinfelder.com 12/27/2006

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Drafted By: J. Hunyadi

Date: December, 2006

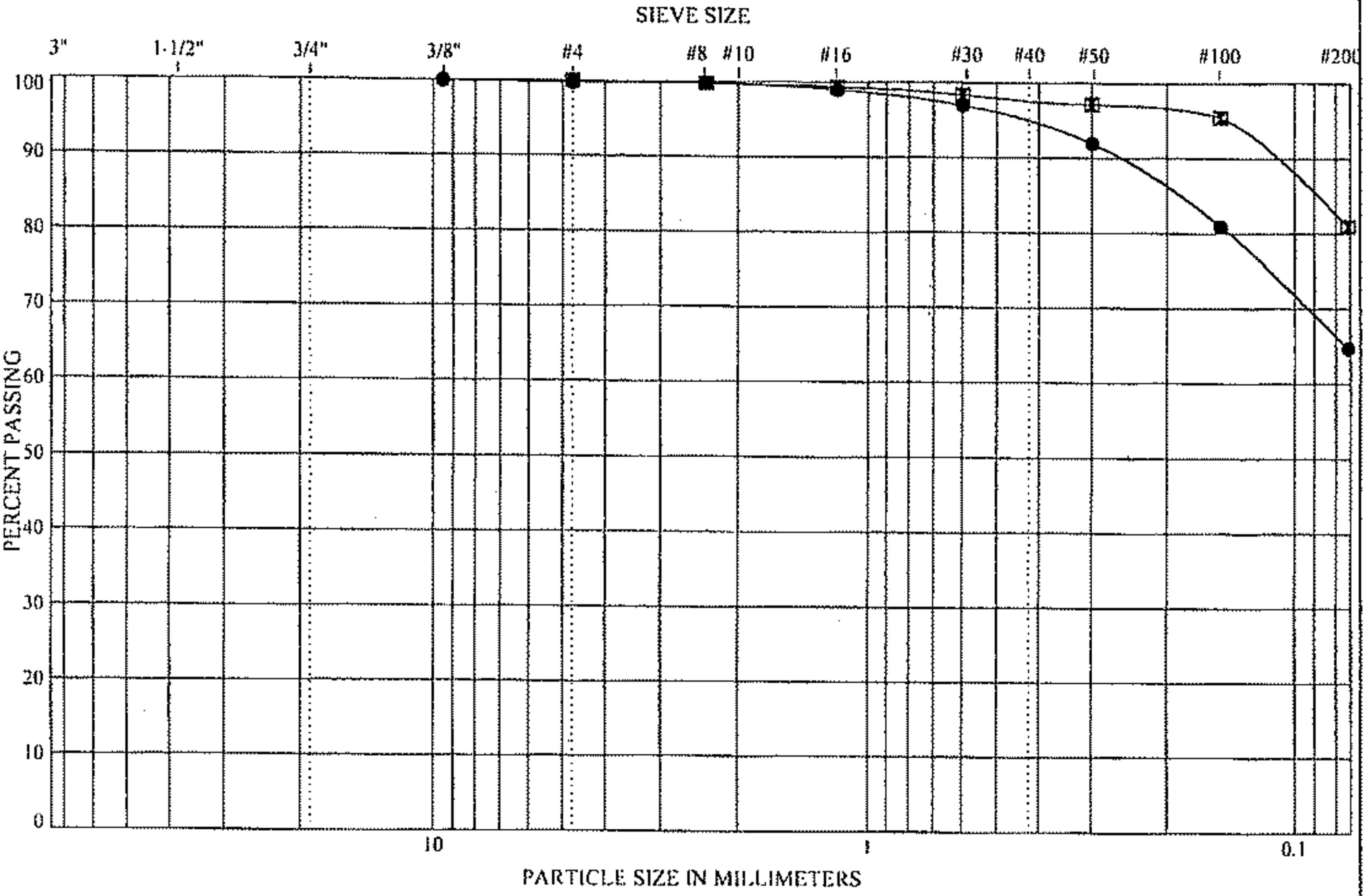
Project Number: 77810

SIEVE ANALYSIS & ATTERBERG LIMITS

Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure

C-1



GRAVEL		SAND		
Coarse	Fine	Coarse	Medium	Fine

LEGEND	SOURCE	DEPTH (ft)	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)	DESCRIPTION
●	B-1 & B-5 COMBINED	10.0	0.2	35.1	64.7	47	32	SANDY CLAYSTONE (CL)
☒	B-1 & B-8 & B-9 COMBINED	20.0	0.0	19.0	81.0	50	35	PIERRE SHALE BEDROCK (CL)

Note: Additional testing performed on these samples included maxium laboratory density (Proctor) and Permeability Testing.

CSPLABSIEVE_ASTM 77810_GINT.GPJ jbunyadi@kleinfelder.com 1/18/2007

KLEINFELDER

Drafted By:

Date: January, 2007

Project Number: 77810

SIEVE ANALYSIS & ATTERBERG LIMITS

Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure

C-2

COMPACTION TEST REPORT

Project No.:

Date: 12/1/06

Project: Mesa Valley Springs

Location: Bulk - B-1 & B-5 Combined

Elev./Depth: Avg. 10'

Sample No. 6193

Remarks:

MATERIAL DESCRIPTION

Description: Sandy Claystone (Processed)

Classifications - **USCS:** CL **AASHTO:**

Nat. Moist. =

Sp.G. =

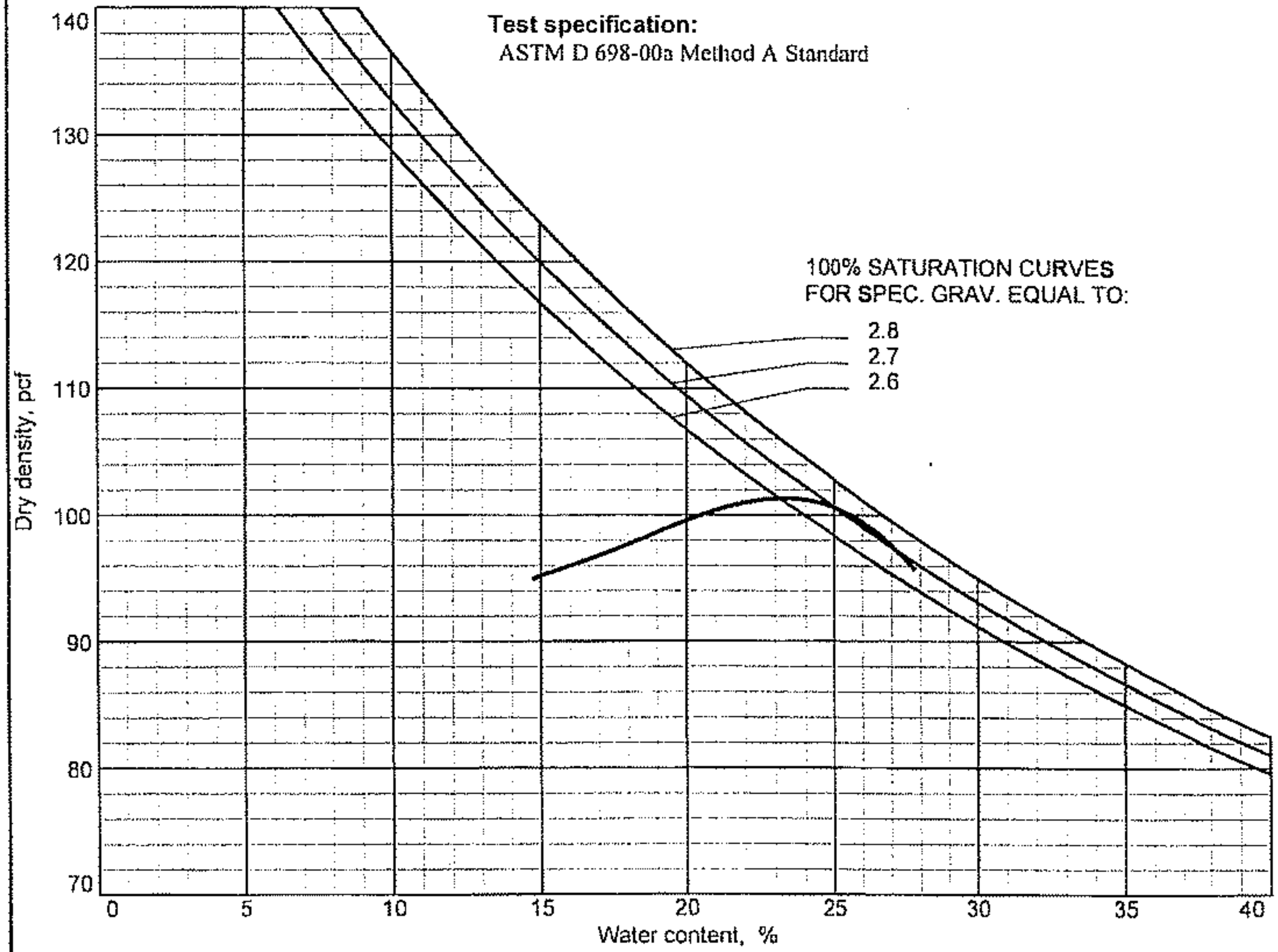
Liquid Limit = 47

Plasticity Index = 32

% > No.4 = 0.2 %

% < No.200 = 64.7 %

TEST RESULTS
Maximum dry density = 101.3 pcf
Optimum moisture = 23.3 %



C-3

COMPACTION TEST REPORT

Curve No.: 6193

Project No.: 77810
Date: 12/4/06
Project: Mesa Valley Springs

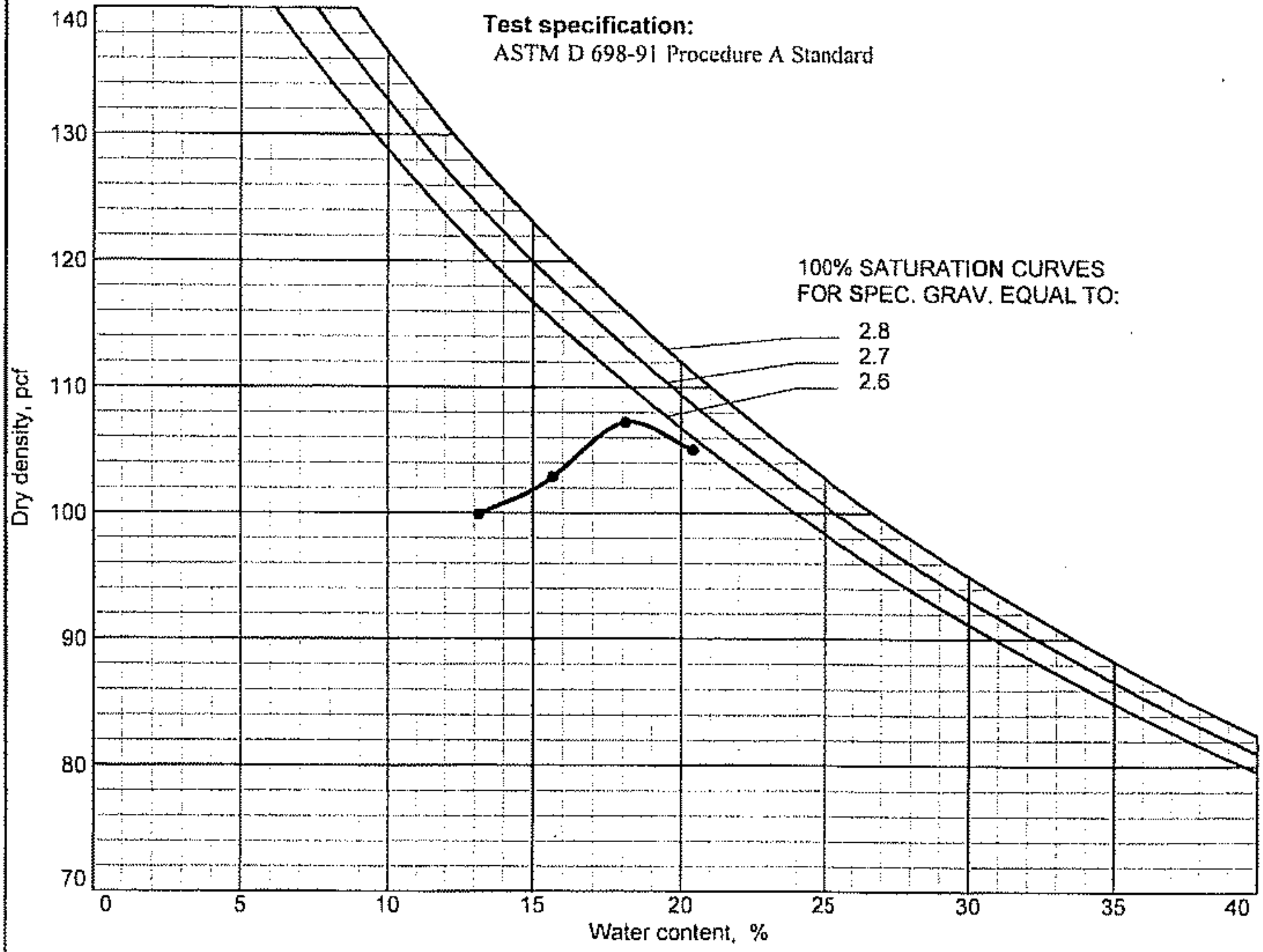
Location: B-1, B-8, B-9 Combined
Elev./Depth: Avg. 20'
Sample No. 6193
Remarks:

MATERIAL DESCRIPTION

Description: Pierre Shale Bedrock (Processed)

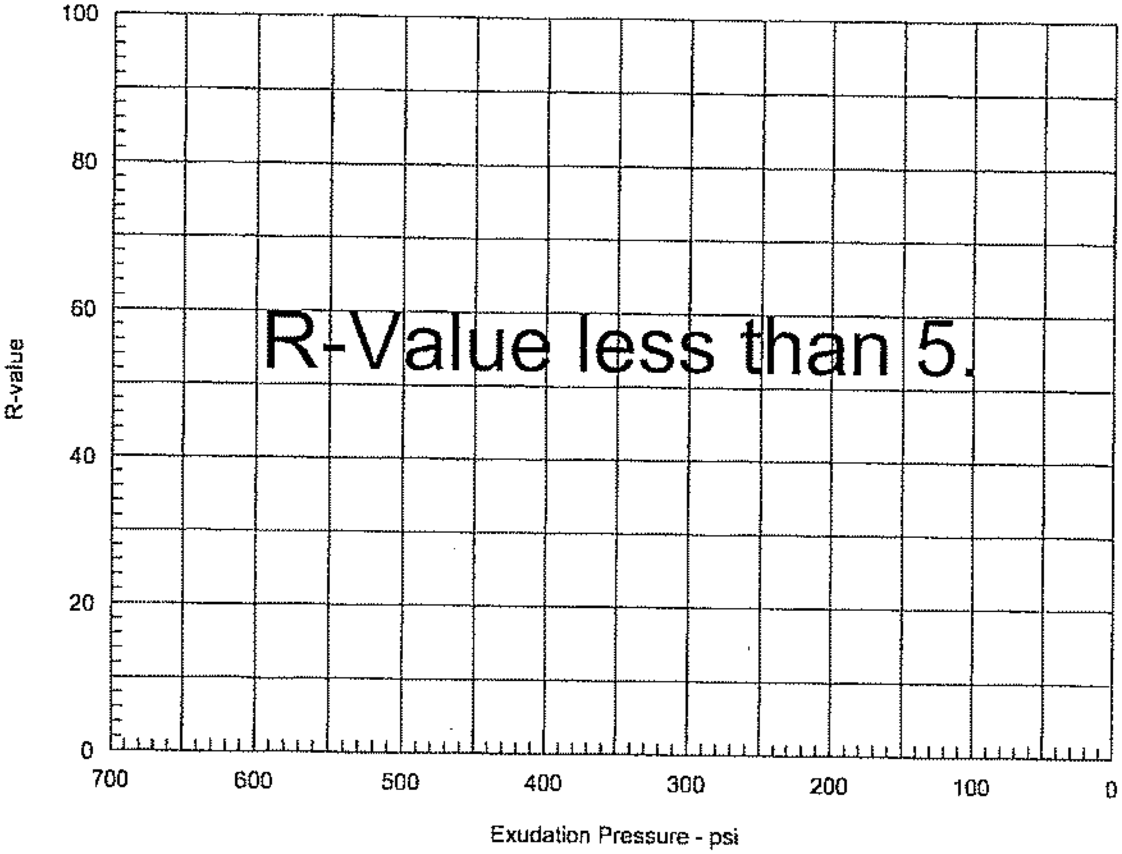
Classifications - **USCS:** CL **AASHTO:**
Nat. Moist. =
Sp.G. =
Liquid Limit = 50
Plasticity Index = 35
% > No.4 = 0.0 %
% < No.200 = 81.0 %

TEST RESULTS
Maximum dry density = 107.3 pcf
Optimum moisture = 18.3 %



Test specification:
ASTM D 698-91 Procedure A Standard

R-VALUE TEST REPORT



R-Value less than 5.

Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1									
2									
3									

Test Results	Material Description
R-value at 300 psi exudation pressure = n/a	

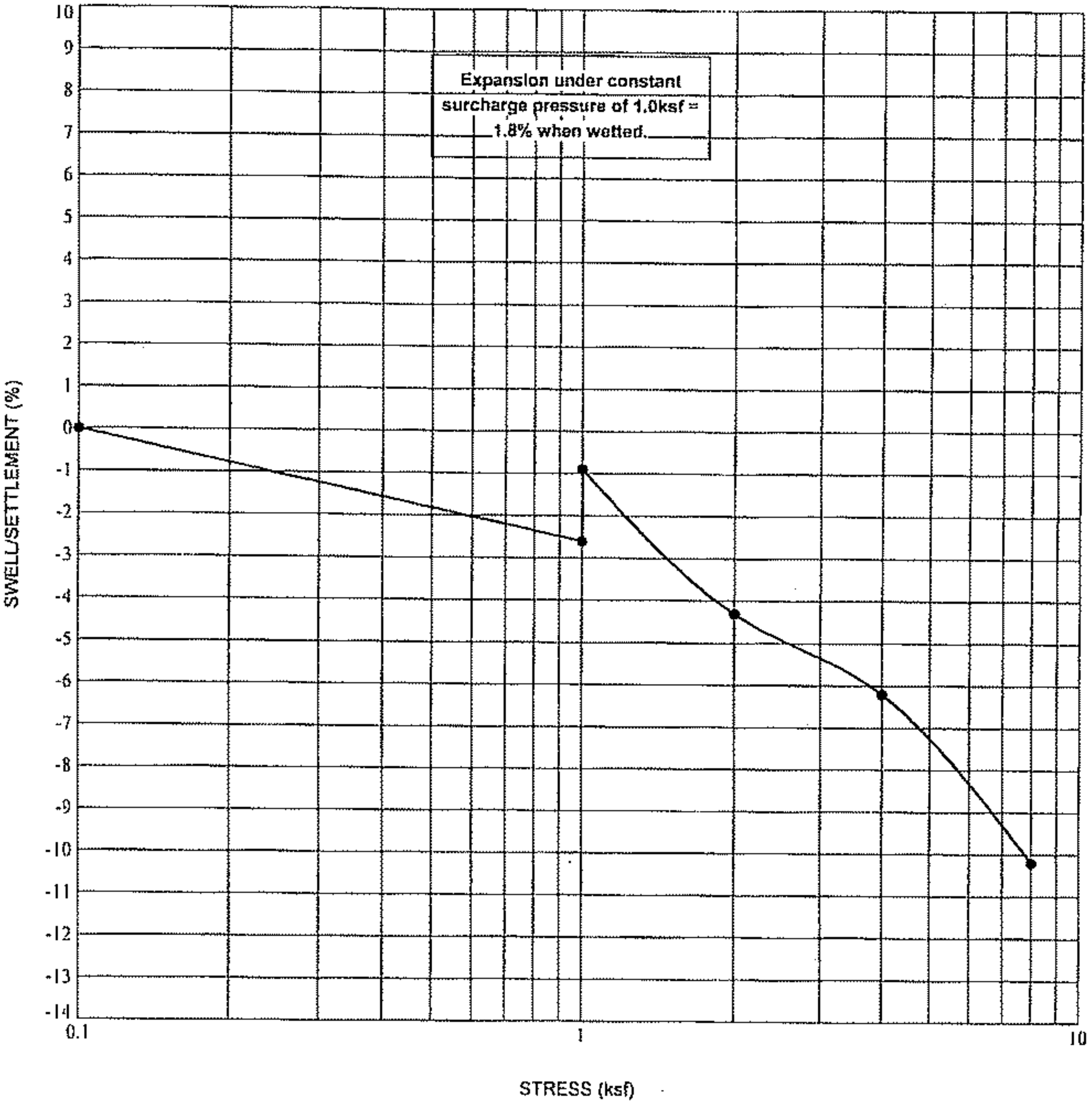
Location: Bulk B-1 & B-5 Combined
Depth:

KLEINFELDER
An employee owned company

Checked By: J. Hunyadi | Drafted By: S. Hyskell
Project Number: 77810 | Date: 1/15/07

R-VALUE TEST REPORT
Mesa Valley Springs Property
Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure
C-5



SOURCE: B-1

At a depth of approximately 9.0 feet

Total Unit Weight (pcf) = 139.9

Moisture Content (%) = 14.9

Dry Unit Weight (pcf) = 121.8

T.GPJ jhunyadi@kleinfelder.com 12/27/2006

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Drafted By: J. Hunyadi

Date: December, 2006

Project Number: 77810

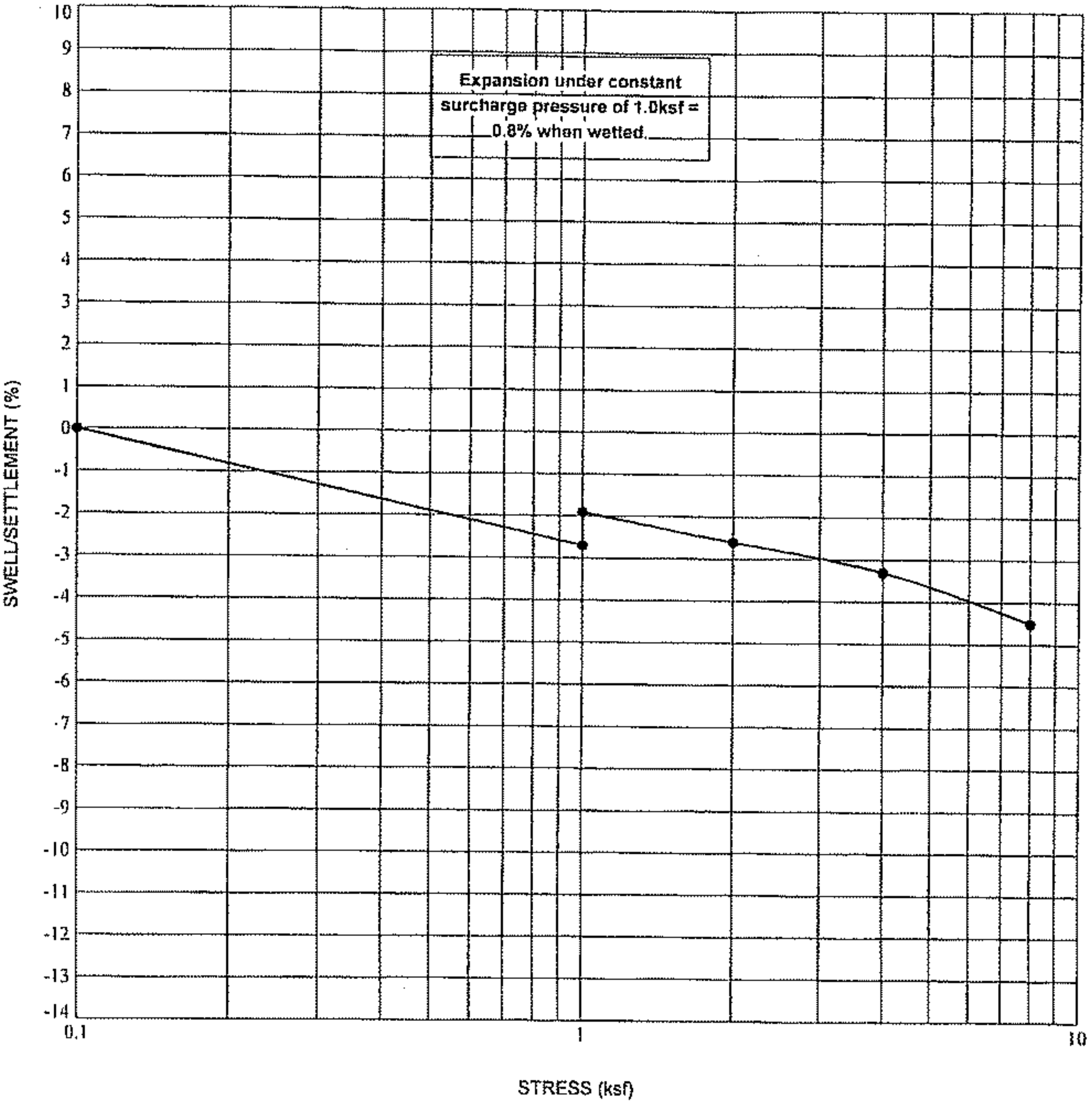
SWELL/SETTLEMENT

Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure

C-6



SOURCE: B-1		Total Unit Weight (pcf) =	143.8
At a depth of approximately 19.0 feet		Moisture Content (%) =	14.8
		Dry Unit Weight (pcf) =	125.3

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Date: December, 2006

Project Number: 77810

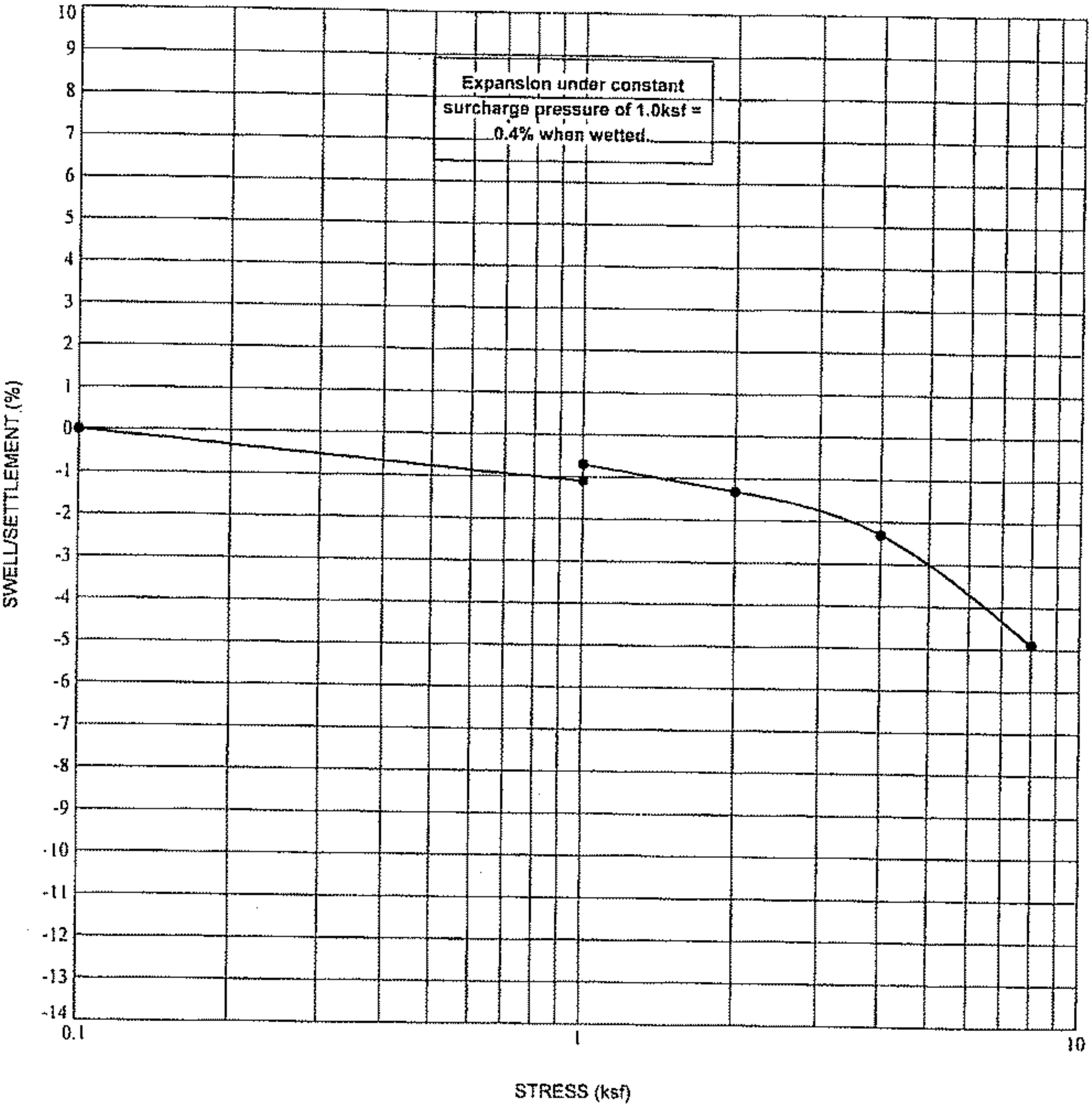
SWELL/SETTLEMENT

Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure

C-7



SOURCE: B-1

At a depth of approximately 29.0 feet

Total Unit Weight (pcf) =	149.0
Moisture Content (%) =	13.6
Dry Unit Weight (pcf) =	131.2

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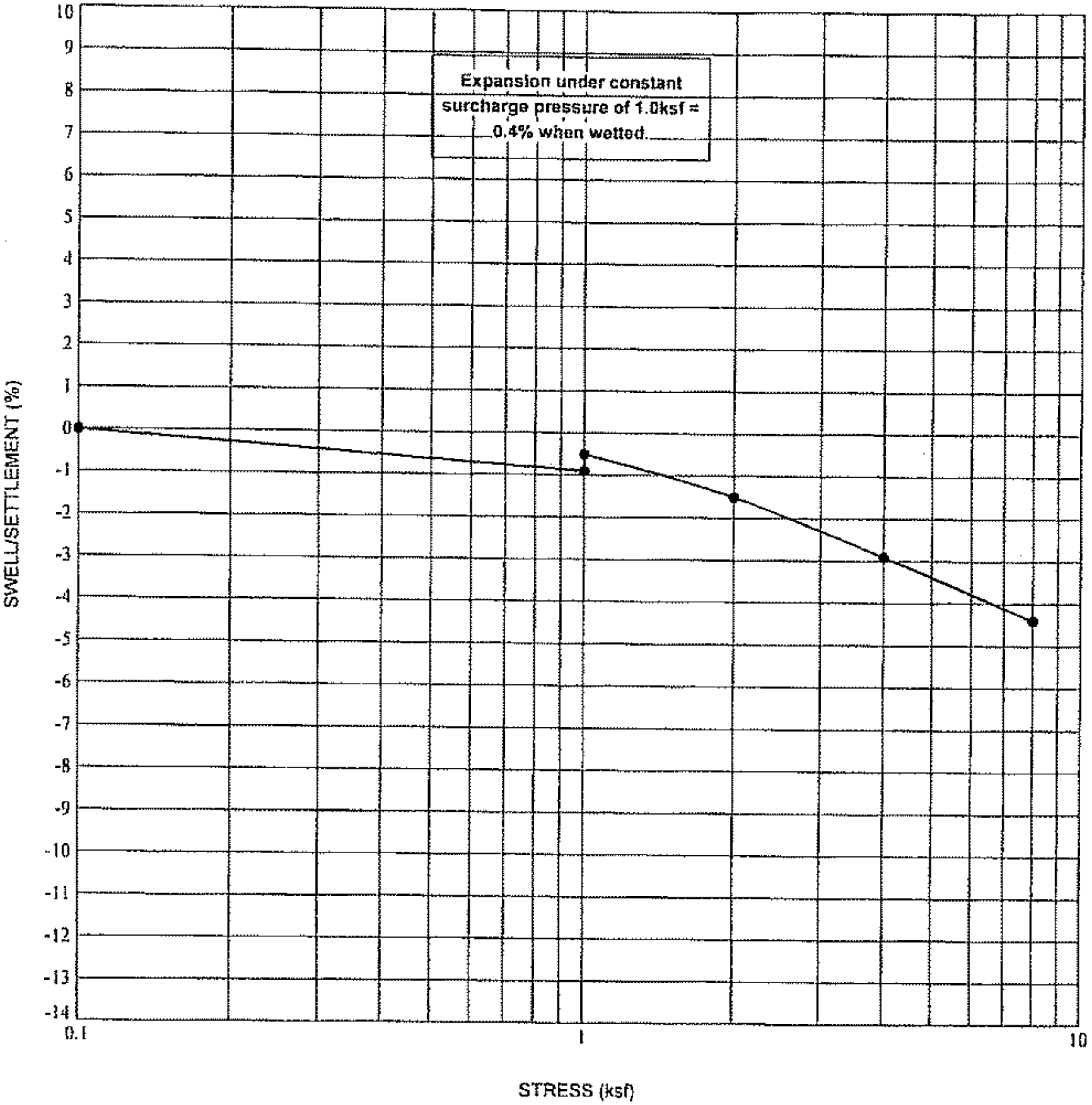
Drafted By: J. Hunyadi
Date: December, 2006

Project Number:
77810

SWELL/SETTLEMENT
Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure
C-8



SOURCE: B-4

At a depth of approximately 2.0 feet

Total Unit Weight (pcf) =	139.9
Moisture Content (%) =	19.1
Dry Unit Weight (pcf) =	117.5

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Drafted By: J. Hunyadi
Date: December, 2006

Project Number: 77810

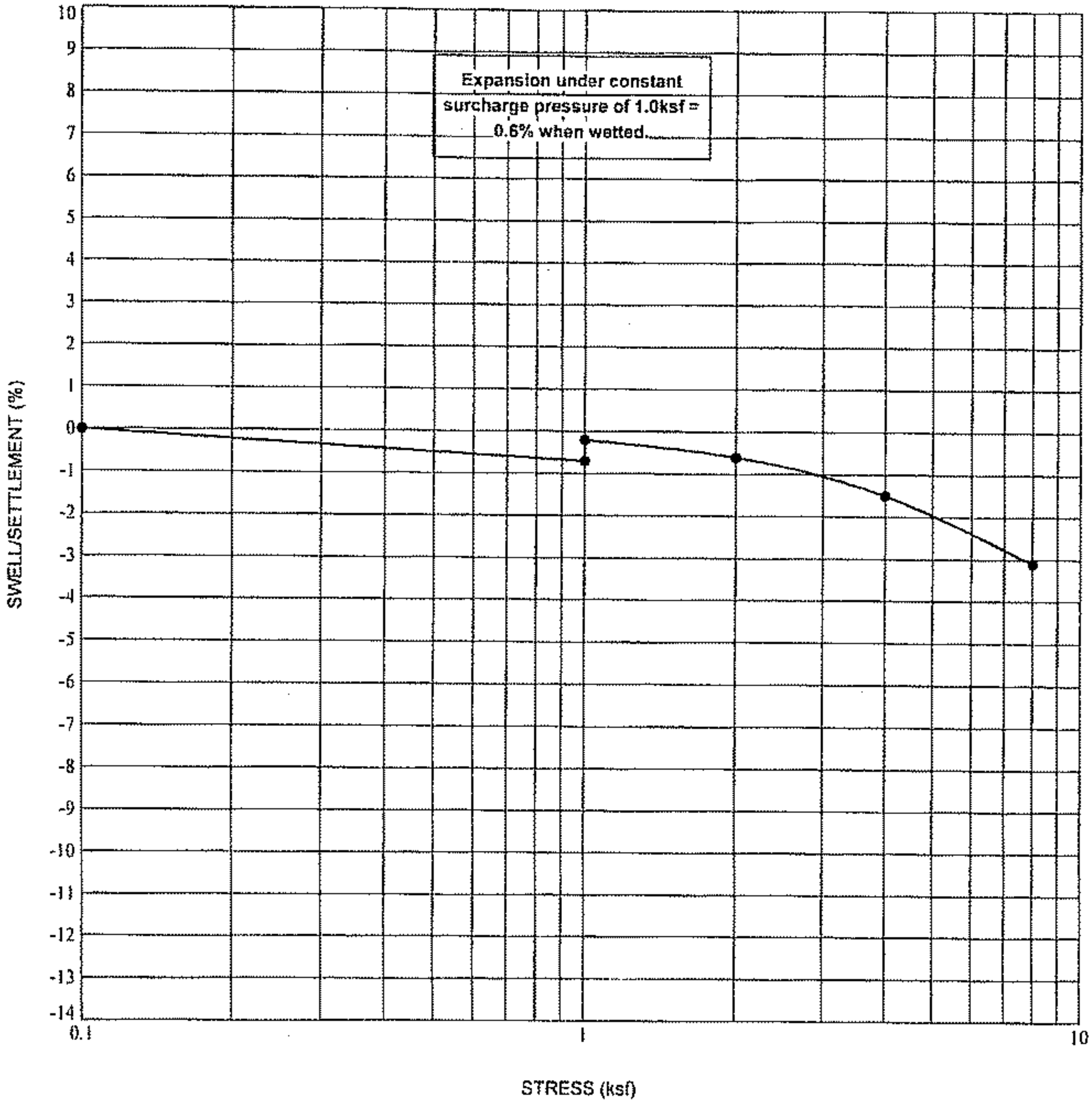
SWELL/SETTLEMENT

Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure

C-9



SOURCE: B-4

At a depth of approximately 9.0 feet

Total Unit Weight (pcf) =	133.7
Moisture Content (%) =	19.5
Dry Unit Weight (pcf) =	111.9

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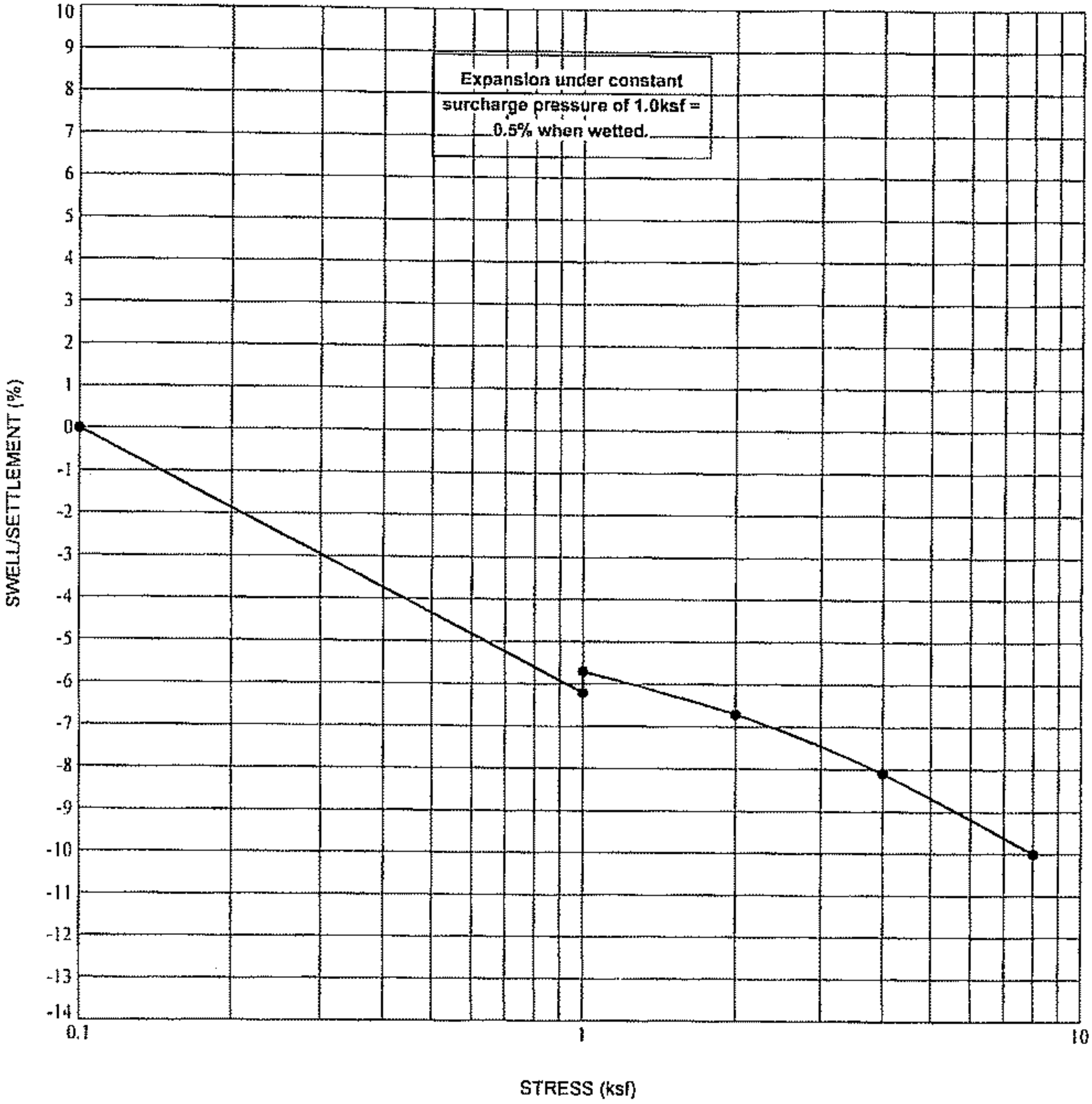
Date: December, 2006
Project Number: 77810

SWELL/SETTLEMENT

Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure C-10



SOURCE: B-5

At a depth of approximately 9.0 feet

Total Unit Weight (pcf) =	138.2
Moisture Content (%) =	15.3
Dry Unit Weight (pcf) =	119.9

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SWELL/SETTLEMENT

Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

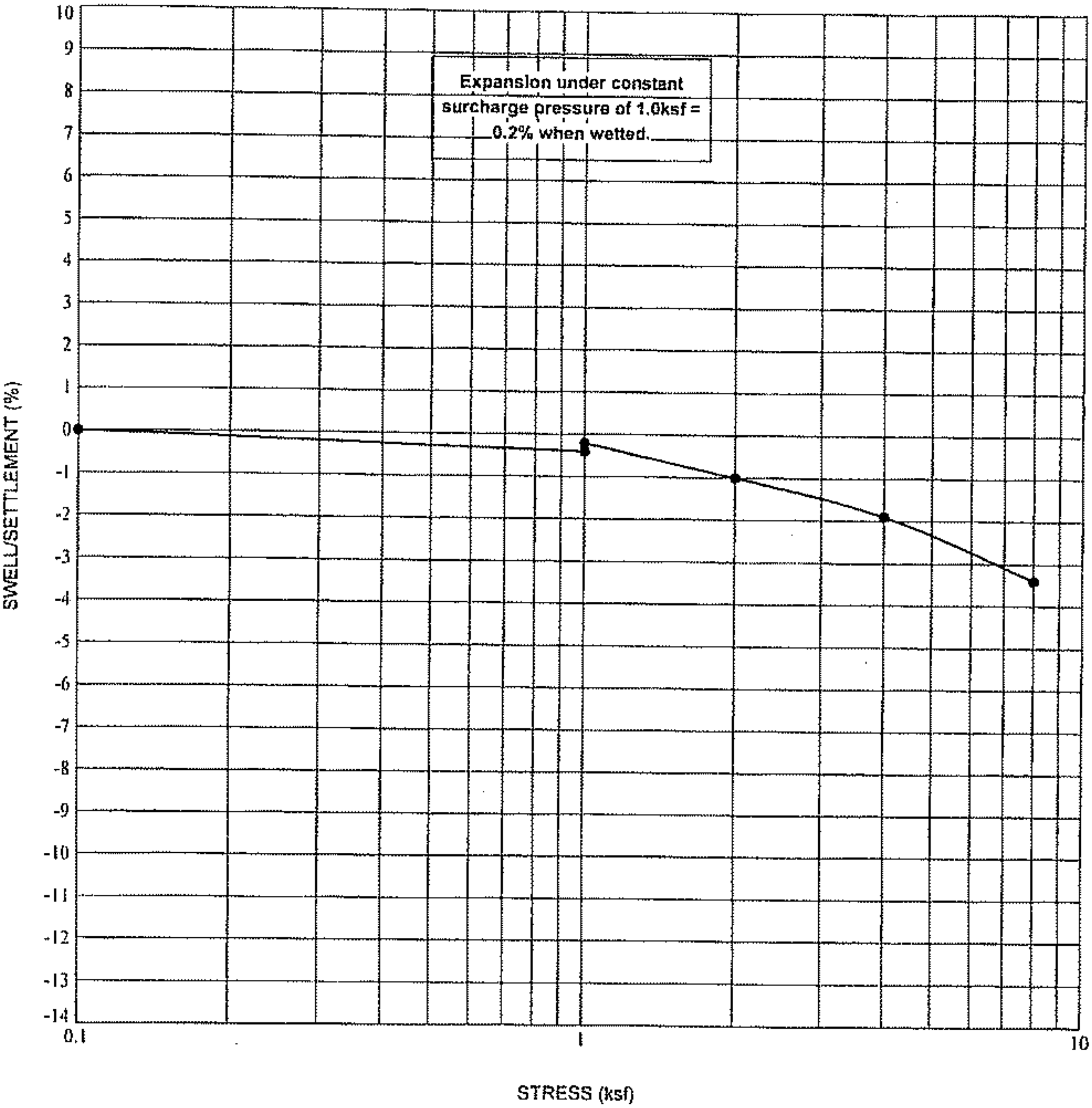
Figure

C-11

Drafted By: J. Hunyadi

Date: December, 2006

Project Number: 77810



SOURCE: B-7

At a depth of approximately 24.0 leet

Total Unil Weight (pcf) = 141.2

Moisture Content (%) = 13.9

Dry Unit Weight (pcf) = 124.0

T.GPJ jhunyadi@kleinfelder.com 12/27/2006

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Date: December, 2006

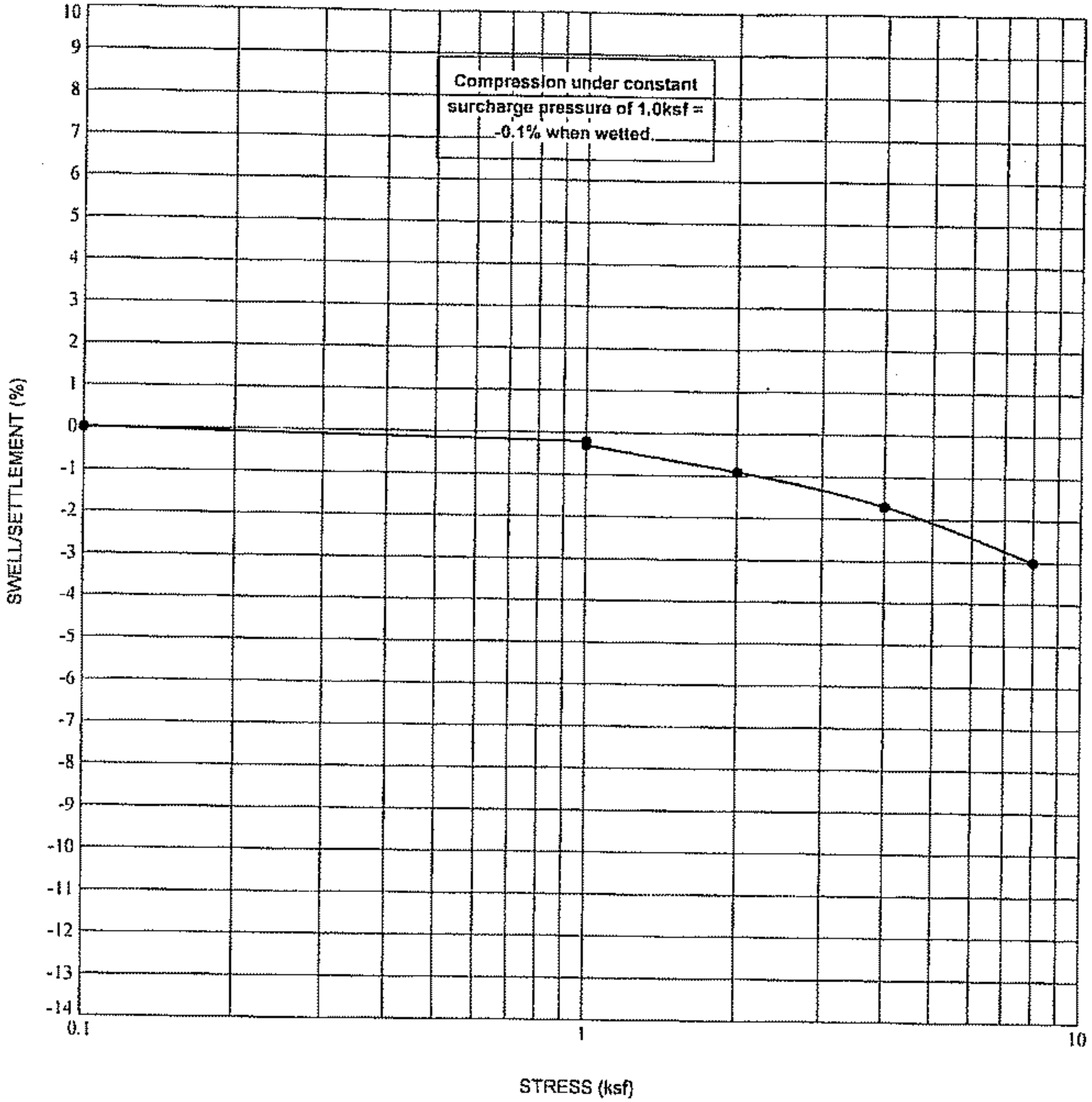
Project Number: 77810

SWELL/SETTLEMENT
Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure

C-12



SOURCE: B-9

At a depth of approximately 4.0 feet

Total Unit Weight (pcf) = 128.8

Moisture Content (%) = 20.3

Dry Unit Weight (pcf) = 107.1

ZCONSOLID 77B T.GPJ jhunyadi@kleinfelder.com 12/27/2006

KLEINFELDER

Drafted By: J. Hunyadi

Date: December, 2006

Project Number: 77810

SWELL/SETTLEMENT

Mesa Valley Springs Property

Existing Landfill West of W. Van Buren St.
Colorado Springs, Colorado

Figure
C-13

TestAmerica
ANALYTICAL TESTING CORPORATION

1110 Elkton Drive, Suite A
Colorado Springs, CO 80907
(719) 593-9595
FAX (719) 593-9911
www.testamericainc.com

13 December, 2006

John Hunyadi
Kleinfelder - C/S
4815 List Drive, Unit 115
Colorado Springs, CO 80919

RE: n/a
Work Order: A612012

Enclosed are the results of analyses for samples received by the laboratory on 12/04/06 15:34. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Tom Fowler
QA Manager/Lab Director

CA ELAP Certificate # 2000

Kleinfelder - C/S
4815 List Drive, Unit 115
Colorado Springs CO, 80919

Project: n/a
Project Number: 77810
Project Manager: John Hunyadi

A612012
Reported:
12/13/06 12:43

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
B4@4'	A612012-01	Soil	12/04/06 00:00	12/04/06 15:34
B8 Combined	A612012-02	Soil	12/04/06 00:00	12/04/06 15:34

Kleinfelder - C/S
4815 List Drive, Unit 115
Colorado Springs CO, 80919

Project: n/a
Project Number: 77810
Project Manager: John Hunyadi

A612012
Reported:
12/13/06 12:43

Wet Chem Preparation

TestAmerica - Colorado Springs

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
B4@4' (A612012-01) Soil Sampled: 12/04/06 00:00 Received: 12/04/06 15:34									
pH	8.4	0.0	pH Units	1	AL60405	12/04/06 13:44	12/04/06	EPA 9045B	
Resistivity	410	0.0	uOhms	"	AL60406	12/04/06 16:03	12/04/06	EPA 9045C	
B8 Combined (A612012-02) Soil Sampled: 12/04/06 00:00 Received: 12/04/06 15:34									
pH	7.4	0.0	pH Units	1	AL60405	12/04/06 13:44	12/04/06	EPA 9045B	
Resistivity	790	0.0	uOhms	"	AL60406	12/04/06 16:03	12/04/06	EPA 9045C	

Kleinfelder - C/S	Project: n/a	A612012
4815 List Drive, Unit 115	Project Number: 77810	Reported:
Colorado Springs CO, 80919	Project Manager: John Hunyadi	12/13/06 12:43

General Chemistry Parameters

TestAmerica - Nashville, TN

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
B4@4' (A612012-01) Soil Sampled: 12/04/06 00:00 Received: 12/04/06 15:34									
Sulfate	1290	200	mg/kg	20	6121424	12/09/06	12/11/06	SW846 9056	
B8 Combined (A612012-02) Soil Sampled: 12/04/06 00:00 Received: 12/04/06 15:34									
Sulfate	1620	200	mg/kg	20	6121424	12/09/06	12/11/06	SW846 9056	

Kleinfelder - C/S 4815 List Drive, Unit 115 Colorado Springs CO, 80919	Project: n/a Project Number: 77810 Project Manager: John Hunyadi	A612012 Reported: 12/13/06 12:43

Wet Chem Preparation - Quality Control

TestAmerica - Colorado Springs

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch AL60405 - Wet Chem preparation / EPA 9045B										
Duplicate (AL60405-DUP1)	**Source: A612011-01**			**Prepared & Analyzed: 12/04/06**						
pH	8.30	0.0	pH Units		8.3			0	20	
Batch AL60406 - Wet Chem preparation / EPA 9045C										
Duplicate (AL60406-DUP1)	**Source: A612012-02**			**Prepared & Analyzed: 12/04/06**						
Resistivity	810	0.0	uOhms		790			2	20	

Kleinfelder - C/S
4815 List Drive, Unit 115
Colorado Springs CO, 80919

Project: n/a
Project Number: 77810
Project Manager: John Hunyadi

A612012
Reported:
12/13/06 12:43

General Chemistry Parameters - Quality Control

TestAmerica - Nashville, TN

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6121424 - METHOD PREP / SW846 9056										
Blank (6121424-BLK1)				Prepared: 12/09/06 Analyzed: 12/10/06						
Sulfate	ND	10.0	mg/kg							
Laboratory Control Sample (6121424-BS1)				Prepared: 12/09/06 Analyzed: 12/10/06						
Sulfate	151	10.0	mg/kg	150		101	90-110			
Duplicate (6121424-DUP1)	Source: NPL1130-01			Prepared: 12/09/06 Analyzed: 12/10/06						
Sulfate	27.9	10.0	mg/kg		22.1			23	20	R2
Matrix Spike (6121424-MS1)	Source: NPL0718-01			Prepared: 12/09/06 Analyzed: 12/10/06						
Sulfate	288	10.0	mg/kg	150	164	83	80-120			
Matrix Spike Dup (6121424-MSD1)	Source: NPL0718-01			Prepared: 12/09/06 Analyzed: 12/10/06						
Sulfate	248	10.0	mg/kg	150	164	56	80-120	15	20	M2

Notes and Definitions

R2	The RPD exceeded the acceptance limit.
M2	The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit or MDL, if MDL is specified
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Appendix F

Assessment Report
Mesa Valley Landfill
Investigation
2018

KLEINFELDER
Bright People. Right Solutions.

August 23, 2018
Kleinfelder Project No.: 20191069.001A/CSP18L83172

Mr. Jack Chappelle, P.E.
Engineering Solutions & Design, Inc.
51 Corporate Woods
9393 West 110th Street, Suite 500
Overland Park, Kansas 66210
mailto:jack@esdworks.com

SUBJECT: Assessment Report
Mesa Valley Landfill Investigation 2018
Colorado Springs, Colorado

Dear Mr. Chappelle:

This letter presents the results of our geotechnical and environmental investigation performed for the existing Mesa Valley Landfill, southwest of the intersection of Centennial Drive and West Van Buren Street in Colorado Springs, Colorado.

Purpose and Scope

The purpose of our geotechnical study was to further explore and evaluate the subsurface conditions at the existing landfill. To meet the intended purpose, we completed the following scope:

- Review of selected geologic and geotechnical data
- Preliminary site visit to locate the borings and assess access
- Notification of Utility Notification Center of Colorado (CO 811)
- Subsurface exploration consisting of the surveying, drilling and logging of 19 borings to bedrock or a maximum depth of 50 feet
- Installation of 7 gas monitoring wells
- Installation of 3 groundwater monitoring wells and associated permitting
- Gas monitoring and collection of groundwater samples
- Groundwater and methane laboratory testing
- Report preparation

Our services excluded collection of geotechnical soil or bedrock samples, geotechnical laboratory testing, and groundwater monitoring well abandonment.

Field Investigation

Our field exploration program was performed using track-mounted and all-terrain drilling rigs equipped with 4-inch solid continuous flight augers. The approximate boring locations are shown in Figure 1. Actual surveyed boring coordinates are attached. Samples were collected at regular intervals using standard penetration test (SPT) samplers. As directed, no soil samples were removed from the site for laboratory testing. The exploration was directed by a qualified representative of the geotechnical engineer who logged the subsurface profile. Upon completion of drilling, borings not used for groundwater or gas monitoring were backfilled with grout.

At 7 boring locations, temporary 1-inch PVC wells were installed in the 4-inch diameter boreholes at a depth of 15 feet for the purpose of landfill gas monitoring. The methane wells were constructed with 10 feet of 0.010-inch slotted screen and sufficient riser to reach approximately 2 feet above the ground surface to allow for future sampling. The slotted screen was surrounded with 10/20 silica sand to two feet above the screen. Bentonite was placed in the annular seal from the top of the filter pack to the ground surface.

Three groundwater monitoring wells were constructed using factory cleaned 2-inch diameter, PVC well casing with 20 feet of 0.010-inch slotted screen and sufficient riser to reach the ground surface. The slotted screen PVC pipe was surrounded with 10/20 silica sand. A 2- to 3-foot bentonite annular seal was placed at the top the filter pack. Grout was placed atop the bentonite annular seal to the ground surface. The State of Colorado groundwater well permit and construction logs are attached.

Boring logs, including well construction details, are attached.

Subsurface Conditions

A summary of the subsurface conditions encountered at the exploration locations is presented in the following table.

Boring ID	Boring Depth (feet)	Depth of Cover (feet)	Depth to Bedrock (feet)	Well Type	Groundwater Depth (feet)[1]
B-16	41.5	20	41	Methane	27
B-17	45.5	20	45	none	35
B-18	46.5	15	45	Methane	28
B-19	46.5	20	45	none	20
B-20	26.5	15	36	Methane	19
B-21	16.5	**	10	none	NGWE
B-22	11	**	3	none	NGWE
B-23	21.5	5	14	Methane	NGWE
B-24	11.5	**	5	none	NGWE
B-25	21.5	10	17	none	NGWE
B-26	11.5	**	5	Methane	NGWE
B-27	21.5	**	5	none	NGWE
B-28	11.5	**	5	none	NGWE
B-29	11.5	**	5	Methane	NGWE
B-30	21	**	5	none	NGWE
B-31	36.5	**	10	Methane	NGWE
B-32	31	5	30	none	NGWE
GW-1	46.5	35	45	Groundwater	31 (18.86)
GW-2	51.5	5	45	Groundwater	23 (18.52)
GW-3	36.5	5	35	Groundwater	29 (19.87)

Notes: ** No debris encountered to maximum depth of boring

1. At completion of drilling, (7/25/18)

NGWE = no groundwater encountered

Groundwater and Methane Sampling and Testing

On July 25, 2018, Kleinfelder collected measurement of methane (CH_4), hydrogen sulfide (H_2S) and oxygen (O_2) using a 4-gas monitor at the seven methane wells installed on the site. Methane and depressed oxygen levels were detected in wells B20 and B23; therefore, air samples were collected from the wells and submitted to an accredited laboratory for methane analysis. Analytical results show methane concentrations of 82.4% by volume in the sample collected from B20 and 0.399% by volume in the sample collected from B23.

Depth to groundwater was measured and groundwater samples collected approximately one week following drilling. Three casing volumes were removed from each well and general water-quality parameters (e.g., temperature, pH, and electrical conductivity) were collected and documented. A groundwater sample was collected from each well and sent to ACZ Laboratories, Inc. in Steamboat Springs, Colorado under standard chain of custody procedures. The groundwater samples were analyzed for the following constituents:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium-dissolved
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium-dissolved
- Manganese-dissolved
- Nickel
- Potassium-dissolved
- Selenium
- Silver
- Sodium-dissolved
- Thallium
- Vanadium
- Zinc

The results of the groundwater laboratory testing are attached.

LIMITATIONS

Limited assessments such as this are non-comprehensive by nature and will not identify all environmental problems or eliminate all risk, associated with environmental issues. The scope of services on this project was presented in our proposal and subsequently approved by our client. Please be aware our scope of services was limited to those items specifically identified in the proposal. Environmental issues not specifically addressed in the proposal or this report are beyond the scope of our services and not included in this evaluation.

Although risk can never be eliminated, more detailed and extensive investigations yield more information, which may help you understand and better manage your risks. Since such detailed services involve greater expense, we ask our clients to participate in identifying the level of service that will provide them with an acceptable level of risk. Please contact the signatories of this report if you would like to discuss this issue of risk further.

Land use, site conditions (both on-site and off-site) and other factors will change over time. Since site activities and regulations beyond our control could change at any time after the completion of this report, our observations, findings and opinions can be considered valid only as of the date of this report.

The property owner is solely responsible for notifying all governmental agencies, and the public at large, of the existence, release, treatment or disposal of any hazardous materials or conditions detected at the project site. Kleinfelder assumes no responsibility or liability whatsoever for any claim, loss of property value, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

If you have any questions regarding this letter or need additional information, please do not hesitate to call our office at 303.327.6601.

Respectfully submitted,

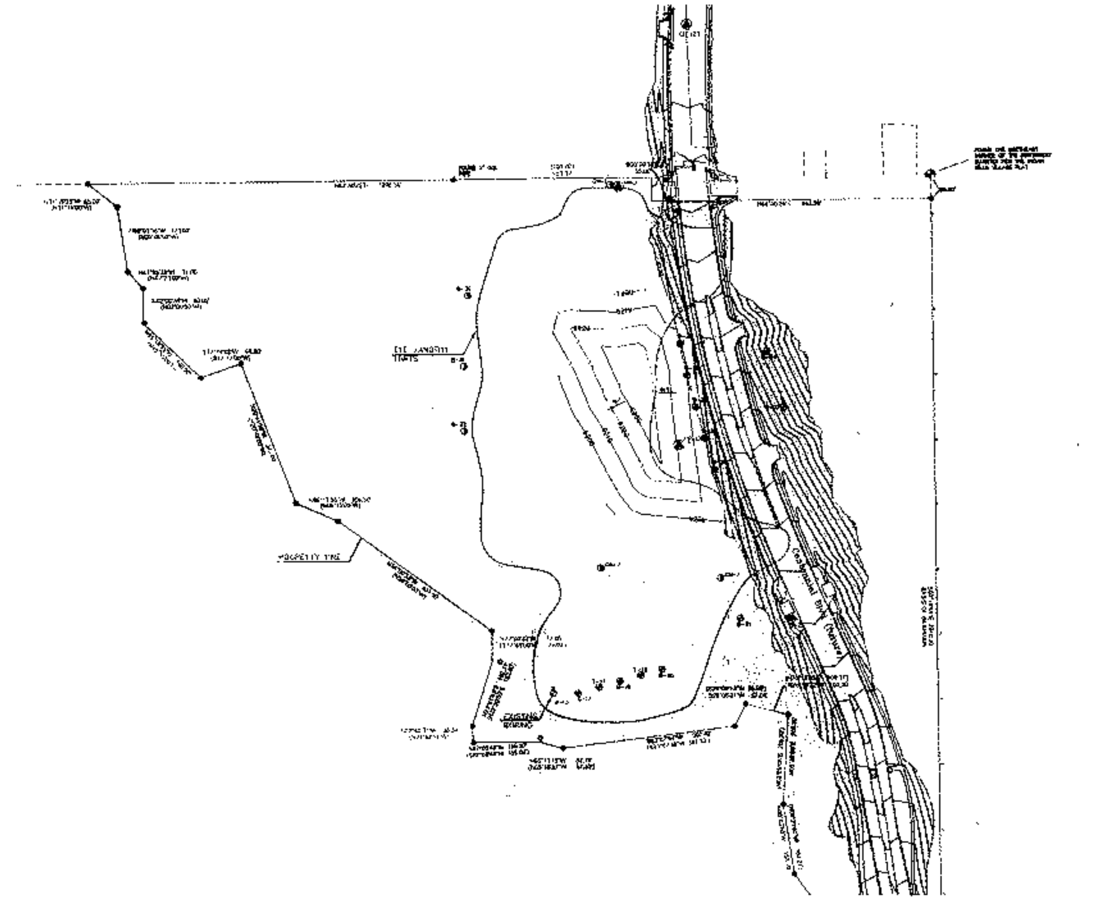
KLEINFELDER, INC.

J. Kevin White, PE
Principal Professional

Brad A. Woodard, CPG
Senior Project Manager

Attachments:

Figure 1, New Boring Locations
Boring Coordinates
Groundwater Well Permit
Boring and Well Construction Logs
Methane Test Results
Groundwater Test Results



1. BORINGS TO BE A MINIMUM OF 20 FEET DEEP OR TO BEDROCK

2. THE GROUNDWATER WELLS ARE TO INCLUDE A [illegible] [illegible] [illegible] [illegible] [illegible] ADJACENT TO THE WELL AND [illegible] [illegible] [illegible] WATER.

3. THE DRILLER IS TO NOTE DEPTH OF EACH [illegible] MATERIAL ENCOUNTERED, LOCATION OF ANY [illegible], THICKNESS OF THE MATERIAL AND ELEVATIONS OF THE TOP OF THE [illegible];

4. EACH BORING LOCATION MAY BE [illegible] IN THE FIELD WITH A STAKE OR OTHER MARKER THAT CANNOT BE EASILY REMOVED

- BORING
- GROUNDWATER WELL
- CONTROL POINT

CONTROL POINTS

NO.	NORTHING	EASTING	ELEVATION
CP-122	378243.463	186318.654	6236.67
CP-125	376291.663	186295.787	1180.66
PP-7	377637.461	186152.606	6223.04

BORING COORDINATES

NO.	NORTHING	EASTING
B-11	376660.67	186068.53
B-17	376703.34	186108.42
B-18	376917.02	186164.01
B-19	376753.60	186202.60
B-20	376744.37	186250.70
B-21	376802.16	186430.64
B-22	376606.60	186550.23
B-23	377405.15	186294.22
B-24	377471.36	186462.01
B-25	377421.76	186505.86
B-26	377340.07	186525.00
B-27	377348.64	186530.23
B-28	377274.78	186346.77
B-29	377204.37	186372.66
B-30	377601.36	187806.02
B-31	377442.96	187785.80
B-32	377285.11	187791.19

GROUNDWATER WELL COORDINATES

NO.	NORTHING	EASTING
GW-1	377687.41	186052.61
GW-2	376978.22	186117.21
GW-3	376865.33	186303.43

NOTE: THE COORDINATE SYSTEM IS BASED ON THE [illegible] COORDINATES FOR THE CENTENNIAL BLVD DESIGN

REV. NO. | DATE | REVISIONS

DESIGNED BY JPC
DRAWN BY JPC
CHECKED BY JPC
APPROVED BY JPC
DATE
FILE

Engineering Solutions & Design, Inc.

ESD

ENGINEER'S STAMP

MVS Development, LLC
Greenwood Village, Colorado

Meso Valley Springs Property

NEW BORING LOCATIONS AND
GROUNDWATER WELLS

PROJECT/FILE NO.

SHEET NO.
1

Div. 2

RECEIVED
JUL 09 2018
WATER RESOURCES
STATE ENGINEER
COLO

GWS-51
02/2017

NOTICE OF INTENT TO CONSTRUCT MONITORING HOLE(S)

Please type or print legibly in black or blue ink or file online, dwrpermitsonline@state.co.us

State of Colorado, Office of the State Engineer 1313 Sherman St, Room 821,
Denver, CO 80203 Phone 303-866-3581 www.water.state.co.us

Well Owner Name(s): MVS Development, LLC

Address: P. O. Box 27560, Albuquerque, NM 87125

Phone: (505) 553-4218

Email: waterman@watermaninc.net

Landowner's Name: MVS Development LLC

Please check one and complete as indicated including contact info:

☐ Water Well Driller Licensed in Colorado - Lic. No. ______

☑ Professional Engineer Registered in Colorado - Reg. No. 50163

☐ Professional Geologist per C.R.S. 23-41-208(b)

☐ Other — anyone directly employed by or under the supervision of a licensed driller, registered professional engineer or professional geologist

Contact / Company Kleinfelder

Address 4815 List Drive, 115

City, State & Zip Colorado Springs

Phone (720) 660-5825

Email jkwhite@kleinfelder.com

Print Name: Kevin White

Signature or enter full name here: Kevin White

Location: Section 51

Township 14 ☐N ☒S, Range 67 ☐E ☒W, ______ PM

County: El Paso

Subdivision: ______

Lot: ______ Block: ______ Filing: ______

Site/Property Address SW of Centennial Blvd and Van Buren Street, Colorado Spring, CO

GPS Location in UTM format if known:

Set GPS unit to true north, datum NAD83, and use meters for the distance units, ☐Zone 12 or ☐Zone 13.

Easting 38.86764444 Northing -104.843214

# of Monitoring Holes to be constructed in Section: 3

Estimated Depth 50 Ft., Aquifer 30

Purpose of Monitoring Hole(s) groundwater samping, level

Anticipated Date of Construction: 07/12/2018

Date Notice Submitted: 07/09/2018
(Must be at least 3 days prior to construction)

ACKNOWLEDGEMENT FROM STATE ENGINEER'S OFFICE

FOR OFFICE USE ONLY

58184 - MH

PROCESSED BY KF

DIV. 2 WD 10 BAS ______ MD ______

DATE ACKNOWLEDGED 7/9/18

CONDITIONS OF MONITORING HOLE ACKNOWLEDGEMENT

A COPY OF THE WRITTEN NOTICE OR ACKNOWLEDGEMENT SHALL BE AVAILABLE AT THE DRILLING SITE.

1) Notice was provided to the State Engineer at least 72 hours prior to construction of monitoring & observation hole(s).

2) Construction of the hole(s) must be completed within 90 days of the date notice was given to the State Engineer. Testing and/or pumping shall not exceed a total of 200 hours unless prior written approval is obtained from the State Engineer. Water diverted during testing must not be used for beneficial purposes. The owner of the hole(s) is responsible for obtaining permit(s) and complying with all rules and regulations pertaining to the discharge of fluids produced during testing.

3) All work must comply with the Water Well Construction Rules, 2 CCR 402-2. Standard permit application and work report forms are found on the DWR website at http://www.water.state.co.us. Well Construction and Yield Estimate Reports (GWS-31) must be completed for each hole drilled. The licensed contractor or authorized individual must submit the completed forms to this office within 60 days of monitoring hole completion. Aquifer testing information must be submitted on Well Yield Test Report (GWS-39).

4) Unless a well permit is obtained or variance approved, the hole(s) must be plugged and sealed within eighteen (18) months after construction. An Abandonment Report (GWS-09) must be submitted within 60 days of plugging & sealing. The above MH acknowledgement number, owner's structure name, and owner's name and address must be provided on all well permit application(s), well construction and abandonment reports.

5) A MONITORING HOLE CANNOT BE CONVERTED TO A PRODUCTION WATER WELL, except for purposes of remediation (recovery) or as a permanent dewatering system, if constructed in accordance with the Water Well Construction Rules and policies of the State Engineer.

6) IF HOLES WILL NOT BE CONSTRUCTED UNDER THIS NOTICE WITHIN 90 DAYS, PLEASE WRITE "NO HOLES CONSTRUCTED" ON A COPY OF THE ACKNOWLEDGED NOTICE WITH THE FILE NUMBER AND EMAIL TO THE DIVISION OF WATER RESOURCES AT DWRpermitsonline@state.co.us.

THIS ACKNOWLEDGEMENT OF NOTICE DOES NOT INDICATE THAT WELL PERMIT(S) CAN BE APPROVED.

Incomplete forms or Notice provided less than 72 hours prior to well construction will not be acknowledged

BORING LOG B-16

Date Begin - End: 7/11/2018
Logged By: J. Brown
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 82°F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: N. McVay
Drilling Equipment: CME-750
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

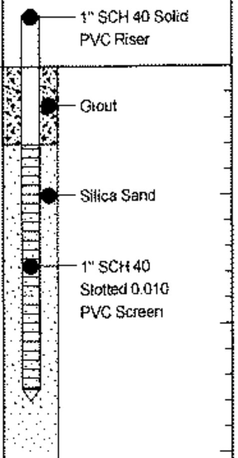
FIELD EXPLORATION

Northing: 376689.6740
Easting: 188058.3470
Surveyed Ground Surface Elevation (ft.): 6,166.73
Surface Condition: Thick grasses, weeds, and shrubs

Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6165			**FILL** **Silty SAND**: fine sand, non-plastic, brown, moist, loose, no significant topsoil, no debris										
			FILL **Clayey SAND**: fine sand, medium plasticity, brown, moist, stiff, no debris										
	5				BC=6 6 8	12"							
6160													
			FILL **Lean CLAY**: medium plasticity, dark brown, slight odor, moist, stiff, no debris										
	10				BC=4 3 5	18"							
6155													
	15				BC=2 2 3								
6150													
	20		- trace glass		BC=4 5 8	14"							
6145			- black										
	25				BC=2 1 4	12"							
61▽0													
	30		- with debris (charred wood) to 10-20% by volume, odor		BC=3 4 8	18"							
6135													
	35				BC=3 5 3	12"							
6130													
	40				BC=6 13 50/6"	15"							
			CLAYSTONE: grey, moderately weathered, weak										
6125													
	45												
6120													

LABORATORY RESULTS

METHANE MONITORING WELL CONSTRUCTION*



The boring was terminated at approximately 41.5 ft. below ground surface. *Monitoring Well installed to a depth of 15'.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 27 ft. below ground surface during drilling.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED:

BORING LOG B-16

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING

B-16

Date Begin - End: 7/11/2018
Drilling Company: Vine Laboratories, Inc.
BORING LOG B-17
Logged By: J. Brown
Drill Crew: N. McVay
Hor.-Vert. Datum: Not Available
Drilling Equipment: CME-750
Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees
Drilling Method: Solid Stem Auger
Weather: Partly Cloudy
Exploration Diameter: 4 in. O.D.

FIELD EXPLORATION

Northing: 376712.0340
Easting: 188104.6560
Surveyed Ground Surface Elevation (ft.): 6,166.45
Surface Condition: Thick grasses, weeds, and shrubs

LABORATORY RESULTS

Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
6165		▨	**FILL** **Silty SAND**: fine sand, low plasticity, reddish brown, no odor, moist, loose, no significant organics (topsoil), no debris											
6160	5	▨	- with clay, trace fine gravel	◣	BC=6 5 6	11"								
6155	10	▨	**FILL** **SAND with Clay**: coarse sand, trace fine gravel, medium plasticity, brown, no odor, moist, medium dense, no debris	◣	BC=4 5 6	11"								
6150	15	▨	- loose below 15 feet	◣	BC=3 4 4	8"								
6145	20	▨	**FILL** **Lean CLAY**: medium plasticity, black, no odor, moist, stiff, trace debris (glass and charred wood)	◣	BC=2 4 7	18"								
6140	25	▨	- with debris (wood, plastic) 15-25% by volume, no odor	◣	BC=3 4 3	11"								
6135	30	▨	- very stiff	◣	BC=5 7 11	18"								
6130	▽▼ 35	▨		◣	BC=15 13 11	8"								
6125	40	▨		◣	BC=18 23 32	18"								
6120	45	▨		◣	BC=50/6"									
6115	50													

The boring was terminated at approximately 45.5 ft. below ground surface. The boring was backfilled with grout on July 11, 2018.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 35 ft. below ground surface during drilling.
▼ Groundwater was observed at approximately 35 ft. below ground surface at the end of drilling.
GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED:

BORING LOG B-17

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-17

BORING LOG B-18

Date Begin - End: 7/12/2018
Logged By: B. Lykins
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 75° F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-750
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

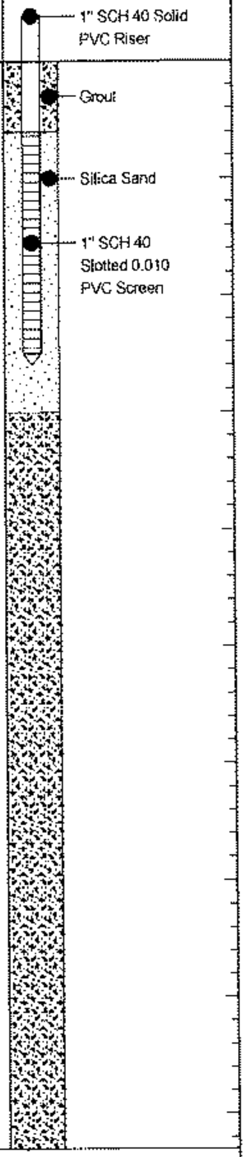
FIELD EXPLORATION

Northing: 376739.1400
Easting: 188142.3570
Surveyed Ground Surface Elevation (ft.): 6,167.09
Surface Condition: Thick glasses, weeds, and shrubs

Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6165			<u>FILL</u> **Silty SAND**: non-plastic, brown, moist, loose, significant organics (topsoil) to 4", no debris										
6160	5		<u>FILL</u> **Lean CLAY**: with medium-grained sand, medium plasticity, reddish brown, moist, medium stiff, no debris	◣	BC=3 5 4								
6155	10			◣	BC=4 5 7								
6150	15		- with trace coarse gravel (<5% by volume) below 15 feet	◣	BC=2 3 6								
6145	20			◣	BC=2 3 6								
6140 ▽	25		- with debris (wire bits, glass shards, wood chips, paper, brick fragments) <20% by volume, odor	◣	BC=3 6 5								
6135	30			◣	BC=1 2 2								
6130	35			◣	BC=3 5 6								
6125	40			◣	BC=6 10 12								
6120	45		**SHALE**: dark grey, moderately weathered, weak	◣	BC=4 23 50/6"								
6115	50												

LABORATORY RESULTS

METHANE MONITORING WELL CONSTRUCTION*



The boring was terminated at approximately 46.5 ft. below ground surface. *Monitoring well installed to a depth of 15'.

<u>GROUNDWATER LEVEL INFORMATION:</u>
▽ Groundwater was observed at approximately 28 ft. below ground surface during drilling.
<u>GENERAL NOTES:</u>
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED: -

BORING LOG B-18

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-18

PAGE: 1 of 1

Date Begin - End: 7/11/2018
Drilling Company: Vine Laboratories, Inc.
BORING LOG B-19
Logged By: B. Lykins
Drill Crew: S. Wright
Hor.-Vert. Datum: Not Available
Drilling Equipment: CME-850
Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees
Drilling Method: Solid Stem Auger
Weather: Clear, 90° F
Exploration Diameter: 4 in. O.D.

FIELD EXPLORATION

Northing: 376766.6990
Easting: 188185.1310
Surveyed Ground Surface Elevation (ft.): 6,166.96
Surface Condition: Thick grasses, weeds, and shrubs

LABORATORY RESULTS

Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**FILL** **Silty SAND**: fine-grained sand, low plasticity, brown, moist, loose, roots to 4", no debris											
5	**FILL** **Lean CLAY**: with coarse sand, medium plasticity, reddish brown, moist, medium stiff, no debris	◣	BC=4 6 4									Drill rig grinding at 5 feet
10		◣	BC=3 5 5									
15		◣	BC=1 2 1									
▽ 20	**FILL** **Fat CLAY**: high plasticity, black to dark grey, wet, very soft, debris (glass, wood) to 15% by volume	◣	BC=1 2 2									
25	- with debris (wood chips to 2" in length, plastic)	◣	BC=6 3 4									
30		◣	BC=2 2 3									
35	- with debris (glass shards) to 5% by volume, odor	◣	BC=3 3 3									
40		◣	BC=3 6 7									
45	**SHALE**: dark grey, moderately weathered, weak	◣	BC=22 37 50/5"									

Surveyed Elevation (feet): 6165, 6160, 6155, 6150, 6145, 6140, 6135, 6130, 6125, 6120, 6115

Depth (feet): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

The boring was terminated at approximately 46.4 ft. below ground surface. The boring was backfilled with grout on July 11, 2018.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 20 ft. below ground surface during drilling.
GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
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PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED:

BORING LOG B-19

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-19

PAGE: 1 of 1

Date Begin - End: 7/11/2018
Drilling Company: Vine Laboratories, Inc.
BORING LOG B-20
Logged By: B. Lykins
Drill Crew: S. Wright
Hor.-Vert. Datum: Not Available
Drilling Equipment: CME-850
Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees
Drilling Method: Solid Stem Auger
Weather: Clear, 88° F
Exploration Diameter: 4 in. O.D.

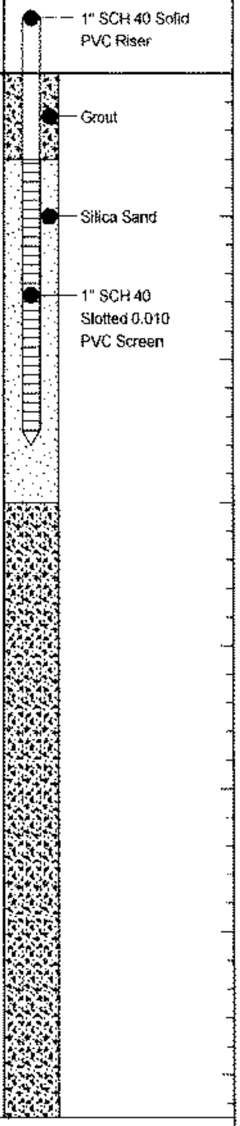
FIELD EXPLORATION

Northing: 376744.5500
Easting: 188250.7800
Surveyed Ground Surface Elevation (ft.): 6,156.75
Surface Condition: Thick grasses, weeds, and shrubs

Surveyed Elevation (feet)	Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6155		**FILL** **Silty SAND**: fine-grained sand, low plasticity, brown, moist, loose, roots to 4", no debris									
6150	5	**FILL** **CLAY**: with fine-grained sand, brown, moist, medium stiff, no debris	BC=4 5 5	NR							
6145	10		BC=1 2 2	6"							
6140	15	- with debris (wood chips to 3", brick fragments), dark grey, odor	BC=3 4 3	7"							
⊻											
6135	20	- wet	BC=2 4 4	12"							
6130	25		BC=3 4 5	18"							
6125	30	- with debris (brick fragments)	BC=5 7 5								
6120	35		BC=18 26 50/6"								
		SHALE: dark grey, moderately weathered, weak									
6115	40										

LABORATORY RESULTS

METHANE MONITORING WELL CONSTRUCTION*



The boring was terminated at approximately 36.5 ft. below ground surface. *Monitoring Well installed to a depth of 15'.

GROUNDWATER LEVEL INFORMATION:
⊻ Groundwater was observed at approximately 19 ft. below ground surface during drilling.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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PROJECT NO.: 20191069
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BORING LOG B-20

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-20

BORING LOG B-21

Date Begin - End: 7/11/2018
Logged By: K. White
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 81°F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: N. McVay
Drilling Equipment: CME-750
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Northing: 376862.1810
Easting: 188430.6100
Surveyed Ground Surface Elevation (ft.): 6,188.94
Surface Condition: Thick grasses, weeds, and shrubs

LABORATORY RESULTS

Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Silty SAND (SM): fine-grained sand, non-plastic, brown, no odor, moist, no debris											Easy drilling
6185														
	5			◣	BC=5 5 5	12"								
6180														
	10		**CLAYSTONE**: greyish brown, moist, highly weathered, weak, (Lean Clay, medium plasticity)	◣	BC=9 17 23	15"								
6175														
	15		-dark grey	◣	BC=12 21 29	16"								
6170														
	20													
6165														

The boring was terminated at approximately 16.5 ft. below ground surface. The boring was backfilled with grout on July 11, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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BORING LOG B-21

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING

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BORING LOG B-22

Date Begin - End: 7/11/2018
Logged By: K. White
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 83°F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: N. McVay
Drilling Equipment: CME-750
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 376846.6740
Easting: 188572.9990
Surveyed Ground Surface Elevation (ft.): 6,197.10
Location Offset: ~30' east due to steep slope
and overhead powerline
Surface Condition: Sparse grasses, weeds, and shrubs

FIELD EXPLORATION							LABORATORY RESULTS								
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Silty SAND (SM): fine-grained sand, low plasticity, brown, moist, loose, no significant organics (topsoil), no debris, no odor											
6195														
			CLAYSTONE: dark grey to reddish brown, moderately weathered, weak, moist (Lean Clay, medium plasticity)											
	5			◣	BC=12 19 22	16"								
6190														
	10			◣	BC=32 50/6"	14"								
6185														
	15													
6180														
	20													
6175														

The boring was terminated at approximately 11 ft. below ground surface. The boring was backfilled with grout on July 11, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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BORING LOG B-22

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-22

PAGE: 1 of 1

Date Begin - End: 7/11/2018
Drilling Company: Vine Laboratories, Inc.
BORING LOG B-23
Logged By: B. Lykins
Drill Crew: N. McVay
Hor.-Vert. Datum: Not Available
Drilling Equipment: CME-850
Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees
Drilling Method: Solid Stem Auger
Weather: Clear, 80° F
Exploration Diameter: 4 in. O.D.

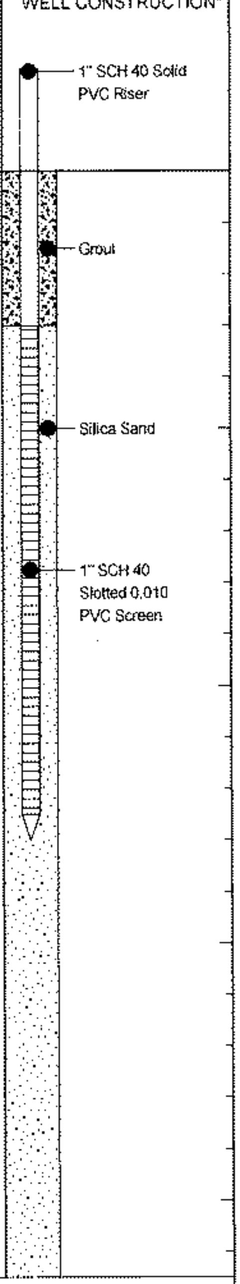
FIELD EXPLORATION

Northing: 377495.1590
Easting: 166294.1460
Surveyed Ground Surfaca Elevation (ft.): 6,202.89
Surface Condition: Thick grasses, shrubs, and weeds

Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
			FILL **Silty SAND**: fine-grained sand, low plasticity, brown, moist, loose, significant organics (topsoil) to 4", no debris										
6200													
	5		**FILL** **Lean CLAY**: brown, moist, very soft, iron oxide staining, debris (metal scraps to ¼") up to 15% by volume		BC=3 2 3	13"							
6195													
	10		- with calcareous nodules		BC=8 17 20	16"							
6190													
			CLAYSTONE: reddish brown, highly weathered, very weak, iron oxide staining										
	15				BC=10 17 20	12"							
6185													
	20				BC=10 18 22								
6180													

LABORATORY RESULTS

METHANE MONITORING WELL CONSTRUCTION*



The boring was terminated at approximately 21.5 ft. below ground surface. *Monitoring Well installed to a depth of 15'.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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BORING LOG B-23

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-23

Date Begin - End:	7/10/2018	**Drilling Company:**	Vine Laboratories, Inc.
Logged By:	J. Brown	**Drill Crew:**	S. Wright
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-750
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger
Weather:	Sunny, Clear	**Exploration Diameter:**	4 in. O.D.

BORING LOG B-24

Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 377450.0180
Easting: 188537.1260
Surveyed Ground Surface Elevation (ft.): 6,240.18
Surface Condition: Thick grasses, weeds, and shrubs

FIELD EXPLORATION							LABORATORY RESULTS							
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
6240			**Silty SAND (SM)**: fine-grained sand, low plasticity, brown, moist, loose, no significant organics, no debris											
6235	5		**CLAYSTONE**: reddish brown, highly weathered, weak	◣	BC=10 20 50/6"									
6230	10			◣	BC=6 20 16									
6225	15													
6220	20													

The boring was terminated at approximately 11.5 ft. below ground surface. The boring was backfilled with grout on July 10, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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BORING LOG B-24

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING

B-24

PAGE: 1 of 1

BORING LOG B-25

Date Begin - End: 7/11/2018
Logged By: B. Lykins
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 80° F
Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-850
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.
Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 377421.6940
Easting: 168309.8590
Surveyed Ground Surface Elevation (ft.): 6,203.77
Surface Condition: Thick grasses, weeds, and shrubs

FIELD EXPLORATION							LABORATORY RESULTS							
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			FILL **Silty SAND (SM)**: fine-grained sand, low plasticity, brown, moist, significant organics (topsoil) with roots to 4", no debris											
6200														
	5		**FILL** **Lean CLAY (CL)**: medium plasticity, brown, moist, medium stiff, iron oxide staining, no debris		BC=6 9 9	11"								
6195														
	10		- with medium sand, very soft, debris (brick, glass fragments, wood chips to ½" thick) to 10-15% by volume, odor		BC=2 0 1	10"								
6190														
	15				BC=1 0 1	10"								
			CLAYSTONE: brownish red, highly weathered, very weak, iron oxide staining, calcareous nodules											
6185														
	20				BC=10 14 22	18"								
6180														

The boring was terminated at approximately 21.5 ft. below ground surface. The boring was backfilled with grout on July 11, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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BORING LOG B-25

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-25

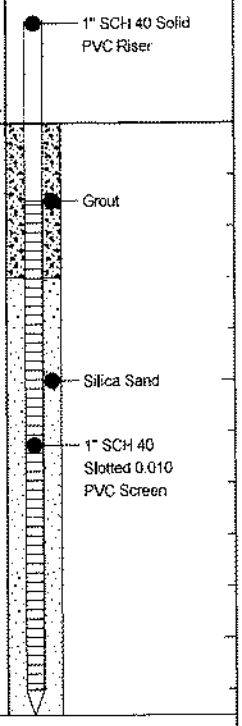
Date Begin - End: 7/11/2018
Drilling Company: Vine Laboratories, Inc.
BORING LOG B-26
Logged By: B. Lykins
Drill Crew: N. McVay
Hor.-Vert. Datum: Not Available
Drilling Equipment: CME-850
Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees
Drilling Method: Solid Stem Auger
Weather: Clear, 85° F
Exploration Diameter: 4 in. O.D.

FIELD EXPLORATION

Northing: 377348.9550
Easting: 188328.7920
Surveyed Ground Surface Elevation (ft.): 6,202.81
Surface Condition: Thick grasses, weeds, and shrubs

Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6200			**Silty SAND**: fine-grained sand, low plasticity, brown, moist, loose, roots to 4", no debris										
	5		**CLAYSTONE**: dark grey to reddish brown, moderately weathered, very weak		BC=16 25 35	18"							
6195													
	10		- with calcareous nodules below 10 feet		BC=15 26 32	18"							

METHANE MONITORING WELL CONSTRUCTION*



6190
15
6185
20
6180

The boring was terminated at approximately 11.5 ft. below ground surface. *Monitoring Well installed to a depth of 15'.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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PROJECT NO.: 20191069
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REVISED: -

BORING LOG B-26

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING

B-26

BORING LOG B-27

Date Begin - End: 7/10/2018
Logged By: J. Brown
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Sunny, Clear
Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-850
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.
Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 377304.3950
Easting: 188518.6980
Surveyed Ground Surface Elevation (ft.): 6,217.88
Surface Condition: Thick grasses, weeds, and shrubs

			FIELD EXPLORATION				LABORATORY RESULTS								
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		▨	**Silty SAND**: fine-grained sand, low plasticity, brown, moist, very loose, no debris, no odor											
6215		▨												
	5	▤	**CLAYSTONE**: dark grey to reddish brown, highly weathered, weak	◣	BC=15 36 48	NR								
6210		▤												
	10	▤		◣	BC=45 50/2"	NR								
6205														
	15													
6200														
	20													
6195														

The boring was terminated at approximately 10.7 ft. below ground surface. The boring was backfilled with grout on July 10, 2018.

GROUNDWATER LEVEL INFORMATION
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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PROJECT NO.: 20191069
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BORING LOG B-27

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-27
PAGE: 1 of 1

BORING LOG B-28

Date Begin - End: 7/11/2018
Logged By: B. Lykins
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 85° F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-750
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 377276.9690
Easting: 188349.6840
Surveyed Ground Surface Elevation (ft.): 6,201.97
Surface Condition: Thick grasses, weeds, and shrubs

FIELD EXPLORATION							LABORATORY RESULTS							
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
6200		▨	**Silty SAND**: fine-grained sand, low plasticity, brown, dry, no debris, no odor											
	5	▤	**CLAYSTONE**: dark grey to reddish brown, highly weathered, weak	◣	BC=11 20 28	18"								
6195		▤												
	10	▤	- with iron oxide staining	◣	BC=11 17 18	18"								
6190														
	15													
6185														
	20													
6180														

The boring was terminated at approximately 11.5 ft. below ground surface. The boring was backfilled with grout on July 11, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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PROJECT NO.: 20191069
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DATE:
REVISED:

BORING LOG B-28

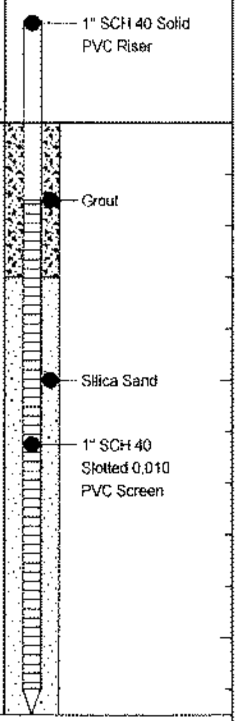
Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-28

Date Begin - End: 7/11/2018
Drilling Company: Vine Laboratories, Inc.
BORING LOG B-29
Logged By: B. Lykins
Drill Crew: S. Wright
Hor.-Vert. Datum: Not Available
Drilling Equipment: CME-850
Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees
Drilling Method: Solid Stem Auger
Weather: Clear, 85° F
Exploration Diameter: 4 in. O.D.

Northing: 377204.6970
Easting: 188372.6080
Surveyed Ground Surface Elevation (ft.): 6,202.10
Surface Condition: Thick grasses, weeds, and shrubs

		FIELD EXPLORATION				LABORATORY RESULTS							METHANE MONITORING WELL CONSTRUCTION*
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	
			Silty SAND: fine-grained sand, low plasticity, brown, dry, loose, no debris, no odor											
6200														
	5		**CLAYSTONE**: dark grey, highly weathered, very weak		BC=4 8 10	12"								
6195														
	10		- with iron oxide staining, calcareous nodules		BC=11 16 18									
6190														
	15													
6185														
	20													
6180														



The boring was terminated at approximately 11.5 ft. below ground surface. *Monitoring Well installed to a depth of 15'.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

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BORING LOG B-29

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-29

Date Begin - End: 7/09/2018
Logged By: B. Lykins
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 82° F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-850
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

BORING LOG B-30

Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 377607.4690
Easting: 187805.0570
Surveyed Ground Surface Elevation (ft.): 6,220.91
Surface Condition: Thick grasses, weeds, and shrubs

FIELD EXPLORATION							LABORATORY RESULTS							
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
6220		▨	**Silty SAND**: fine-grained sand, low plasticity, brown, dry, loose, roots to 3", no debris, no odor											
	5	▤	**CLAYSTONE**: dark grey to reddish brown, highly weathered, extremely weak, iron oxide staining, calcareous nodules	◣	BC=8 12 15									
6215														
	10		- moderately weathered, very weak below 10 feet	◣	BC=12 18 25									
6210														
	15			◣	BC=15 26 50/6"									
6205		▤	**SHALE**: dark grey, moderately weathered, very hard, no debris											Hard drilling at 16 feet
	20			◣	BC=26 50/5"									
6200														

The boring was terminated at approximately 20.9 ft. below ground surface. The boring was backfilled with grout on July 09, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED: -

BORING LOG B-30

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING

B-30

Date Begin - End: 7/09/2018
Logged By: B. Lykins
Hor.-Vert. Datum: WGS 1984 - Not Available
Plunge: -90 degrees
Weather: Clear, 84° F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-850
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

BORING LOG B-31

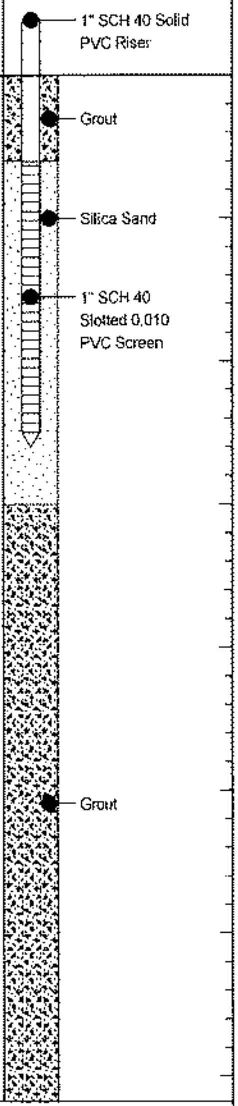
Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 377444.0160
Easting: 187795.9900
Surveyed Ground Surface Elevation (ft.): 6,215.52
Surface Condition: Thick grasses, weeds, and shrubs

		FIELD EXPLORATION				LABORATORY RESULTS						
Surveyed Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6215		**Silty SAND (SM)**: fine-grained sand, low plasticity, brown, dry, loose, roots to 3", no debris			6"							
6210	5	**Lean CLAY (CL)**: medium plasticity, light grey, moist, stiff, no debris		BC=6 14 16	18"							
6205	10	**CLAYSTONE**: medium to high plasticity, grey, moist, very stiff		BC=13 20 30	18"							
6200	15	- dark grey		BC=20 36 40	18"							
6195	20	- with iron oxide staining		BC=10 18 18	18"							
6190	25			BC=12 24 25	18"							
6185	30	- with calcareous nodules		BC=19 30 36	18"							
6180	35	**SHALE**: dark bluish grey, hard, moderately weathered		BC=40 50/5"	11"							
6175	40											

The boring was terminated at approximately 35.9 ft. below ground surface. *Monitoring Well installed to a depth of 15'.

METHANE MONITORING WELL CONSTRUCTION*



GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.
An iPad integrated GPS unit was used to locate the exploration with an accuracy of 5 meters.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED:

BORING LOG B-31

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-31

BORING LOG B-32

Date Begin - End: 7/10/2018
Logged By: J. Brown
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Sunny, Clear

Drilling Company: Vine Laboratories, Inc.
Drill Crew: N. McVay
Drilling Equipment: CME-850
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

Northing: 377295.2400
Easting: 187797.0820
Surveyed Ground Surface Elevation (ft.): 6,212.22
Surface Condition: Thick grasses, weeds, and shrubs

			FIELD EXPLORATION				LABORATORY RESULTS							
Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			FILL **Silty SAND**: fine-grained sand, low plasticity, brown, no odor, dry, loose, roots to 3", no debris											
6210														
	5		- with trace glass	◣	BC=6 8 10									
6205														
	10		- with lean clay	◣	BC=8 12 18									
6200														
	15			◣	BC=8 18 24									
6195														
	20			◣	BC=18 25 32									
6190														
	25		- with trace glass	◣	BC=11 19 21									
6185														
	30		**CLAYSTONE**: dark grey to reddish brown, moderately weathered, very weak	◣	BC=32 50/3"									
6180														
	35													
6175														

The boring was terminated at approximately 30.8 ft. below ground surface. The boring was backfilled with grout on July 10, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED: -

BORING LOG B-32

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
B-32

Date Begin - End: 7/12/2018
Drilling Company: Vine Laboratories, Inc.
BORING LOG GW-1
Logged By: B. Lykins
Drill Crew: S. Wright
Hor.-Vert. Datum: Not Available
Drilling Equipment: CME-750
Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees
Drilling Method: Solid Stem Auger
Weather: Overcast, 70°F
Exploration Diameter: 4 in. O.D.

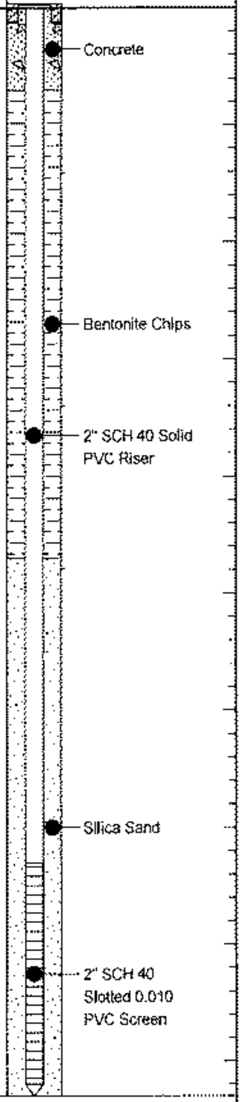
FIELD EXPLORATION

Northing: 377815.3310
Easting: 188090.8180
Surveyed Ground Surface Elevation (ft.): 6,217.44
Surface Condition: Bare Earth, no grass or shrubs

LABORATORY RESULTS

Surveyed Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6215		**FILL** **Silty SAND**: fine-grained sand, low plasticity, brown, dry, loose, no debris										
	5	**FILL** **Lean CLAY**: with fine to medium sand, low plasticity, reddish brown, moist, medium dense, no debris	◣	BC=4 8 8								
6210												
	10											
6205												
	15		◣	BC=3 4 6								
6200												
	20											
6195												
	25	- grey	◣	BC=3 2 7								
6190												
▽	30											
6185												
	35	- with debris (wood chips, glass fragments) to 10% by volume	◣	BC=7 2 3								
6180												
	40											
6175												
	45	**CLAYSTONE**: light reddish brown, moderately weathered, very weak, iron oxide staining, calcareous nodules	◣	BC=17 25 44								
6170												
	50											
6165												

GROUNDWATER MONITORING WELL CONSTRUCTION*
Completion Method: Flush mount cap in concrete



The boring was terminated at approximately 46.5 ft. below ground surface. *Monitoring Well installed to a depth of 46.5'.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 31 ft. below ground surface during drilling.
GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED: -

BORING LOG GW-1

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
GW-1

BORING LOG GW-2

Date Begin - End: 7/12/2018
Logged By: B. Lykins
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Overcast, 66° F

Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-750
Drilling Method: Solid Stem Auger
Exploration Diameter: 4 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

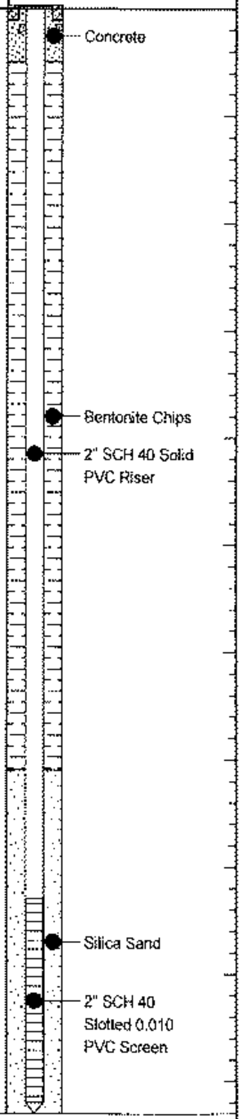
FIELD EXPLORATION

Northing: 376999.3950
Easting: 188129.6840
Surveyed Ground Surface Elevation (ft.): 6,185.68
Surface Condition: Thick grasses, weeds, and shrubs

Surveyed Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6185		**FILL** **Silty SAND**: fine sand, low plasticity, brown, moist, loose, roots to 4", no debris										
6180	5	**FILL** **SAND with Clay**: fine to medium sand, reddish brown, moist, very soft, debris (wire, plastic, glass) to 20% by volume	◣	BC=2 1 3								
6175	10		◣	BC=1 1 2								
6170	15	- with debris (concrete chunks to 1.5" diameter)	◣	BC=3 5 5								
6165 ▽	20		◣	BC=2 2 6								
6160	25	**FILL** **Lean CLAY**: dark grey to black, moist, medium stiff, debris (metal scraps, wood chips, concrete chunks to 1.5" diameter, glass shards) to 20% by volume	◣	BC=5 5 6								
6155	30		◣	BC=4 3 3								
6150	35											
6145	40		◣	BC=7 3 20								
6140	45	**CLAYSTONE**: dark grey, highly weathered, weak, iron oxide staining	◣	BC=4 6 11								
6135	50	- moderately weathered	◣	BC=8 14 23								
6130	55											

LABORATORY RESULTS

GROUNDWATER MONITORING WELL CONSTRUCTION*
Completion Method.
Flush mount cap in concrete



The boring was terminated at approximately 51.5 ft. below ground surface. *Monitoring Well installed to a depth of 51.5'.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 23 ft. below ground surface during drilling.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED: -

BORING LOG GW-2

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
GW-2
PAGE: 1 of 1

BORING LOG GW-3

Date Begin - End: 7/12/2018
Logged By: B. Lykins
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Clear, 80° F
Drilling Company: Vine Laboratories, Inc.
Drill Crew: S. Wright
Drilling Equipment: CME-750
Drilling Method: Hollow Stem Auger
Exploration Diameter: 4 in. O.D.
Hammer Type - Drop: 140 lb. Auto - 30 in.

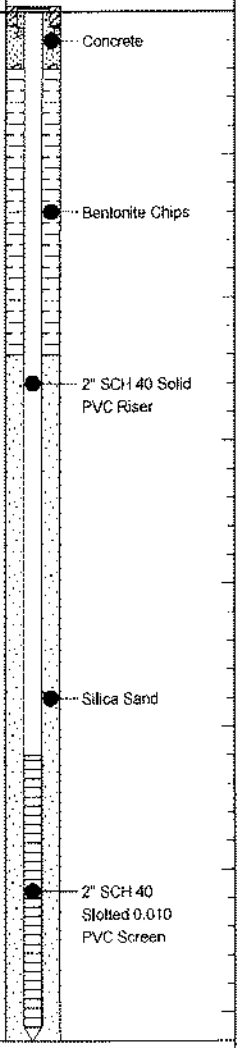
FIELD EXPLORATION

Northing: 376987.5920
Easting: 188389.2310
Surveyed Ground Surface Elevation (ft.): 6,191.33
Surface Condition: Thick grasses, weeds, and shrubs

Surveyed Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
6190			**FILL** **Silty SAND**: fine sand, low plasticity, brown, dry, loose, roots to approximately 4", no debris, no odor										
6185	5		**FILL** **Lean CLAY**: medium plasticity, reddish brown, moist, soft, debris (wood chips, glass fragments) to 15% by volume	◣	BC=3 5 3								
6180	10		- odor	◣	BC=3 10 15								
6175	15		- with debris (trace metal scraps)	◣	BC=3 5 6								
6170	20		**FILL** **Fat CLAY**: high plasticity, dark brown, moist, soft, iron oxide staining	◣	BC=1 3 3								
6165	25		- with debris (wood chips) to 5% by volume	◣	BC=2 2 6								
6160	30		**CLAYSTONE**: reddish brown, highly weathered, very weak, iron oxide staining	◣	BC=2 3 6								
6155	35		**SHALE**: dark bluish grey, moderately weathered, weak	◣	BC=28 50/6"								
6150	40												

The boring was terminated at approximately 36 ft. below ground surface. *Monitoring Well installed to a depth of 36.5'.

GROUNDWATER MONITORING WELL CONSTRUCTION*
Completion Method: Flush mount cap in concrete



GROUNDWATER LEVEL INFORMATION:
∇ Groundwater was observed at approximately 29 ft. below ground surface during drilling.

GENERAL NOTES:
The exploration location and elevation were surveyed by Ridgeline Survey.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20191069
DRAWN BY: MAP
CHECKED BY:
DATE:
REVISED: -

BORING LOG GW-3

Mesa Valley Landfill Investigation 2018
Mesa Valley Landfill (Waterman project)
Colorado Springs, CO

BORING
GW-3

Form No.
GWS-31
02/2017

WELL CONSTRUCTION AND YIELD ESTIMATE REPORT

State of Colorado, Office of the State Engineer
1313 Sherman St., Room 821, Denver, CO 80203 303.866.3581
www.water.state.co.us and dwrpermitsonline@state.co.us

For Office Use Only

1. Well Permit Number: 58184-MH **Receipt Number:**

2. Owner's Well Designation: GW-1

3. Well Owner Name: MVS Development, LLC

4. Well Location Street Address: P.O. Box 27560 Albauquerque, NM 87125

5. As Built GPS Well Location (required): ☐ Zone 12 ☑ Zone 13 Easting: 188090.8 Northing: 377815.3310

6. Legal Well Location: _____ 1/4, _____ 1/4, Sec., _____ Twp. _____ ☐ N or S ☐, Range _____ ☐ E or W ☐, _____ P.M.
County: ____________
Subdivision: ____________, Lot _____, Block _____, Filing (Unit) _____

7. Ground Surface Elevation: 6217.44 feet **Date Completed:** 07/12/2018 **Drilling Method:** Solid Stem Auger

8. Completed Aquifer Name : ____________ **Total Depth:** 46.5 feet **Depth Completed:** 46.5 feet

9. Advance Notification: Was Notification Required Prior to Construction? ☑ Yes ☐ No, Date Notification Given: 07/09/2018

10. Aquifer Type: ☐ Type I (One Confining Layer) ☐ Type I (Multiple Confining Layers) ☐ Laramie-Fox Hills
(Check one) ☑ Type II (Not overlain by Type III) ☐ Type II (Overlain by Type III) ☐ Type III (alluvial/colluvial)

11. Geologic Log:

Depth	Type	Grain Size	Color	Water Loc.
0' - 4.5'	SAND	FINE	BROWN	
4.5' - 45'	CLAY	CLAY	BROWN	31'
45' - 46.5'	CLAYSTONE	CLAY	LT BROWN	

Remarks:

12. Hole Diameter (in.)

Hole Diameter (in.)	From (ft)	To (ft)
4	0	46.5

13. Plain Casing

OD (in)	Kind	Wall Size (in)	From (ft)	To (ft)
2.375	PVC	.375	0	36.5

Perforated Casing Screen Slot Size (in): 0.010

OD (in)	Kind	Wall Size (in)	From (ft)	To (ft)
2.375	PVC	.375	36.5	46.5

14. Filter Pack:
Material Silica Sand
Size 10/20
Interval 23.5' - 46.5'

15. Packer Placement:
Type N/A
Depth N/A

16. Grouting Record

Material	Amount	Density	Interval	Method
Bentonite Chips	20'	4 bags	2' - 22'	gravity
Cement Mix	3.5'	2	0' - 3.5'	gravity

17. Disinfection: Type N/A Amt. Used None

18. Well Yield Estimate Data: ☐ Check box if Test Data is submitted on Form Number GWS-39, Well Yield Test Report
Well Yield Estimate Method: ____________
Static Level: ____________
Date/Time measured: ____________
Estimated Yield (gpm) ____________
Estimate Length (hrs) ____________

Remarks:

19. I have read the statements made herein and know the contents thereof, and they are true to my knowledge. This document is signed (or name entered if filing online) and certified in accordance with Rule 17.4 of the Water Well Construction Rules, 2 CCR 402 2. The filing of a document that contains false statements is a violation of section 37 91 108(1)(e), C.R.S., and is punishable by fines up to $1,000 and/or revocation of the contracting license. If filing online the State Engineer considers the entry of the licensed contractor's name to be compliance with Rule 17.4.

Company Name: Kleinfelder, Inc.
Email: jkwhite@kleinfelder.com
Phone w/area code: (719) 632-3593
License Number: 50163
Mailing Address:
Sign (or enter name if filing online)
Print Name and Title
Date:

GWS-31
02/2017

INSTRUCTIONS FOR WELL CONSTRUCTION AND YIELD ESTIMATE REPORT

This report must be computer generated online, typed or printed in **BLACK OR BLUE INK** and may be reproduced by photocopy or computer generation. Photocopy reproductions must retain margins and print quality. Attach additional sheets if more space is required. Each additional sheet must be identified at the top by the well owner's name, the permit number, form name/number and a sequential page number. Report depths in feet below ground surface. If filing online please see online form submittal instructions at http://water.state.co.us/groundwater/wellpermit/onlineformsubmittal/Pages/DWRSite1.aspx You may also save, print and email the completed form to: dwrpermitsonline@state.co.us

The form must be submitted to the State Engineer's Office within 60 days after completing the well or 7 days after the permit expiration date, whichever is earlier. A copy of the form must be provided to the well owner.

Item Instructions: (numbers correspond with those on the front of this form)

1. Complete the well permit and receipt number.
2. Provide the identification (owner's well designation) for the well.
3. Fill in well owner name.
4. Provide the street address where the well is located.
5. Provide the GPS location where the well was drilled (required field).

   Colorado contains two (2) UTM zones. Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone.
6. Complete the legal description location of the well and county. For wells located in subdivisions, the name, lot, block, and filing, must be provided.
7. Report the ground surface elevation in feet above sea level if available. This value may be obtained from a topographic map. Provide the date the well was completed and describe the drilling method used to construct the well.
8. Indicate the aquifer in which the well was completed, the total depth drilled, and the actual completed depth of the well.
9. Indicate whether or not the well inspection team was required to be notified prior to construction. If required, provide the date notification was given. See http://water.state.co.us/groundwater/BOE/Pages/VariancesWaivers.aspx for more information on Notifications.
10. Check the box indicating the type aquifer in which the well is completed (See Rule 5.2.2 Well Construction Rules).
11. Fully describe the materials encountered in drilling. Do not use formation names unless they are in conjunction with a description of materials. Examples of descriptive terms include:

    Type - sandstone, sand, etc.
    Grain size - Boulders, gravel, sand, silt, clay, etc.
    Color - Denote for all materials, most critical in sedimentary rock
    Water Location - Depth where water is encountered (if it can be determined)
12. Provide the diameters of the drilled borehole.
13. The outside diameter, type, wall thickness, and interval of plain and perforated casing lengths must be indicated. For perforated casing, the screen size must be indicated.
14. Indicate the material and size of filter pack (e.g. sand, gravel, etc.) and the interval where placed.
15. Indicate the type and setting depth for any packers installed.
16. The material, amount, and interval of the grout slurry must be reported. Density may be indicated as pounds per gallon, gallons of water per sack, total gallons of water used, or number of sacks used, etc. Specify the grout placement method, i.e. tremie pipe or positive placement. The percentage of additives mixed with the grout should be reported under remarks.
17. Record the type and the amount of disinfection used, how placed, and the length of time left in the hole.
18. Report Well Yield Estimate data as required by Rule 17.1.1. Spaces are provided to report all estimates made during the assessment. The report should show that the estimate complied with the provisions of the rules. If available, report clock time when measurements were taken. If an estimate was not performed, explain when it will be done. A full Well Yield Test may be performed instead of an estimate; if so, check the appropriate box and submit the data on form GWS-39.
19. Fill in Company Name, Email, and Address and License Number (or PE/PG) of the Individual who is responsible for the well construction. The licensed contractor or authorized individual responsible for the construction of the well must sign or if filing online, enter his/her name on the report. If filing online the State Engineer considers the entering of the licensed contractors name on the form to be a certification of accuracy and truthfulness in compliance with Rule 17.4 of the Water Well Construction Rules and Regulations, 2 CCR 402-2.

    Rule 17.4 Certification - Work reports must be signed and certified as to accuracy and truthfulness of the information on the report by the well construction or pump installation contractors or authorized individuals responsible for the work performed by them or under their direction or supervision, or by the private driller or private pump installer if the work was performed by them. Such reports are deemed to be completed, signed and certified under oath.

Submit completed report to: State of Colorado, Office of the State Engineer, 1313 Sherman St, Room 821, Denver, CO 80203. You may also save, print, scan and email the completed form to dwrpermitsonline@state.co.us

IF YOU HAVE ANY QUESTIONS regarding any item on this form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to our web site at www.water.state.co.us for general information, forms, online filing instructions and access to state rules and statutes.

Form No.
GWS-31
02/2017

WELL CONSTRUCTION AND YIELD ESTIMATE REPORT

State of Colorado, Office of the State Engineer
1313 Sherman St., Room 821, Denver, CO 80203 303.866.3581
www.water.state.co.us and dwrpermitsonline@state.co.us

For Office Use Only

1. Well Permit Number: 58184-MH **Receipt Number:**

2. Owner's Well Designation: GW-2

3. Well Owner Name: MVS Development, LLC

4. Well Location Street Address: P.O. Box 27560 Albauquerque, NM 87125

5. As Built GPS Well Location (required): ☐ Zone 12 ☒ Zone 13 Easting: 188129.6 Northing: 376999.3950

6. Legal Well Location: _____ 1/4, _____ 1/4, Sec., _____ Twp. _____ ☐ N or S ☐, Range _____ ☐ E or W ☐, _____ P.M.

County: ____________________

Subdivision: ____________________, Lot _____, Block _____, Filing (Unit) _____

7. Ground Surface Elevation: 6185.68 feet **Date Completed:** 07/12/2018 **Drilling Method:** Hollow Stem Auger

8. Completed Aquifer Name: ____________ **Total Depth:** 51.5 feet **Depth Completed:** 51.5 feet

9. Advance Notification: Was Notification Required Prior to Construction? ☒ Yes ☐ No, Date Notification Given: 07/09/2018

10. Aquifer Type: (Check one)
☐ Type I (One Confining Layer)
☐ Type I (Multiple Confining Layers)
☐ Laramie-Fox Hills
☒ Type II (Not overlain by Type III)
☐ Type II (Overlain by Type III)
☐ Type III (alluvial/colluvial)

11. Geologic Log:

Depth	Type	Grain Size	Color	Water Loc.
0' - 4'	SAND	FINE - MED	BROWN	
4' - 25'	SAND W/ CLAY	FINE - MED	BROWN	23'
25' - 45'	CLAY	CLAY	GREY	
45' - 51.5'	CLAYSTONE	CLAY	GREY	

Remarks:

12. Hole Diameter (in.)

Hole Diameter (in.)	From (ft)	To (ft)
4	0	51.5

13. Plain Casing

OD (in)	Kind	Wall Size (in)	From (ft)	To (ft)
2.375		.375	0	41.5

Perforated Casing Screen Slot Size (in): 0.010

OD (in)	Kind	Wall Size (in)	From (ft)	To (ft)
2.375	PVC	.375	41.5	51.5

14. Filter Pack:
Material Silica Sand
Size 10/20
Interval 35.5' - 51.5'

15. Packer Placement:
Type N/A
Depth N/A

16. Grouting Record

Material	Amount	Density	Interval	Method
Bentonite Chips	33'	5 bags	2' - 35'	gravity
Cement Mix	2.5'	1	0' - 2.5'	gravity

17. Disinfection: Type N/A Amt. Used None

18. Well Yield Estimate Data: ☐ Check box if Test Data is submitted on Form Number GWS-39, Well Yield Test Report

Well Yield Estimate Method: ____________________

Static Level: ____________________ Estimated Yield (gpm) __________

Date/Time measured: ____________________ Estimate Length (hrs) __________

Remarks:

19. I have read the statements made herein and know the contents thereof, and they are true to my knowledge. This document is signed (or name entered if filing online) and certified in accordance with Rule 17.4 of the Water Well Construction Rules, 2 CCR 402 2. The filing of a document that contains false statements is a violation of section 37 91 108(1)(e), C.R.S., and is punishable by fines up to $1,000 and/or revocation of the contracting license. If filing online the State Engineer considers the entry of the licensed contractor's name to be compliance with Rule 17.4.

Company Name:	Email:	Phone w/area code:	License Number:
Kleinfelder, Inc.	jkwhite@kleinfelder.com	(719) 632-3593	50163

Mailing Address:

Sign (or enter name if filing online)	Print Name and Title	Date:

GWS-31
02/2017

INSTRUCTIONS FOR WELL CONSTRUCTION AND YIELD ESTIMATE REPORT

This report must be computer generated online, typed or printed in **BLACK OR BLUE INK** and may be reproduced by photocopy or computer generation. Photocopy reproductions must retain margins and print quality. Attach additional sheets if more space is required. Each additional sheet must be identified at the top by the well owner's name, the permit number, form name/number and a sequential page number. Report depths in feet below ground surface. If filing online please see online form submittal instructions at http://water.state.co.us/groundwater/wellpermit/onlineformsubmittal/Pages/DWRSite1.aspx You may also save, print and email the completed form to: dwrpermitsonline@state.co.us

The form must be submitted to the State Engineer's Office within 60 days after completing the well or 7 days after the permit expiration date, whichever is earlier. A copy of the form must be provided to the well owner.

Item Instructions: (numbers correspond with those on the front of this form)

1. Complete the well permit and receipt number.
2. Provide the identification (owner's well designation) for the well.
3. Fill in well owner name.
4. Provide the street address where the well is located.
5. Provide the GPS location where the well was drilled (required field).

   Colorado contains two (2) UTM zones. Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone.

6. Complete the legal description location of the well and county. For wells located in subdivisions, the name, lot, block, and filing, must be provided.
7. Report the ground surface elevation in feet above sea level if available. This value may be obtained from a topographic map. Provide the date the well was completed and describe the drilling method used to construct the well.
8. Indicate the aquifer in which the well was completed, the total depth drilled, and the actual completed depth of the well.
9. Indicate whether or not the well inspection team was required to be notified prior to construction. If required, provide the date notification was given. See http://water.state.co.us/groundwater/BOE/Pages/VariancesWaivers.aspx for more information on Notifications.
10. Check the box indicating the type aquifer in which the well is completed (See Rule 5.2.2 Well Construction Rules).
11. Fully describe the materials encountered in drilling. Do not use formation names unless they are in conjunction with a description of materials. Examples of descriptive terms include:

    Type - sandstone, sand, etc.
    Grain size - Boulders, gravel, sand, silt, clay, etc.
    Color - Denote for all materials, most critical in sedimentary rock
    Water Location - Depth where water is encountered (if it can be determined)

12. Provide the diameters of the drilled borehole.
13. The outside diameter, type, wall thickness, and interval of plain and perforated casing lengths must be indicated. For perforated casing, the screen size must be indicated.
14. Indicate the material and size of filter pack (e.g. sand, gravel, etc.) and the interval where placed.
15. Indicate the type and setting depth for any packers installed.
16. The material, amount, and interval of the grout slurry must be reported. Density may be indicated as pounds per gallon, gallons of water per sack, total gallons of water used, or number of sacks used, etc. Specify the grout placement method, i.e. tremie pipe or positive placement. The percentage of additives mixed with the grout should be reported under remarks.
17. Record the type and the amount of disinfection used, how placed, and the length of time left in the hole.
18. Report Well Yield Estimate data as required by Rule 17.1.1. Spaces are provided to report all estimates made during the assessment. The report should show that the estimate complied with the provisions of the rules. If available, report clock time when measurements were taken. If an estimate was not performed, explain when it will be done. A full Well Yield Test may be performed instead of an estimate; if so, check the appropriate box and submit the data on form GWS-39.
19. Fill in Company Name, Email, and Address and License Number (or PE/PG) of the Individual who is responsible for the well construction. The licensed contractor or authorized individual responsible for the construction of the well must sign or if filing online, enter his/her name on the report. If filing online the State Engineer considers the entering of the licensed contractors name on the form to be a certification of accuracy and truthfulness in compliance with Rule 17.4 of the Water Well Construction Rules and Regulations, 2 CCR 402-2.

    Rule 17.4 Certification - Work reports must be signed and certified as to accuracy and truthfulness of the information on the report by the well construction or pump installation contractors or authorized individuals responsible for the work performed by them or under their direction or supervision, or by the private driller or private pump installer if the work was performed by them. Such reports are deemed to be completed, signed and certified under oath.

Submit completed report to: State of Colorado, Office of the State Engineer, 1313 Sherman St, Room 821, Denver, CO 80203. You may also save, print, scan and email the completed form to dwrpermitsonline@state.co.us

IF YOU HAVE ANY QUESTIONS regarding any item on this form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to our web site at www.water.state.co.us for general information, forms, online filing instructions and access to state rules and statutes.

Form No.
GWS-31
02/2017

WELL CONSTRUCTION AND YIELD ESTIMATE REPORT

State of Colorado, Office of the State Engineer
1313 Sherman St., Room 821, Denver, CO 80203 303.866.3581
www.water.state.co.us and dwrpermitsonline@state.co.us

For Office Use Only

1. Well Permit Number: 58184-MH **Receipt Number:**

2. Owner's Well Designation: GW-3

3. Well Owner Name: MVS Development, LLC

4. Well Location Street Address: P.O. Box 27560 Albauquerque, NM 87125

5. As Built GPS Well Location (required): ☐ Zone 12 ☒ Zone 13 Easting: 188389.2 Northing: 376987.5920

6. Legal Well Location: _____ 1/4, _____ 1/4, Sec., _____ Twp. _____ ☐ N or S ☐, Range _____ ☐ E or W ☐, _____ P.M.

County: ____________________

Subdivision: ____________________, Lot ____, Block ________, Filing (Unit) ______

7. Ground Surface Elevation: 6191.33 feet **Date Completed:** 07/12/2018 **Drilling Method:** Solid Stem Auger

8. Completed Aquifer Name : ____________ **Total Depth:** 36.5 feet **Depth Completed:** 36.5 feet

9. Advance Notification: Was Notification Required Prior to Construction? ☒ Yes ☐ No, Date Notification Given: 07/09/2018

10. Aquifer Type: (Check one)
☐ Type I (One Confining Layer)
☒ Type II (Not overlain by Type III)
☐ Type I (Multiple Confining Layers)
☐ Type II (Overlain by Type III)
☐ Laramie-Fox Hills
☐ Type III (alluvial/colluvial)

11. Geologic Log:

Depth	Type	Grain Size	Color	Water Loc.
0' - 5'	SAND	FINE	BROWN	
5' - 19.5'	LEAN CLAY	CLAY	BROWN	
19.5' - 29'	FAT CLAY	CLAY	DRK BROWN	29'
29' - 35'	CLAYSTONE	CLAY	RED-BROWN	
35' - 36'	SHALE		DRK GREY	

Remarks:

12. Hole Diameter (in.)

Hole Diameter (in.)	From (ft)	To (ft)
4	0	36.5

13. Plain Casing

OD (in)	Kind	Wall Size (in)	From (ft)	To (ft)
2.375		.375	0	26.5

Perforated Casing Screen Slot Size (in): 0.010

OD (in)	Kind	Wall Size (in)	From (ft)	To (ft)
2.375	PVC	.375	26.5	36.5

14. Filter Pack:
Material Silica Sand
Size 10/20
Interval 11.5' - 36'

15. Packer Placement:
Type ________
Depth ________

16. Grouting Record

Material	Amount	Density	Interval	Method
Bentonite Chips	10'	2	2' - 12'	gravity
Cement Mix	2'	1	0' - 2'	gravity

17. Disinfection: Type N/A Amt. Used N/A

18. Well Yield Estimate Data: ☐ Check box if Test Data is submitted on Form Number GWS-39, Well Yield Test Report

Well Yield Estimate Method: ____________________

Static Level: ____________________

Date/Time measured: ____________________

Estimated Yield (gpm) ________

Estimate Length (hrs) ________

Remarks:

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Company Name:	Email:	Phone w/area code:	License Number:
Kleinfelder, Inc.	jkwhite@kleinfelder.com	(719) 632-3593	50163

Mailing Address:

Sign (or enter name if filing online)

Print Name and Title

Date:

GWS-31
02/2017

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2655 Park Center Dr., Suite A
Simi Valley, CA 93065
T: +1 805 526 7161
F: +1 805 526 7270
www.alsglobal.com

LABORATORY REPORT

August 13, 2018

Brad Woodard
Kleinfelder
1801 California Street, Suite 100
Denver, CO 80202

RE: Mesa Valley Landfill / 20191069

Dear Brad:

Enclosed are the results of the samples submitted to our laboratory on July 30, 2018. For your reference, these analyses have been assigned our service request number P1803928.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Kate Kaneko
By Kate Kaneko at 12:44 pm, 08/13/18

Kate Kaneko
Project Manager

2655 Park Center Dr., Suite A
Simi Valley, CA 93065
T: +1 805 526 7161
F: +1 805 526 7270
www.alsglobal.com

Client: Kleinfelder
Project: Mesa Valley Landfill / 20191069

Service Request No: P1803928

CASE NARRATIVE

The samples were received intact under chain of custody on July 30, 2018 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Methane Analysis

The samples were analyzed for methane according to modified EPA Method 3C (single injection) using a gas chromatograph equipped with a thermal conductivity detector (TCD). This procedure is described in laboratory SOP VOA-EPA3C. This method is included on the laboratory's DoD-ELAP scope of accreditation, however it is not part of the NELAP accreditation.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

Use of ALS Environmental (ALS)'s Name. Client shall not use ALS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to ALS any test result, tolerance or specification derived from ALS's data ("Attribution") without ALS's prior written consent, which may be withheld by ALS for any reason in its sole discretion. To request ALS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If ALS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use ALS's name or trademark in any Materials or Attribution shall be deemed denied. ALS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of ALS's name or trademark may cause ALS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

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Simi Valley, CA 93065
T: +1 805 526 7161
F: +1 805 526 7270
www.alsglobal.com

ALS Environmental - Simi Valley

CERTIFICATIONS, ACCREDITATIONS, AND REGISTRATIONS

Agency	Web Site	Number
Alaska DEC	http://dec.alaska.gov/eh/lab.aspx	17-019
Arizona DHS	http://www.azdhs.gov/preparedness/state-laboratory/lab-licensure-certification/index.php#laboratory-licensure-home	AZ0694
Florida DOH (NELAP)	http://www.floridahealth.gov/licensing-and-regulation/environmental-laboratories/index.html	E871020
Louisiana DEQ (NELAP)	http://www.deq.louisiana.gov/page/la-lab-accreditation	05071
Maine DHHS	http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/professionals/labCert.shtml	2016036
Minnesota DOH (NELAP)	http://www.health.state.mn.us/accreditation	1347317
New Jersey DEP (NELAP)	http://www.nj.gov/dep/enforcement/oqa.html	CA009
New York DOH (NELAP)	http://www.wadsworth.org/labcert/elap/elap.html	11221
Oregon PHD (NELAP)	http://www.oregon.gov/oha/ph/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	4068-005
Pennsylvania DEP	http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx	68-03307 (Registration)
PJLA (DoD ELAP)	http://www.pjlabs.com/search-accredited-labs	65818 (Testing)
Texas CEQ (NELAP)	http://www.tceq.texas.gov/agency/qa/env_lab_accreditation.html	T104704413-18-9
Utah DOH (NELAP)	http://health.utah.gov/lab/lab_cert_env	CA016272017-8
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C946

Analyses were performed according to our laboratory's NELAP and DoD-ELAP approved quality assurance program. A complete listing of specific NELAP and DoD-ELAP certified analytes can be found in the certifications section at www.alsglobal.com, or at the accreditation body's website.

Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact the laboratory for information corresponding to a particular certification.

ALS ENVIRONMENTAL

DETAIL SUMMARY REPORT

Client: Kleinfelder
Project ID: Mesa Valley Landfill / 20191069

Service Request: P1803928

Date Received: 7/30/2018
Time Received: 09:15

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	3C Modified - Fxd Gases Can
SG-1	P1803928-001	Air	7/25/2018	12:33	SC01533	-2.92	3.71	X
SG-2	P1803928-002	Air	7/25/2018	12:45	SC00182	-3.99	3.65	X

ALS

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 1

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10-Day-Standard

ALS Project No. P1803928

ALS Contact:

Company Name & Address (Reporting Information): Kleinfelder

Project Name: Mesa Valley Landfill

Project Number: 20191069

Project Manager: Brad Woodard

Phone: 7815724574

Fax:

P.O. # / Billing Information: 20191069

Email Address for Result Reporting: bwoodard@kleinfelder.com

Sampler (Print & Sign): Bill Berger

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method		Comments e.g. Actual Preservative or specific instructions
SG-1	01533	7/25/17	12:33	01533	AUG04745	11	0	6L	Methane		
SG-2	00182	7/25/17	12:45	00182	AUG04574	12	0	6L	↓		

BB 7/26/18

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required YES / No
Type: ____ Units: ____

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature) Date: 7/26/18 Time: 1430
Received by: (Signature) Date: 7/30/18 Time: 0915

Relinquished by: (Signature) Date: Time:
Received by: (Signature) Date: Time:

Cooler / Blank Temperature ____°C

ALS Environmental

Sample Acceptance Check Form

Client: Kleinfelder Work order: P1803928

Project: Mesa Valley Landfill / 20191069

Sample(s) received on: 7/30/2018 Date opened: 7/30/2018 by: AARON GONZALEZ

Note: This form is used for all samples received by ALS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Did **sample containers** arrive in good condition?	☒	☐	☐
3	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
4	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
5	Was **sample volume** received adequate for analysis?	☒	☐	☐
6	Are samples within specified holding times?	☒	☐	☐
7	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
8	Were **custody seals** on outside of cooler/Box/Container?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
9	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
10	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
11	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
P1803928-001.01	6.0 L Source Can					
P1803928-002.01	6.0 L Source Can					
P1803928-003.01	6.0 L Source Can					

Explain any discrepancies: (include lab sample ID numbers): ______

RSK - MEEPP, HCl (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Page 1 of 1

Client: **Kleinfelder**
Client Project ID: **Mesa Valley Landfill / 20191069**
ALS Project ID: P1803928

Methane

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Gilbert Gutierrez
Sample Type: 6.0 L Summa Canister(s)
Test Notes:

Date(s) Collected: 7/25/18
Date Received: 7/30/18
Date Analyzed: 8/1/18

Client Sample ID	ALS Sample ID	Container Dilution Factor	Injection Volume ml(s)	**Result %, v/v**	MRL %, v/v	Data Qualifier
SG-1	P1803928-001	3.36	0.10	**0.399**	0.34	
SG-2	P1803928-002	4.16	0.10	**82.4**	0.42	
Method Blank	P180801-MB	1.00	0.10	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Page 1 of 1

Client: **Kleinfelder**
Client Sample ID: **Lab Control Sample**
Client Project ID: **Mesa Valley Landfill / 20191069**

ALS Project ID: P1803928
ALS Sample ID: P180801-LCS

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Gilbert Gutierrez
Sample Type: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 8/01/18
Volume(s) Analyzed: NA ml(s)

CAS #	**Compound**	Spike Amount ppmV	**Result ppmV**	**% Recovery**	ALS Acceptance Limits	Data Qualifier
74-82-8	Methane	40,000	**39,600**	**99**	98-110	

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

August 10, 2018

Report to:
Bill Bergeron
Kleinfelder, Inc.
1801 California Street
Denver, CO 80002

cc: Brad Woodard

Bill to:
Brenda Anthony
Kleinfelder, Inc.
4815 List Drive, Unit 115
Colorado Springs, CO 80919

Project ID: 20191069
ACZ Project ID: L45886

Bill Bergeron:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on July 27, 2018. This project has been assigned to ACZ's project number, L45886. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L45886. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after September 09, 2018. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

Max janicek

Max Janicek has reviewed and approved this report.

Inorganic Analytical Results

Kleinfelder, Inc.
Project ID: 20191069
Sample ID: GW-1

ACZ Sample ID: ***L45886-01***
Date Sampled: *07/26/18 10:45*
Date Received: *07/27/18*
Sample Matrix: *Groundwater*

Inorganic Prep

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP-MS				*				08/03/18 14:28	rap
Total Hot Plate Digestion	M200.2 ICP				*				08/02/18 13:45	dcm

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Antimony, total	M200.8 ICP-MS	10	0.011	B		mg/L	0.004	0.02	08/06/18 14:10	bsu
Arsenic, total	M200.8 ICP-MS	10	0.048			mg/L	0.002	0.01	08/06/18 14:10	bsu
Barium, total	M200.7 ICP	5	0.60			mg/L	0.02	0.08	08/03/18 23:26	dcm
Beryllium, total	M200.8 ICP-MS	10	0.0014	B		mg/L	0.0005	0.003	08/06/18 23:21	mfm
Cadmium, total	M200.8 ICP-MS	10	0.004	B		mg/L	0.001	0.005	08/06/18 14:10	bsu
Calcium, dissolved	M200.7 ICP	5	39.5			mg/L	0.5	3	08/06/18 13:46	aeh
Chromium, total	M200.7 ICP	5		U		mg/L	0.05	0.3	08/03/18 23:26	dcm
Cobalt, total	M200.7 ICP	5		U		mg/L	0.05	0.3	08/03/18 23:26	dcm
Copper, total	M200.7 ICP	5	0.08	B		mg/L	0.05	0.3	08/03/18 23:26	dcm
Iron, total	M200.7 ICP	5	63.2		*	mg/L	0.1	0.3	08/03/18 23:26	dcm
Lead, total	M200.8 ICP-MS	10	0.257			mg/L	0.001	0.005	08/06/18 14:10	bsu
Magnesium, dissolved	M200.7 ICP	5	485			mg/L	1	5	08/06/18 13:46	aeh
Manganese, dissolved	M200.7 ICP	5	0.05	B	*	mg/L	0.03	0.1	08/06/18 13:46	aeh
Nickel, total	M200.7 ICP	5	0.07	B		mg/L	0.04	0.2	08/03/18 23:26	dcm
Potassium, dissolved	M200.7 ICP	5	57			mg/L	1	5	08/06/18 13:46	aeh
Selenium, total	M200.8 ICP-MS	10	0.017			mg/L	0.001	0.003	08/06/18 14:10	bsu
Silver, total	M200.7 ICP	5		U		mg/L	0.05	0.1	08/03/18 23:26	dcm
Sodium, dissolved	M200.7 ICP	5	4090			mg/L	1	5	08/06/18 13:46	aeh
Thallium, total	M200.8 ICP-MS	10		U		mg/L	0.001	0.005	08/06/18 14:10	bsu
Vanadium, total	M200.7 ICP	5	0.11			mg/L	0.03	0.1	08/03/18 23:26	dcm
Zinc, total	M200.7 ICP	5	0.75			mg/L	0.05	0.3	08/03/18 23:26	dcm

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Hardness as CaCO3 (dissolved)	SM2340B - Calculation		2100			mg/L	1	30	08/10/18 0:00	calc
Lab Filtration (0.45um) & Acidification	M200.7/200.8/3005A	1							08/01/18 17:00	dcm

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Kleinfelder, Inc.
Project ID: 20191069
Sample ID: GW-2

ACZ Sample ID: ***L45886-02***
Date Sampled: *07/26/18 11:45*
Date Received: *07/27/18*
Sample Matrix: *Groundwater*

Inorganic Prep

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP-MS				*				08/03/18 14:48	rap
Total Hot Plate Digestion	M200.2 ICP				*				08/02/18 13:57	dcm

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Antimony, total	M200.8 ICP-MS	10	0.016	B		mg/L	0.004	0.02	08/06/18 14:12	bsu
Arsenic, total	M200.8 ICP-MS	10	0.494			mg/L	0.002	0.01	08/06/18 14:12	bsu
Barium, total	M200.7 ICP	5	9.20			mg/L	0.02	0.08	08/03/18 23:30	dcm
Beryllium, total	M200.8 ICP-MS	10	0.0421			mg/L	0.0005	0.003	08/06/18 23:24	mfm
Cadmium, total	M200.8 ICP-MS	10	0.064			mg/L	0.001	0.005	08/06/18 14:12	bsu
Calcium, dissolved	M200.7 ICP	5	304			mg/L	0.5	3	08/06/18 13:49	aeh
Chromium, total	M200.7 ICP	5	1.16			mg/L	0.05	0.3	08/03/18 23:30	dcm
Cobalt, total	M200.7 ICP	5	0.45			mg/L	0.05	0.3	08/03/18 23:30	dcm
Copper, total	M200.7 ICP	5	2.09			mg/L	0.05	0.3	08/03/18 23:30	dcm
Iron, total	M200.7 ICP	5	1300		*	mg/L	0.1	0.3	08/03/18 23:30	dcm
Lead, total	M200.8 ICP-MS	10	4.98			mg/L	0.001	0.005	08/06/18 14:12	bsu
Magnesium, dissolved	M200.7 ICP	5	258			mg/L	1	5	08/06/18 13:49	aeh
Manganese, dissolved	M200.7 ICP	5	1.05			mg/L	0.03	0.1	08/06/18 13:49	aeh
Nickel, total	M200.7 ICP	5	1.05			mg/L	0.04	0.2	08/03/18 23:30	dcm
Potassium, dissolved	M200.7 ICP	5	32			mg/L	1	5	08/06/18 13:49	aeh
Selenium, total	M200.8 ICP-MS	10	0.035			mg/L	0.001	0.003	08/06/18 14:12	bsu
Silver, total	M200.7 ICP	5		U		mg/L	0.05	0.1	08/03/18 23:30	dcm
Sodium, dissolved	M200.7 ICP	5	2570			mg/L	1	5	08/06/18 13:49	aeh
Thallium, total	M200.8 ICP-MS	10	0.010			mg/L	0.001	0.005	08/06/18 14:12	bsu
Vanadium, total	M200.7 ICP	5	1.95			mg/L	0.03	0.1	08/03/18 23:30	dcm
Zinc, total	M200.7 ICP	5	18.7			mg/L	0.05	0.3	08/03/18 23:30	dcm

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Hardness as CaCO3 (dissolved)	SM2340B - Calculation		1820			mg/L	1	30	08/10/18 0:00	calc
Lab Filtration (0.45um) & Acidification	M200.7/200.8/3005A	1							08/01/18 17:00	dcm

Arizona license number: AZ0102

Inorganic Analytical Results

Kleinfelder, Inc.
Project ID: 20191069
Sample ID: GW-3

ACZ Sample ID: ***L45886-03***
Date Sampled: *07/26/18 12:25*
Date Received: *07/27/18*
Sample Matrix: *Groundwater*

Inorganic Prep

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP-MS				*				08/03/18 15:07	rap
Total Hot Plate Digestion	M200.2 ICP				*				08/02/18 14:09	dcm

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Antimony, total	M200.8 ICP-MS	10	0.006	B		mg/L	0.004	0.02	08/06/18 14:14	bsu
Arsenic, total	M200.8 ICP-MS	10	0.238			mg/L	0.002	0.01	08/06/18 14:14	bsu
Barium, total	M200.7 ICP	5	2.43			mg/L	0.02	0.08	08/03/18 23:33	dcm
Beryllium, total	M200.8 ICP-MS	10	0.0141			mg/L	0.0005	0.003	08/06/18 23:27	mfm
Cadmium, total	M200.8 ICP-MS	10	0.009			mg/L	0.001	0.005	08/06/18 14:14	bsu
Calcium, dissolved	M200.7 ICP	5	239			mg/L	0.5	3	08/06/18 13:53	aeh
Chromium, total	M200.7 ICP	5	0.36			mg/L	0.05	0.3	08/03/18 23:33	dcm
Cobalt, total	M200.7 ICP	5	0.20	B		mg/L	0.05	0.3	08/03/18 23:33	dcm
Copper, total	M200.7 ICP	5	0.34			mg/L	0.05	0.3	08/03/18 23:33	dcm
Iron, total	M200.7 ICP	5	339		*	mg/L	0.1	0.3	08/03/18 23:33	dcm
Lead, total	M200.8 ICP-MS	10	0.354			mg/L	0.001	0.005	08/06/18 14:14	bsu
Magnesium, dissolved	M200.7 ICP	5	547			mg/L	1	5	08/06/18 13:53	aeh
Manganese, dissolved	M200.7 ICP	5	0.32			mg/L	0.03	0.1	08/06/18 13:53	aeh
Nickel, total	M200.7 ICP	5	0.31			mg/L	0.04	0.2	08/03/18 23:33	dcm
Potassium, dissolved	M200.7 ICP	5	35			mg/L	1	5	08/06/18 13:53	aeh
Selenium, total	M200.8 ICP-MS	10	0.018			mg/L	0.001	0.003	08/06/18 14:14	bsu
Silver, total	M200.7 ICP	5		U		mg/L	0.05	0.1	08/03/18 23:33	dcm
Sodium, dissolved	M200.7 ICP	5	4490			mg/L	1	5	08/06/18 13:53	aeh
Thallium, total	M200.8 ICP-MS	10	0.004	B		mg/L	0.001	0.005	08/06/18 14:14	bsu
Vanadium, total	M200.7 ICP	5	0.74			mg/L	0.03	0.1	08/03/18 23:33	dcm
Zinc, total	M200.7 ICP	5	1.44			mg/L	0.05	0.3	08/03/18 23:33	dcm

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Hardness as CaCO3 (dissolved)	SM2340B - Calculation		2850			mg/L	1	30	08/10/18 0:00	calc
Lab Filtration (0.45um) & Acidification	M200.7/200.8/3005A	1							08/01/18 17:01	dcm

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Kleinfelder, Inc.

Project ID:	20191069
Sample ID:	GW-4
ACZ Sample ID:	***L45886-04***
Date Sampled:	*07/26/18 11:00*
Date Received:	*07/27/18*
Sample Matrix:	*Groundwater*

Inorganic Prep

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP-MS				*				08/03/18 15:27	rap
Total Hot Plate Digestion	M200.2 ICP				*				08/02/18 14:45	dcm

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Antimony, total	M200.8 ICP-MS	10	0.011	B		mg/L	0.004	0.02	08/06/18 14:16	bsu
Arsenic, total	M200.8 ICP-MS	10	0.049			mg/L	0.002	0.01	08/06/18 14:16	bsu
Barium, total	M200.7 ICP	5	0.41			mg/L	0.02	0.08	08/03/18 23:50	dcm
Beryllium, total	M200.8 ICP-MS	10	0.0013	B		mg/L	0.0005	0.003	08/06/18 23:30	mfm
Cadmium, total	M200.8 ICP-MS	10	0.003	B		mg/L	0.001	0.005	08/06/18 14:16	bsu
Calcium, dissolved	M200.7 ICP	5	38.6			mg/L	0.5	3	08/06/18 13:56	aeh
Chromium, total	M200.7 ICP	5		U		mg/L	0.05	0.3	08/03/18 23:50	dcm
Cobalt, total	M200.7 ICP	5		U		mg/L	0.05	0.3	08/03/18 23:50	dcm
Copper, total	M200.7 ICP	5	0.07	B		mg/L	0.05	0.3	08/03/18 23:50	dcm
Iron, total	M200.7 ICP	5	44.4		*	mg/L	0.1	0.3	08/03/18 23:50	dcm
Lead, total	M200.8 ICP-MS	10	0.257			mg/L	0.001	0.005	08/06/18 14:16	bsu
Magnesium, dissolved	M200.7 ICP	5	488			mg/L	1	5	08/06/18 13:56	aeh
Manganese, dissolved	M200.7 ICP	5	0.04	B	*	mg/L	0.03	0.1	08/06/18 13:56	aeh
Nickel, total	M200.7 ICP	5		U		mg/L	0.04	0.2	08/03/18 23:50	dcm
Potassium, dissolved	M200.7 ICP	5	57			mg/L	1	5	08/06/18 13:56	aeh
Selenium, total	M200.8 ICP-MS	10	0.017			mg/L	0.001	0.003	08/06/18 14:16	bsu
Silver, total	M200.7 ICP	5		U		mg/L	0.05	0.1	08/03/18 23:50	dcm
Sodium, dissolved	M200.7 ICP	5	4100			mg/L	1	5	08/06/18 13:56	aeh
Thallium, total	M200.8 ICP-MS	10		U		mg/L	0.001	0.005	08/06/18 14:16	bsu
Vanadium, total	M200.7 ICP	5	0.06	B		mg/L	0.03	0.1	08/03/18 23:50	dcm
Zinc, total	M200.7 ICP	5	0.45			mg/L	0.05	0.3	08/03/18 23:50	dcm

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Hardness as CaCO3 (dissolved)	SM2340B - Calculation		2110			mg/L	1	30	08/10/18 0:00	calc
Lab Filtration (0.45um) & Acidification	M200.7/200.8/3005A	1							08/01/18 17:01	dcm

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit unless omitted or equal to the PQL (see comment #5). Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit. Synonymous with the EPA term "minimum level".
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Inorganic QC Summary

Kleinfelder, Inc.

ACZ Project ID: ***L45886***

NOTE: If the Rec% column is null, the high/low limits are in the same units as the result. If the Rec% column is not null, then the high/low limits are in % Rec.

Antimony, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453278													
WG453278ICV	ICV	08/06/18 13:19	MS180730-1	.02		.01952	mg/L	98	90	110			
WG453278ICB	ICB	08/06/18 13:21				U	mg/L		-0.0012	0.0012			
WG453142LRB	LRB	08/06/18 13:23				U	mg/L		-0.00088	0.00088			
WG453142LFB	LFB	08/06/18 13:25	MS180621-2	.01		.01032	mg/L	103	85	115			
L45881-01LFM	LFM	08/06/18 14:06	MS10XW	.1	U	.1052	mg/L	105	70	130			
L45881-01LFMD	LFMD	08/06/18 14:08	MS10XW	.1	U	.1051	mg/L	105	70	130	0	20	

Arsenic, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453278													
WG453278ICV	ICV	08/06/18 13:19	MS180730-1	.05		.04645	mg/L	93	90	110			
WG453278ICB	ICB	08/06/18 13:21				U	mg/L		-0.0006	0.0006			
WG453142LRB	LRB	08/06/18 13:23				U	mg/L		-0.00044	0.00044			
WG453142LFB	LFB	08/06/18 13:25	MS180621-2	.0501		.04853	mg/L	97	85	115			
L45881-01LFM	LFM	08/06/18 14:06	MS10XW	.501	U	.4822	mg/L	96	70	130			
L45881-01LFMD	LFMD	08/06/18 14:08	MS10XW	.501	U	.4902	mg/L	98	70	130	2	20	

Barium, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2		1.953	mg/L	98	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.009	0.009			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.0066	0.0066			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.5025		.4975	mg/L	99	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.5	2.43	5.025	mg/L	104	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.5	2.43	5.01	mg/L	103	70	130	0	20	

Beryllium, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453313													
WG453313ICV	ICV	08/06/18 22:32	MS180730-1	.05		.04621	mg/L	92	90	110			
WG453313ICB	ICB	08/06/18 22:35				U	mg/L		-0.00015	0.00015			
WG453142LRB	LRB	08/06/18 22:38				U	mg/L		-0.00011	0.00011			
WG453142LFB	LFB	08/06/18 22:41	MS180621-2	.05035		.04878	mg/L	97	85	115			
L45881-01LFM	LFM	08/06/18 23:16	MS10XW	.5035	.0062	.5135	mg/L	101	70	130			
L45881-01LFMD	LFMD	08/06/18 23:19	MS10XW	.5035	.0062	.5157	mg/L	101	70	130	0	20	

Cadmium, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453278													
WG453278ICV	ICV	08/06/18 13:19	MS180730-1	.05		.04825	mg/L	97	90	110			
WG453278ICB	ICB	08/06/18 13:21				U	mg/L		-0.0003	0.0003			
WG453142LRB	LRB	08/06/18 13:23				U	mg/L		-0.00022	0.00022			
WG453142LFB	LFB	08/06/18 13:25	MS180621-2	.05005		.04994	mg/L	100	85	115			
L45881-01LFM	LFM	08/06/18 14:06	MS10XW	.5005	.231	.7125	mg/L	96	70	130			
L45881-01LFMD	LFMD	08/06/18 14:08	MS10XW	.5005	.231	.7219	mg/L	98	70	130	1	20	

Kleinfelder, Inc. ACZ Project ID: ***L45886***

NOTE: If the Rec% column is null, the high/low limits are in the same units as the result. If the Rec% column is not null, then the high/low limits are in % Rec.

Calcium, dissolved M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453268													
WG453268ICV	ICV	08/06/18 12:38	II180727-1	100		100.38	mg/L	100	95	105			
WG453268ICB	ICB	08/06/18 12:45				U	mg/L		-0.3	0.3			
WG453268LFB	LFB	08/06/18 12:58	II180731-2	68.22088		70.98	mg/L	104	85	115			
L45886-04AS	AS	08/06/18 13:59	II180731-2	341.1044	38.6	393.45	mg/L	104	85	115			
L45886-04ASD	ASD	08/06/18 14:03	II180731-2	341.1044	38.6	395.95	mg/L	105	85	115	1	20	

Chromium, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2		1.98	mg/L	99	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.03	0.03			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.022	0.022			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.5		.505	mg/L	101	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.505	.36	2.879	mg/L	101	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.505	.36	2.894	mg/L	101	70	130	1	20	

Cobalt, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2.002		1.909	mg/L	95	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.03	0.03			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.022	0.022			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.501		.494	mg/L	99	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.5	.2	2.496	mg/L	92	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.5	.2	2.504	mg/L	92	70	130	0	20	

Copper, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2		1.954	mg/L	98	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.03	0.03			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.022	0.022			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.4975		.497	mg/L	100	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.5	.34	2.726	mg/L	95	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.5	.34	2.755	mg/L	97	70	130	1	20	

Iron, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2		1.906	mg/L	95	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.06	0.06			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.044	0.044			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	1.0018		.998	mg/L	100	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	5.007	339	394.5	mg/L	1108	70	130			M3
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	5.007	339	392	mg/L	1059	70	130	1	20	M3

Kleinfelder, Inc. ACZ Project ID: ***L45886***

NOTE: If the Rec% column is null, the high/low limits are in the same units as the result. If the Rec% column is not null, then the high/low limits are in % Rec.

Lead, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453278													
WG453278ICV	ICV	08/06/18 13:19	MS180730-1	.05		.04895	mg/L	98	90	110			
WG453278ICB	ICB	08/06/18 13:21				U	mg/L		-0.0003	0.0003			
WG453142LRB	LRB	08/06/18 13:23				U	mg/L		-0.00022	0.00022			
WG453142LFB	LFB	08/06/18 13:25	MS180621-2	.0496		.0487	mg/L	98	85	115			
L45881-01LFM	LFM	08/06/18 14:06	MS10XW	.496	.136	.6309	mg/L	100	70	130			
L45881-01LFMD	LFMD	08/06/18 14:08	MS10XW	.496	.136	.6406	mg/L	102	70	130	2	20	

Magnesium, dissolved M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453268													
WG453268ICV	ICV	08/06/18 12:38	II180727-1	100		101.38	mg/L	101	95	105			
WG453268ICB	ICB	08/06/18 12:45				U	mg/L		-0.6	0.6			
WG453268LFB	LFB	08/06/18 12:58	II180731-2	50.05667		50.45	mg/L	101	85	115			
L45886-04AS	AS	08/06/18 13:59	II180731-2	250.28335	488	743.5	mg/L	102	85	115			
L45886-04ASD	ASD	08/06/18 14:03	II180731-2	250.28335	488	751.5	mg/L	105	85	115	1	20	

Manganese, dissolved M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453268													
WG453268ICV	ICV	08/06/18 12:38	II180727-1	2		1.9982	mg/L	100	95	105			
WG453268ICB	ICB	08/06/18 12:45				U	mg/L		-0.015	0.015			
WG453268LFB	LFB	08/06/18 12:58	II180731-2	.5005		.5046	mg/L	101	85	115			
L45886-04AS	AS	08/06/18 13:59	II180731-2	2.5025	.04	2.556	mg/L	101	85	115			
L45886-04ASD	ASD	08/06/18 14:03	II180731-2	2.5025	.04	2.559	mg/L	101	85	115	0	20	

Nickel, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2.004		1.9538	mg/L	97	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.024	0.024			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.0176	0.0176			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.5015		.5073	mg/L	101	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.5	.31	2.69	mg/L	95	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.5	.31	2.673	mg/L	95	70	130	1	20	

Potassium, dissolved M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453268													
WG453268ICV	ICV	08/06/18 12:38	II180727-1	20		20.28	mg/L	101	95	105			
WG453268ICB	ICB	08/06/18 12:45				U	mg/L		-0.6	0.6			
WG453268LFB	LFB	08/06/18 12:58	II180731-2	99.72934		104.1	mg/L	104	85	115			
L45886-04AS	AS	08/06/18 13:59	II180731-2	498.6467	57	586.5	mg/L	106	85	115			
L45886-04ASD	ASD	08/06/18 14:03	II180731-2	498.6467	57	586.5	mg/L	106	85	115	0	20	

Inorganic QC Summary

Kleinfelder, Inc.

ACZ Project ID: ***L45886***

NOTE: If the Rec% column is null, the high/low limits are in the same units as the result. If the Rec% column is not null, then the high/low limits are in % Rec.

Selenium, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453278													
WG453278ICV	ICV	08/06/18 13:19	MS180730-1	.05		.0481	mg/L	96	90	110			
WG453278ICB	ICB	08/06/18 13:21				U	mg/L		-0.0003	0.0003			
WG453142LRB	LRB	08/06/18 13:23				U	mg/L		-0.00022	0.00022			
WG453142LFB	LFB	08/06/18 13:25	MS180621-2	.05005		.04799	mg/L	96	85	115			
L45881-01LFM	LFM	08/06/18 14:06	MS10XW	.5005	U	.5023	mg/L	100	70	130			
L45881-01LFMD	LFMD	08/06/18 14:08	MS10XW	.5005	U	.5038	mg/L	101	70	130	0	20	

Silver, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	1.001		1.001	mg/L	100	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.03	0.03			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.022	0.022			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.5		.491	mg/L	98	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.5025	U	2.338	mg/L	93	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.5025	U	2.362	mg/L	94	70	130	1	20	

Sodium, dissolved M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453268													
WG453268ICV	ICV	08/06/18 12:38	II180727-1	100		101.63	mg/L	102	95	105			
WG453268ICB	ICB	08/06/18 12:45				U	mg/L		-0.6	0.6			
WG453268LFB	LFB	08/06/18 12:58	II180731-2	100.6711		104.5	mg/L	104	85	115			
L45886-04AS	AS	08/06/18 13:59	II180731-2	503.3555	4100	4616.5	mg/L	103	85	115			
L45886-04ASD	ASD	08/06/18 14:03	II180731-2	503.3555	4100	4640.5	mg/L	107	85	115	1	20	

Thallium, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453278													
WG453278ICV	ICV	08/06/18 13:19	MS180730-1	.05		.0491	mg/L	98	90	110			
WG453278ICB	ICB	08/06/18 13:21				U	mg/L		-0.0003	0.0003			
WG453142LRB	LRB	08/06/18 13:23				U	mg/L		-0.00022	0.00022			
WG453142LFB	LFB	08/06/18 13:25	MS180621-2	.0501		.04821	mg/L	96	85	115			
L45881-01LFM	LFM	08/06/18 14:06	MS10XW	.501	.002	.4923	mg/L	98	70	130			
L45881-01LFMD	LFMD	08/06/18 14:08	MS10XW	.501	.002	.5003	mg/L	99	70	130	2	20	

Vanadium, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2		2.0002	mg/L	100	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.015	0.015			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.011	0.011			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.501		.4981	mg/L	99	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.5	.74	3.445	mg/L	108	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.5	.74	3.492	mg/L	110	70	130	1	20	

NOTE: If the Rec% column is null, the high/low limits are in the same units as the result. If the Rec% column is not null, then the high/low limits are in % Rec.

Zinc, total M200.7 ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec%	Lower	Upper	RPD	Limit	Qual
WG453216													
WG453216ICV	ICV	08/03/18 22:12	II180626-2	2		2.011	mg/L	101	95	105			
WG453216ICB	ICB	08/03/18 22:18				U	mg/L		-0.03	0.03			
WG453040LRB	LRB	08/03/18 22:31				U	mg/L		-0.022	0.022			
WG453040LFB	LFB	08/03/18 22:35	II180731-2	.4942		.523	mg/L	106	85	115			
L45886-03LFM	LFM	08/03/18 23:36	II5XWATER	2.5025	1.44	3.998	mg/L	102	70	130			
L45886-03LFMD	LFMD	08/03/18 23:40	II5XWATER	2.5025	1.44	3.994	mg/L	102	70	130	0	20	

Inorganic Extended Qualifier Report

Kleinfelder, Inc.

ACZ Project ID: ***L45886***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L45886-01	WG453216	Iron, total	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG453268	Manganese, dissolved	M200.7 ICP	DA	Sample required dilution due to reactivity.
			M200.7 ICP	DD	Sample required dilution due to matrix color or odor.
	WG453040	Total Hot Plate Digestion	M200.2 ICP	DA	Sample required dilution due to reactivity.
			M200.2 ICP	DD	Sample required dilution due to matrix color or odor.
	WG453142		M200.2 ICP-MS	DF	Sample required dilution due to high sediment.
	WG453040		M200.2 ICP	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.
	WG453142		M200.2 ICP-MS	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.
L45886-02	WG453216	Iron, total	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG453040	Total Hot Plate Digestion	M200.2 ICP	DA	Sample required dilution due to reactivity.
			M200.2 ICP	DD	Sample required dilution due to matrix color or odor.
	WG453142		M200.2 ICP-MS	DF	Sample required dilution due to high sediment.
	WG453040		M200.2 ICP	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.
	WG453142		M200.2 ICP-MS	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.
L45886-03	WG453216	Iron, total	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG453040	Total Hot Plate Digestion	M200.2 ICP	DA	Sample required dilution due to reactivity.
			M200.2 ICP	DD	Sample required dilution due to matrix color or odor.
	WG453142		M200.2 ICP-MS	DF	Sample required dilution due to high sediment.
	WG453040		M200.2 ICP	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.
	WG453142		M200.2 ICP-MS	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.
L45886-04	WG453216	Iron, total	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG453268	Manganese, dissolved	M200.7 ICP	DA	Sample required dilution due to reactivity.
			M200.7 ICP	DD	Sample required dilution due to matrix color or odor.
	WG453040	Total Hot Plate Digestion	M200.2 ICP	DA	Sample required dilution due to reactivity.
			M200.2 ICP	DD	Sample required dilution due to matrix color or odor.
	WG453142		M200.2 ICP-MS	DF	Sample required dilution due to high sediment.
	WG453040		M200.2 ICP	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.
	WG453142		M200.2 ICP-MS	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.

Certification Qualifiers

Kleinfelder, Inc.

ACZ Project ID: ***L45886***

No certification qualifiers associated with this analysis

Sample Receipt

Kleinfelder, Inc.
20191069

ACZ Project ID: L45886
Date Received: 07/27/2018 12:36
Received By:
Date Printed: 7/30/2018

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody form or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?		X	▨
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		▨
6) Is the Chain of Custody form complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody form prior to ACZ receiving the samples?		X	▨

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody form match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits? [1]		X	

L45886-01 Container B2015616 (RED PC): Added 2 mls nitric acid to the sub-sample to adjust the pH to the appropriate range.

L45886-02 Container B2015618 (RED PC): Added 2 mls nitric acid to the sub-sample to adjust the pH to the appropriate range.

L45886-03 Container B2015620 (RED PC): Added 2 mls nitric acid to the sub-sample to adjust the pH to the appropriate range.

L45886-04 Container B2015622 (RED PC): Added 2 mls nitric acid to the sub-sample to adjust the pH to the appropriate range.

	YES	NO	NA
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

NA indicates Not Applicable

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

Cooler Id	Temp(°C)	Temp Criteria(°C)	Rad(µR/Hr)	Custody Seal Intact?

Kleinfelder, Inc.
20191069

ACZ Project ID: L45886
Date Received: 07/27/2018 12:36
Received By:
Date Printed: 7/30/2018

```
---------  --------  -----------  ----------  ------------
NA28809    2.7       NA           20          Yes
```

Was ice present in the shipment container(s)?

`Yes - Wet ice was present in the shipment container(s).`

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

[1] The preservation of the following bottle types is not checked at sample receipt: Orange (oil and grease), Purple (total cyanide), Pink (dissolved cyanide), Brown (arsenic speciation), Sterile (fecal coliform), EDTA (sulfite), HCl preserved vial (organics), Na2S2O3 preserved vial (organics), and HG-1631 (total/dissolved mercury by method 1631).

ACZ Laboratories, Inc. L45886

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Bill Bergeron
Company: Kleinfelder
E-mail: bbergeron@kleinfelder
Address:
Telephone: 781 572 4574

Copy of Report to:

Name: Brad Woodard
Company: Kleinfelder
E-mail: bwoodard@kleinfelder.c
Telephone:

Invoice to:

Name: Same as above
Company:
E-mail:
Address:
Telephone:

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified

Are samples for SDWA Compliance Monitoring? Yes ☐ No ☐

If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name: R.Berger **Sampler's Site Information** **State**____ **Zip code**____ **Time Zone**____

***Sampler's Signature**

*I attest to the authenticity and validity of this sample. I understand that intentionally mislabeling the time/date/location or tampering with the sample in anyway, is considered fraud and punishable by State Law.

PROJECT INFORMATION ANALYSES REQUESTED *(attach list or use quote number)*

Quote #:
PO#: 20191069
Reporting state for compliance testing:
Check box if samples include NRC licensed material? ☐

SAMPLE IDENTIFICATION	DATE:TIME		Matrix	# of Containers	Total Metals	Dissolved Metals
G-W-1	7/26/18	1045	W	2	X	X
G-W-2	↓	1145	W	2	X	X
G-W-3		1225	W	2	X	X
G-W-4		1100	W	2	X	X

BP 7/26/18

Matrix: SW (Surface Water) · [✓ GW (Ground Water)] · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Dissolved are unfiltered

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	7/26/18 1455	D Haney	7/26/18 2:35
D Haney to UPS	7/26/18 3:30	JJC	7.27.18 12:36

L45886 Chain of Custod

Appendix G

Groundwater Sampling Results 2011 and 2018

Groundwater Sampling Results

Parameter	Units	Sampling Event 3/28/2006	Sampling Event 4/11/2011	Sampling Event GW-1 7/26/2018	GW-2 7/26/2018	GW-3 7/26/2018	GW-4 7/26/2018	MCL	PQL
Arsenic	mg/L	0.0071	0.01	0.048	0.494	0.238	0.049	0.005	0.003
Barium	mg/L	0.056	0.095	0.6	9.2	2.43	0.41	2	0.01
Calcium	mg/L	338	360	39.5	304	239	38.6		10
Chromium	mg/L	0.01	BDL		1.16	0.36		0.01	0.05
Cobalt	mg/L	0.02	BDL		0.45	0.2			0.05
Magnesium	mg/L	593	190	485	258	547			10
Manganese	mg/L	1.45	BDL	0.05	1.05	0.32	0.04	0.05*	0.3
Nickel	mg/L	0.03	BDL	0.07	1.05	0.31		0.1	0.05
Potassium	mg/L	21	19	57	32	35	57		10
Sodium	mg/L	3380	5000	4090	2570	4490	4100		10
Thallium	mg/L	0.0003	BDL		0.01	0.004		0.0002	0.0005
Vanadium	mg/L	0.013	BDL	0.11	1.95	0.74	0.06		0.03
Zinc	mg/L	0.04	BDL	0.75	18.7	1.44	0.45		0.05
Iron	mg/L	BDL	7.7	5	1300	339	44.4	0.3*	0.5
Alkalinity Bicarbonate	mg/L	1310	940						20
Total Alkalinity	mg/L	1310	940						20
Total Organic Carbon	mg/L	47	14						30
Cation-Anion Balance	%	1.7	BDL						
Sum of Anions	meq/L	208	BDL						0.5
Sum of Cations	meq/L	215	BDL						0.5
Chloride	mg/L	480	200					250*	50
Conductivity	umhos/cm	15700	19000						10
Hardness	mg/L	3280	1900	2100	1820				7
Nitrate	mg/L	0.1	BDL					10	0.1
pH	units	7.8	7.5					6.5-8.5*	0.1
Filterable Residue	mg/L	15400	BDL						20
Sodium Absorption		26	BDL						0.15
Sulfate	mg/L	8030	12000					250*	300
TDS	mg/L	13600	18000					500*	50
TDS (ratio)		1.13							
cis-1,2-Dichloroethene	ug/L	29.8	BDL					5	1
Trichloroethene	ug/L	12	BDL					2000	1

*Secondary (Non-Enforceable) Regulations

PQL - Practical Quantification Limit

MCL - Maximum Contaminant Level

BDL - Below Detectable Level

mg/L - Milligrams per Liter

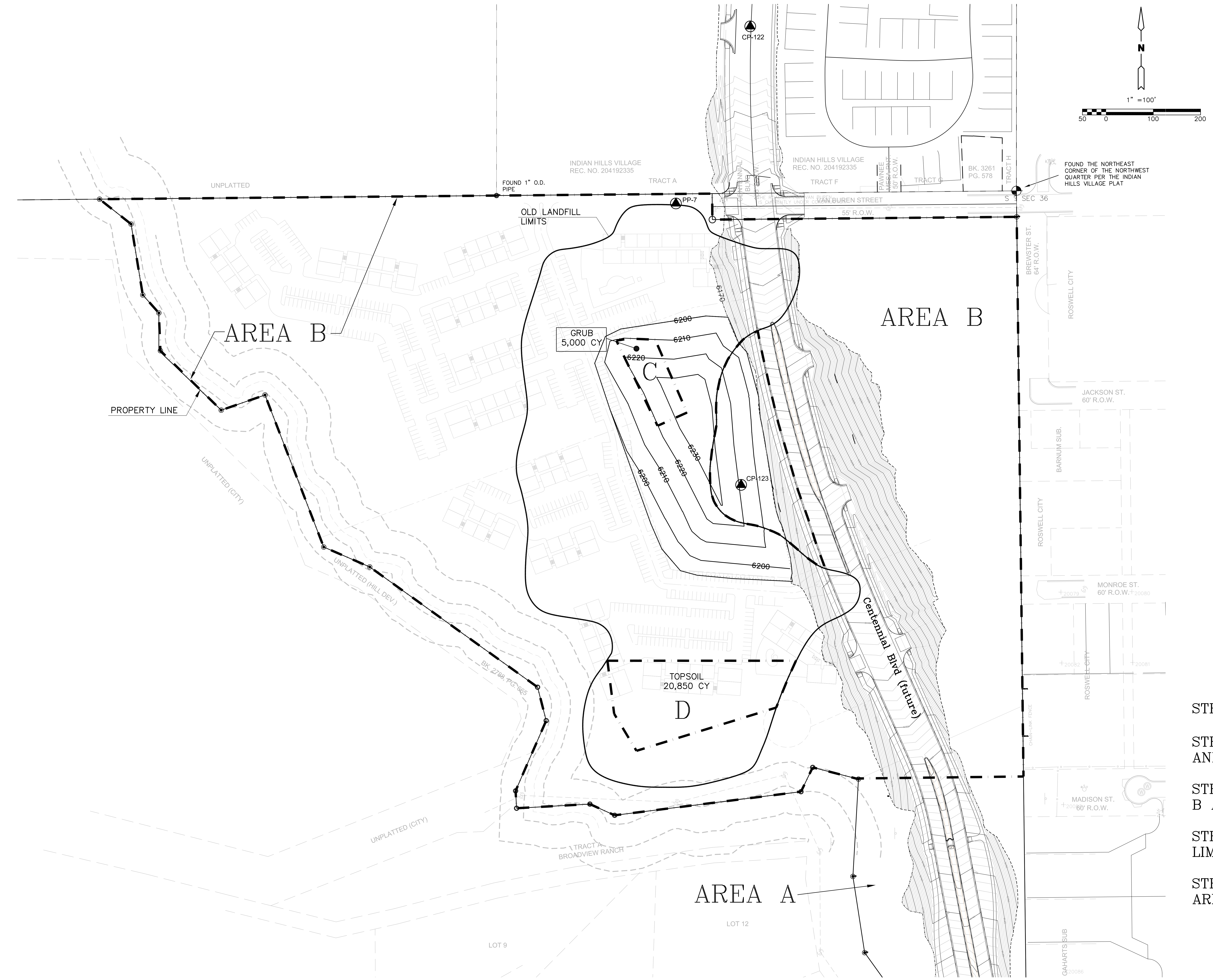
meq/L - Milliequivalents per Liter

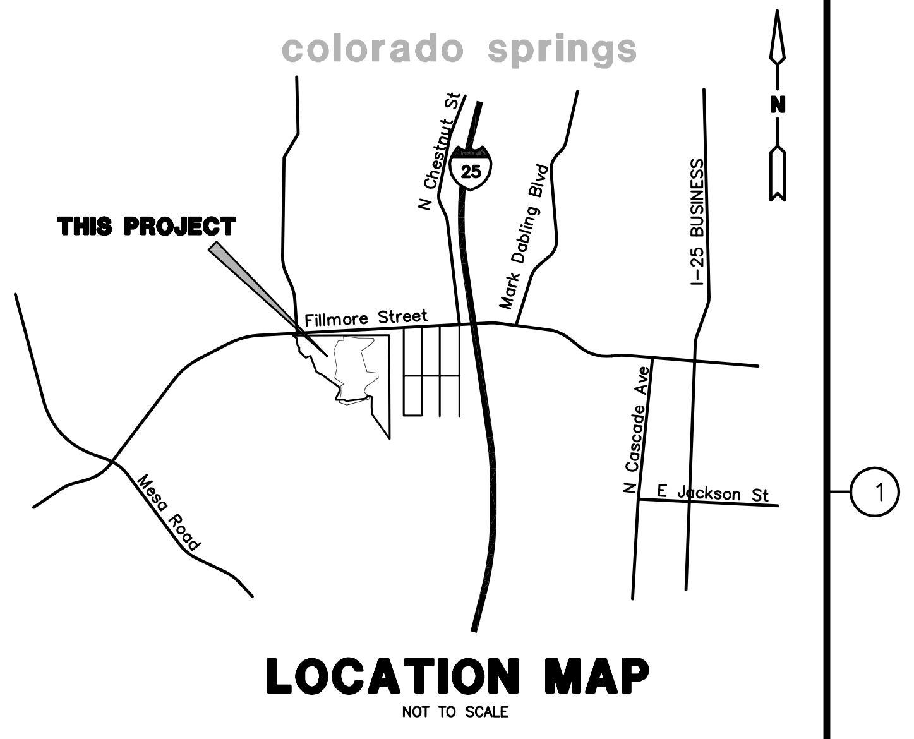
umhos/cm - Micromhos per Centimeter

ug/L - Micrograms per Liter

Appendix H

Drawings





LOCATION MAP

NOT TO SCALE

STEPS:

STEP 1: CLEAR/CHIP TREES IN AREA B AND STOCKPILE IN AREA A

STEP 2: GRUB THE VEGETATION IN AREA B AND STOCKPILE VEGETATION IN AREA C

STEP 3: EXCAVATE ALL TOP SOIL WITHIN LIMITS OF AREA B.

STEP 4: STOCKPILE SOIL FROM AREA B IN AREA D.

REV. NO.	DATE	REVISIONS

DESIGNED BY: JPC
DRAWN BY: MDK
SHEET CHK'D BY: JPC
APPROVED BY: JPC
DATE: OCTOBER 2018
FILE:
XREFS:

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ESD

ENGINEER'S STAMP

MVS Development, LLC
Greenwood Village, Colorado

Mesa Valley Springs Property

SITE CLEANUP PROCEDURES

PROJECT/FILE NO.

SHEET NO.
1

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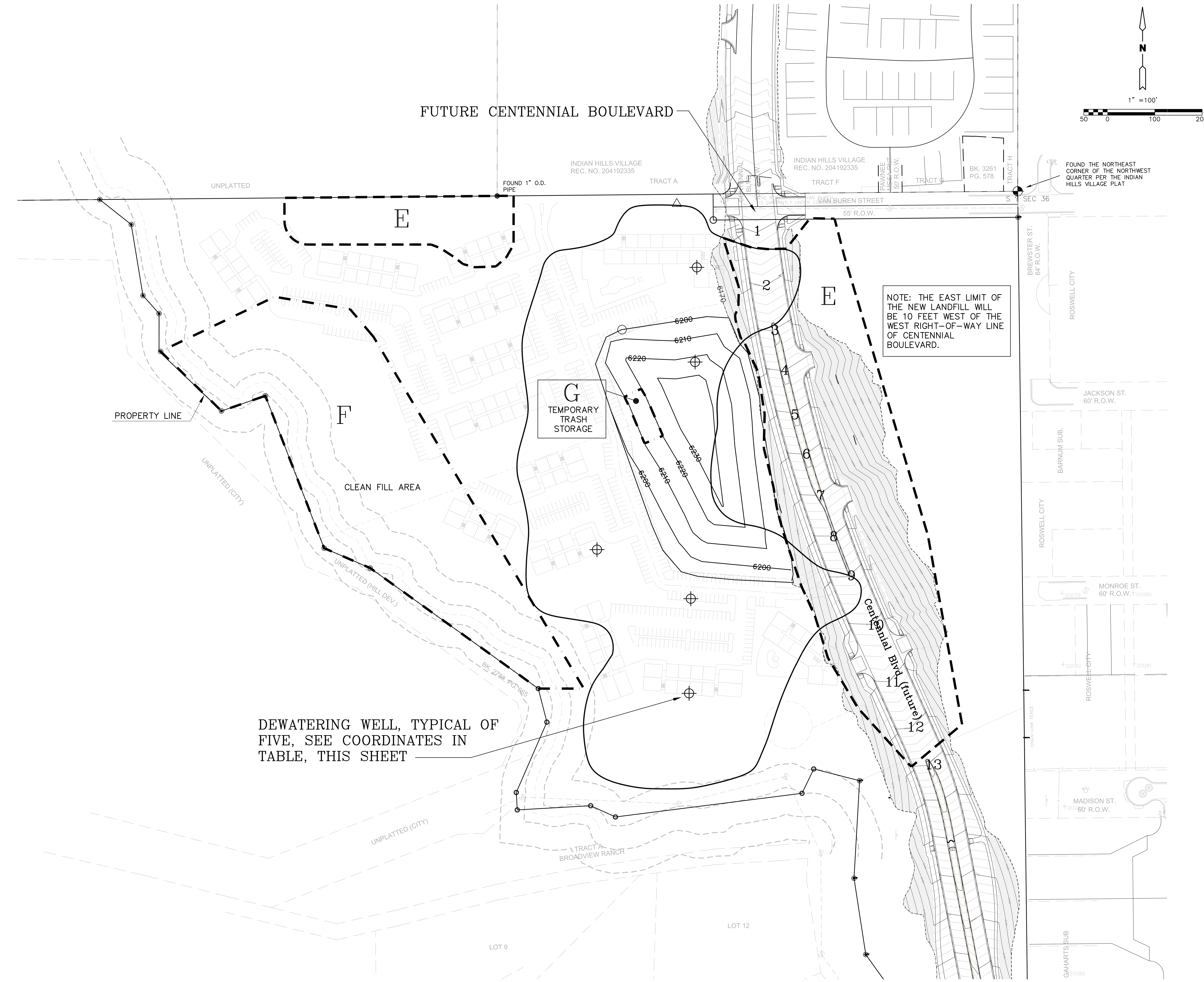

STEP 5: EXCAVATE AREA E AND PLACE AND COMPACT CLEAN SOIL IN AREA F. PLACE ANY SOLID WASTE THAT IS EXCAVATED IN TEMPORARY STORAGE AREA G. SOLID WASTE PLACED IN STORAGE AREA G TO HAVE DAILY COVER PLACED EACH DAY NEW SOLID WASTE IS ADDED.

STEP 6: INSTALL 5 DEWATERING WELLS IN EXISTING WASTE AREA. WELL COORDINATES ARE:

WELL	NORTHING	EASTING
113	377723.5150	188195.0932
121	377523.5480	188191.4608
134	377127.2464	187984.2290
141	377023.6305	188182.3798
151	376823.6635	188178.7475

STEP 7: AREA E SHALL BE EXCAVATED TO MATCH SUBGRADE OF FUTURE CENTENNIAL BOULEVARD. THE PROPOSED ELEVATIONS (24 INCHES OVER-EXCAVATION OF THE SUBGRADE CENTERLINE ARE PROVIDED IN THE FOLLOWING TABLE:

PONT	ELEVATION
1	6018
2	6013
3	6008
4	6003
5	5998
6	5993
7	5988
8	5983
9	5978
10	5973
11	5968
12	5963
13	5958

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SITE CLEANUP PROCEDURES

PROJECT/FILE NO.

SHEET NO.
2

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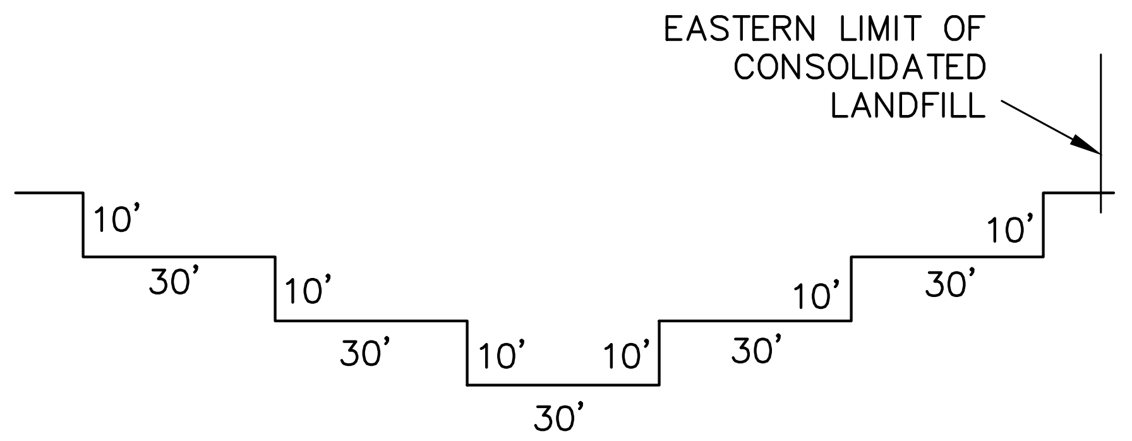
NOTE: THE EAST LIMIT OF THE NEW LANDFILL WILL BE 10 FEET WEST OF THE WEST RIGHT-OF-WAY LINE OF CENTENNIAL BOULEVARD.

STEP 8: EXCAVATE AREA H UTILIZING SCRAPERS.

EXCAVATION SHOULD BE CONDUCTED AS SHOWN IN THE CROSS SECTION BELOW. AREA H_A SHOULD BE EXCAVATED FIRST. THERE SHOULD BE NO SOLID WASTE IN THE AREA LABELED H_A. THE SOIL FROM AREA H_A SHOULD BE PLACED AND COMPACTED IN THE CLEAN FILL AREA. ONCE AREA H HAS BEEN EXCAVATED, MOVE SOLID WASTE FROM TEMPORARY STORAGE AREA G AND FROM THOSE PORTIONS OF AREA H THAT CONTAIN SOLID WASTE INTO AREA H .

NOTE:
THE GRADE OF EACH TERRACE SHOULD BE SET BY THE CUT SUBGRADE OF ADJACENT CENTENNIAL BLVD.



VCUP PIT #1 SECTION

SECTION

SCALE: 1"=30'

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3

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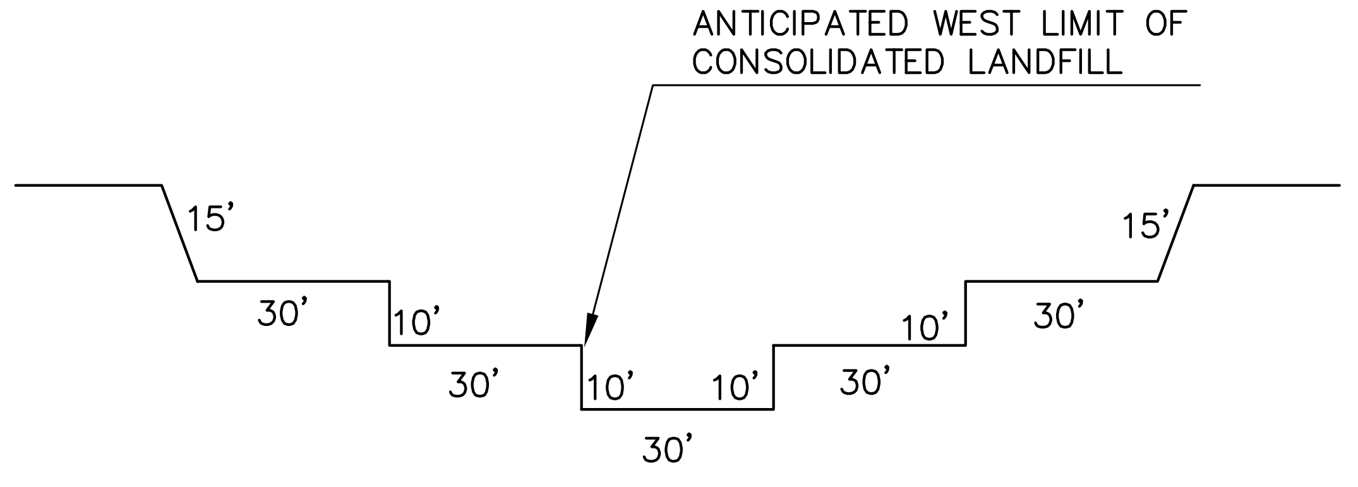
NOTE: THE EAST LIMIT OF THE NEW LANDFILL WILL BE 10 FEET WEST OF THE WEST RIGHT-OF-WAY LINE OF CENTENNIAL BOULEVARD.

STEP 9: MOVE WASTE FROM AREA I TO TRASH FILL AREA ON EASTERN PORTION OF NEW LANDFILL (AREA H).

STEP 10: EXCAVATE AREA I UTILIZING STEP METHOD SHOWN BELOW.



SECTION
SCALE: 1"=30'

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STEP 11: MOVE WASTE FROM AREA NORTH OF CONSOLIDATED LANDFILL AND PLACE IN AREA H.

WHEN PLACING WASTE IN NEW LANDFILL AREA PLACE IN MAXIMUM OF THREE FOOT LIFTS. COMPACT EACH LIFT WITH A MINIMUM OF SIX PASSES, THREE EAST-WEST AND THREE NORTH-SOUTH.

AT THE END OF EACH DAY'S WORK, PLACE 6-INCHES OF SOIL OVER ALL EXPOSED WASTE WITHIN THE LIMITS OF THE CONSOLIDATED LANDFILL.

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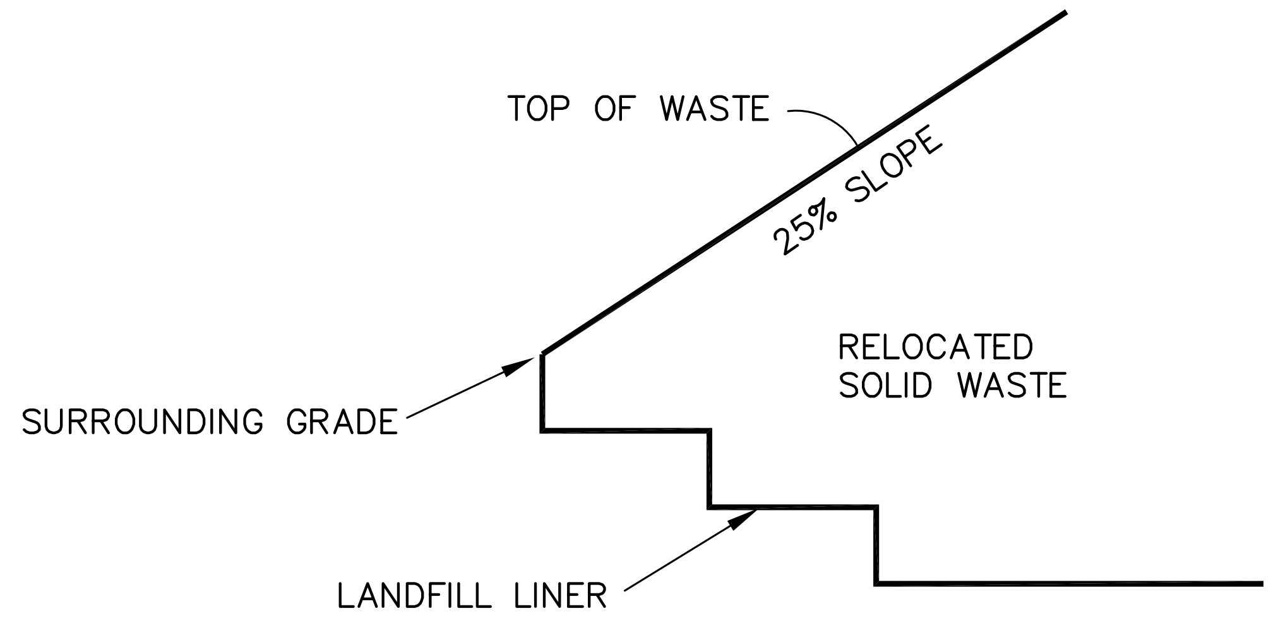
STEP 12:

REMOVE WASTE FROM DASHED AREA AND PLACE IN AREAS H AND I. PLACE WASTE IN MAXIMUM OF THREE FOOT LIFTS. WHEN THE WASTE REACHES THE SURROUNDING GRADE ELEVATION, BEGIN FILLING THE LANDFILL AT A 25% GRADE. SEE DRAWING BELOW. CONTINUE FILLING INSIDE THE LIMITS OF THE CONSOLIDATED LANDFILL UNTIL ALL WASTE IS WITHIN THE LIMITS OF THE CONSOLIDATED LANDFILL.



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STEP 13:
WHEN ALL WASTE IS WITHIN LIMITS OF THE CONSOLIDATED LANDFILL, CONTOUR THE AREA THAT IS ABOVE GRADE AT A SLOPE OF 25%. THE SLOPING SHOULD BEGIN AT THE SOUTH, NORTH, EAST, AND WEST EDGES OF THE LANDFILL AND SLOPE UPWARD. BASED ON THE INITIAL CALCULATION OF WASTE AT THE SITE, THE FINAL ELEVATION SHOULD BE 6230 BUT THIS ELEVATION MAY BE LESS OR MORE DEPENDING UPON THE EFFICIENCY OF PLACEMENT AND COMPACTION OF THE WASTE AS WELL AS THE ACTUAL QUANTITY OF THE WASTE.

ONCE THE LANDFILL IS SHAPED INSTALL THE FINAL COVER. THE FINAL COVER WILL BE INSTALLED AS PROVIDED IN THE FINAL DESIGN FOR THE LANDFILL.

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SITE CLEANUP PROCEDURES

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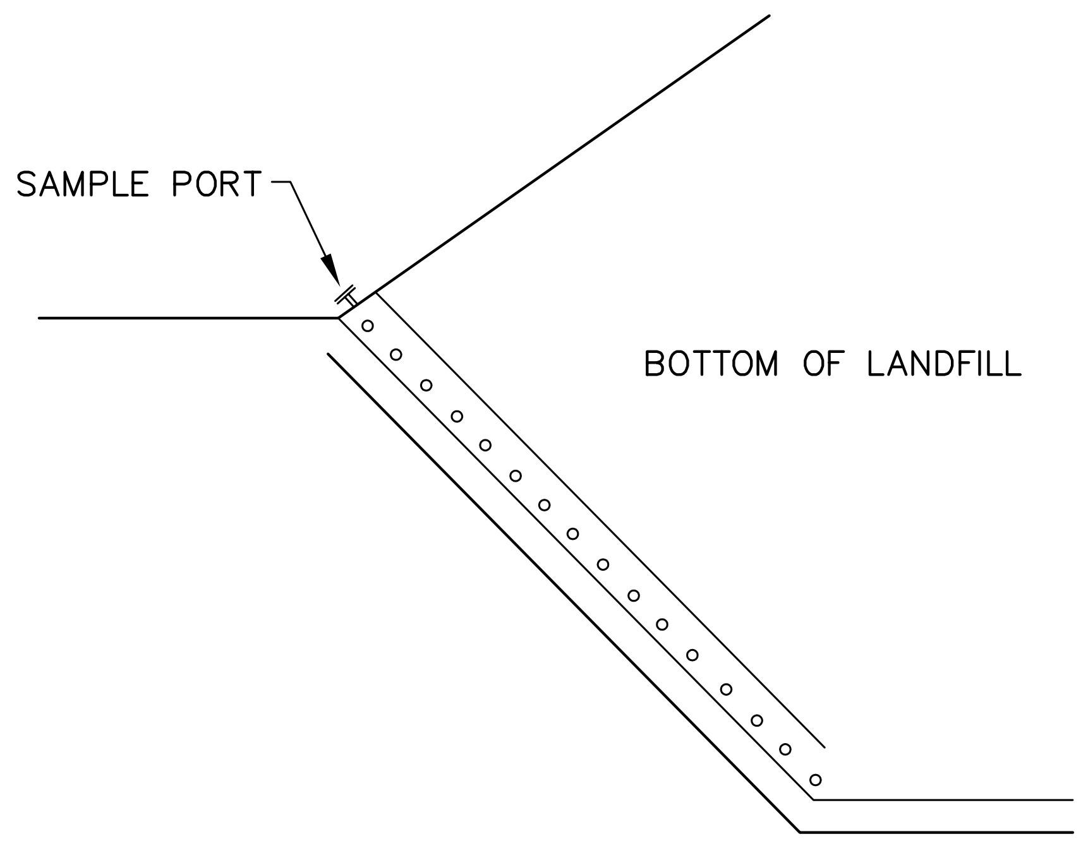
NOTE: THE EAST LIMIT OF THE NEW LANDFILL WILL BE 10 FEET WEST OF THE WEST RIGHT-OF-WAY LINE OF CENTENNIAL BOULEVARD.

STEP 14:
A LANDFILL GAS MONITORING SYSTEM WILL BE INSTALLED AT THE LANDFILL. THIS SYSTEM WILL UTILIZE 3-INCH PVC SCHEDULE 40 PERFORATED PIPE THAT WILL BE INSTALLED AT EACH CORNER OF THE LANDFILL AS WELL AS AT POINTS ALONG THE EDGE OF THE LANDFILL. THE PIPE WILL BE INSTALLED ALONG THE SIDES OF THE LANDFILL AND WILL BE PLACED AS SHOWN IN THE DRAWING BELOW. THE TOP OF THE PIPE WILL HAVE A SECURED CAP WHERE A SAMPLE PORT WILL BE INSTALLED.



LANDFILL GAS MONITORING SYSTEM

STEP 15:
IN THE SOUTHEAST CORNER OF THE PROPERTY A STORMWATER DETENTION POND WILL BE CONSTRUCTED. THIS POND WILL OVERLAY SOLID WASTE THAT IS PRESENTLY BURIED UNDER 25 FEET OF SOIL. THE CONTRACTOR WILL REMOVE THE OVERBURDEN AND WHATEVER WASTE MAY BE IN THE SOIL TO EXPOSE THE SOLID WASTE AT DEPTH. THE SOLID WASTE WILL BE COMPACTED AND THEN COVERED WITH SOIL. A LINER SYSTEM WILL BE INSTALLED TO PROTECT THE SOLID WASTE FROM MOISTURE AS WELL AS RETAIN THE STORMWATER WITHIN THE POND. APPENDIX O PROVIDES FURTHER DETAILS REGARDING THE STORMWATER DETENTION POND.

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SITE CLEANUP PROCEDURES

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Appendix I

Final Cover Analysis

FINAL COVER ANALYSIS

INTRODUCTION

After the solid waste is properly consolidated, the landfill will receive a final cover designed to protect the landfill and allow for the area to be used as open space. This document addresses options and analysis of final covers for the proposed consolidated landfill.

FINAL COVER OPTIONS

For this site, the final cover must be capable of supporting native vegetation and, possibly foot traffic. Because of this anticipated use, it will be important to select a final cover that provides protection as well as flexibility to accommodate future uses of the site.

There are a number of final covers that could be utilized for this site: (1) prescribed cover; (2) composite cover; (3) monolithic cover; (4) evapotranspiration cover; and (5) capillary barrier cover. A description of each cover is provided in the following paragraphs.

The prescribed cover is comprised of two layers: (a) an infiltration layer typically at least 18 inches thick and (b) a vegetative layer that is a minimum of 6 inches thick. The first layer, which must be a minimum of 18-inches thick, is an infiltration layer that is comprised of material that has a permeability of no greater than 1×10^{-5} cm/sec. This first layer is covered by a 6-inch vegetative layer. Based on the geotechnical testing conducted at this site (see Appendix B, C, D, E, and F) the on-site soils have the potential to meet the permeability requirements for this type of final cover.

The composite cover consists of a 6-inch soil base (on-site soils can be utilized) overlain by a geomembrane with a minimum thickness of 30 mil. A minimum 12-inch soil layer is placed over the geomembrane to protect it and allow for vegetative growth. This protective layer would be a minimum of eighteen inches thick. Based on geotechnical analyses of the on-site soils, these soils would be acceptable for use in this cover.

ALTERNATIVE FINAL COVERS

The monolithic, evapotranspiration, and capillary barrier covers are all considered alternative final covers. Each of these covers must be capable of providing equivalent protection as the prescribed or composite cover.

The monolithic cover consists of one layer of soil and is typically utilized in low precipitation areas or where there is a significant amount of soil available. The soil layer has a thickness of at least 30 to 48 inches. The actual thickness is based on the results of computer modeling that identifies the thickness of the soil needed to be equivalent to the prescribed cover. Based on the laboratory testing conducted on the on-site soils, the soils have a hydraulic conductivity of 1.18 x10^{-6} cm/sec or greater. This result indicates that the on-site soils, when properly compacted, can provide sufficient protection for final cover.

The evapotranspiration cover is comprised of one layer that is capable of supporting significant vegetative growth which is placed over a compacted subgrade. The utilization of vegetation is critical to the function of the cover as the vegetation is utilized to absorb precipitation that infiltrates the cover. A silty or loam type of soil is best for this type of cover, although sandy or clayey soils can be utilized if they are mixed with compost or other materials that will allow for vegetative growth. The type of vegetation used for this cover should be carefully considered because roots that have been left by vegetation that has died off due frost can become conduits for precipitation.

The capillary barrier cover is a variation on the evapotranspiration cover. This cover utilizes vegetation to absorb precipitation that infiltrates the cover and also includes a coarse and sand layer that creates a barrier to the migration of precipitation from the vegetative soil to the sand. A disadvantage to this cover is availability of sands or similar materials.

DETERMINATION OF FINAL COVER

It is important to identify the optimal cover for this consolidated landfill site. As noted previously, the landfill will be utilized as open space. Walking trails and certain native vegetation may be established on portions of the consolidated landfill. Because of these uses, it is necessary that the final cover can support vegetation, allow for foot traffic, be flexible in its ability to respond to these uses, and be easily repaired. In addition to identifying the proper cover, it is important to establish a maximum slope for the landfill area to better control the impact of erosion on the final cover. To accomplish this, the maximum slope should be 25% or 4:1.

Given the proposed use of the site and the slope criteria, the recommended optimal final cover should be either the evapotranspiration or capillary barrier final cover. These two covers offer the best potential for vegetative growth, can respond to foot traffic, and will be the most flexible given the soil circumstances at the site. More importantly, given the low permeability of the on-site soils, any precipitation that reaches the bottom of the final cover will be retained on the surface of the subsoil.

The cost of installing the final cover and the estimated level of effort to maintain it should determine which final cover is selected for use on the consolidated landfill area. Considering the cost to import the fine and coarse sand, the capillary barrier cover would be more expensive to install due to material, hauling, and placement costs.

As noted earlier the evapotranspiration final cover may have maintenance issues due to potential impacts from certain vegetation. By choosing the proper vegetation and conducting regularly scheduled inspections of the cover, the impact of unacceptable vegetation can be controlled. It is anticipated that the cost for these maintenance efforts would be less than the costs for installing the capillary barrier final cover.

Appendix J

Soil Sampling Program

SOIL SAMPLING PROGRAM

INTRODUCTION

Once properly consolidated, the landfill will receive a final cover designed to protect the landfill and allow for the area to be utilized as open space. To ensure the soils that are directly adjacent to and below the existing landfill are clean and free of any contaminants, these soils will be sampled as outlined in the following program.

SOIL SAMPLING PROGRAM

To confirm that all solid waste and contaminants associated with the solid waste have been removed during the excavation of the existing landfill, the soils directly adjacent to and below the existing landfill will be sampled. Samples will be taken at the side walls and bottom of the excavation once all of the solid waste is removed.

The sampling procedure involves two steps. The first step is to insert a 1-inch probe into the side wall and bottom of each excavation, which will penetrate the side wall and bottom at least 2 feet. The probe will be removed and the resulting hole will be checked for landfill gas and other volatile organics utilizing a gas/vapor meter. If the test is positive, the excavation will be allowed to ventilate to remove the vapors including VOCs.

Once the vapors have diminished or if the test results indicate the vapors/gases are below minimum concentration levels, then a sample of the soil will be taken. This sample will be placed in a container of adequate size to allow for testing the soils for all metals listed on the following page.

Once the results of the soil samples are obtained and the samples are found to contain no contaminants, the area sampled will be backfilled. If any contaminants are found, the excavation will be further expanded until clean soil is found. Once clean soil is encountered, the sampling process is ended and the next area of concern will be tested.

It is anticipated that there will be a minimum of four excavations – one on each side of the landfill. A minimum of four different locations within each excavation will be randomly selected for sampling. If there are significant contamination issues within an excavation, more samples will be taken.

As a part of the final design for the consolidated landfill, a detailed specification will be prepared for this sampling procedures. The specification will be submitted to CDPHE and results of all sampling tests will be provided in the Engineer’s Report which will be submitted to CDPHE when the landfill consolidation is completed.

Metals to be Tested for From Soil Samples Gathered from the Bottom and Side Walls of the Excavations

- Magnesium
- Sodium
- Potassium
- Calcium
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Copper
- Cobalt
- Lead
- Nickel
- Selenium
- Silver
- Thallium
- Zinc
- Sulfate
- Nitrite
- Nitrate
- Vanadium

Appendix K

Erosion Protection Program

EROSION PROTECTION PROGRAM

INTRODUCTION

A continual issue with any landfill site is the control of erosion. This document addresses the issue of erosion on the consolidated landfill.

STORMWATER POTENTIAL

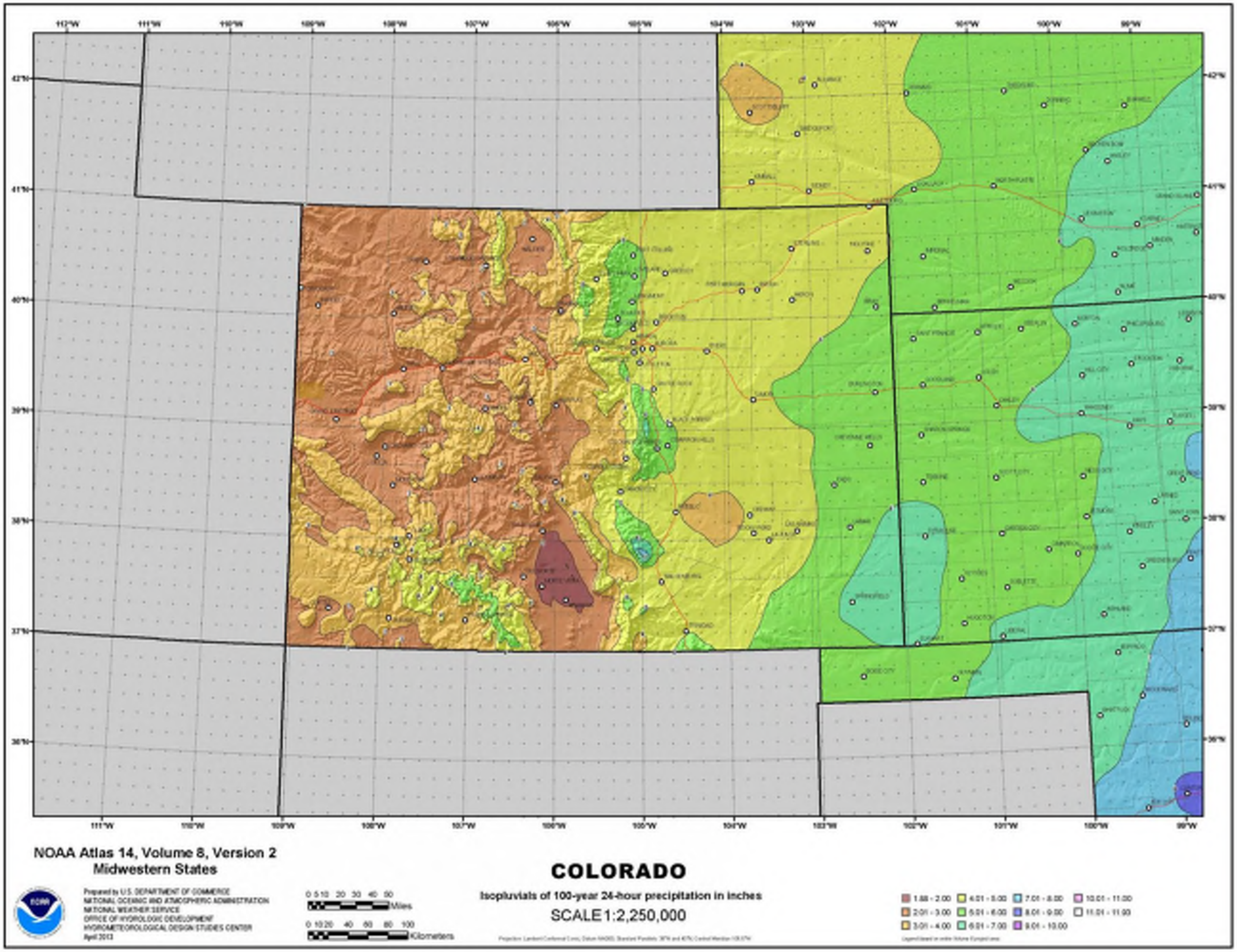
The Colorado Department of Public Health and Environment requested that the landfill site be capable of controlling the impact of a 100-year, 24-hour storm event. The greatest impact to the site from a 100-year, 24-hour storm event would be erosion. Data from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8 indicates the anticipated precipitation of a 100-year, 24-hour storm event, at this location, is 5.25 inches (see NOAA map on following page). This type of rainfall event can create an overland flow event which has the potential to create small rivulets, which can create gully erosion depending upon the side slope of the site. The other impact that can occur from this rainfall intensity is the mass movement of the face of the side slope soil.

A 5.25-inch rainfall occurring over the 3.6-acre consolidated landfill site would generate a maximum of 69,000 cubic feet of water. If it is assumed that the rain falls uniformly over the site, then the maximum amount of stormwater that falls on any one acre is less than 19,200 cubic feet. Assuming an infiltration rate of 0.15, the maximum amount of stormwater discharging over the 25% slopes is less than 16,320 cubic feet over a period of 24 hours with an anticipated peak of 9 cubic feet per second for a duration of less than 0.5 hours. These rates of flow and duration would result in limited erosion depending upon the erosion control methods.

EROSION CONTROL METHODS

Many factors affect the rate of erosion. The most important of these are vegetative cover, artificial or temporary cover, soil type, and land slope. Because of the erosive impact of raindrops falling on soil, vegetation provides significant protection against erosion by absorbing the energy of the falling drops and generally reducing the drop size that reaches the ground. Vegetation may also provide mechanical protection to the soil against gully erosion.

Another advantage of vegetal cover is the improved infiltration capacity given the higher organic content of the soil. This infiltration is also complimented by the uptake capabilities of the vegetation.


112°W
111°W
110°W
109°W
108°W
107°W
106°W
105°W
104°W
103°W
102°W
101°W
100°W
99°W
42°N
41°N
40°N
39°N
38°N
37°N
36°N
NOAA Atlas 14, Volume 8, Version 2
Midwestern States
Prepared by U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
OFFICE OF HYDROLOGIC DEVELOPMENT
HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
April 2013
0 5 10 20 30 40 50
Miles
0 10 20 40 60 80 100
Kilometers
COLORADO
Isopluvials of 100-year 24-hour precipitation in inches
SCALE 1:2,250,000
1.88 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.00
5.01 - 6.00
6.01 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 11.00
11.01 - 11.93

Artificial or temporary covers include gravels, rip-rap, and straw. These covers create an armoring effect that resist splash erosion. By reducing splash erosion, the impact of major storm events is minimized.

Soil types affect the potential for erosion. Sandy soils have a larger granular structure and take more energy to be moved. Clayey soil binds together better than sandy soil but the clay particles are much smaller and lighter and thus can be dislodged easier.

The most significant impact on soil type is the slope of the surface. Typically, overland-flow velocities are greater on steeper side slopes and the potential for mass movement increases significantly as the slope increases.

METHODS TO ADDRESS EROSION AT THIS SITE

Two erosion control methods will be implemented at this site. The first is to utilize a soil mixed with a good organic component. This soil mix will be utilized on all bare areas of the site. The mix will be comprised of on-site soils mixed with a minimum of 20% compost or similar material to ensure the soil can support and maintain vegetation.

The second will address the protection of the final cover on the consolidated landfill. Once the final cover is installed it will be seeded utilizing a spreader system that is also capable of spreading gravel. The gravel/seed mix (gravel size is 1/4 inch minus with no fines smaller than a #4 sieve) will be hydrated to allow for rapid germination. Native vegetation will be selected for seeding. The site will also be covered with blown-on straw.

The final cover will be sloped at 25% or 4:1 to minimize side slope erosion. The final lift of the vegetative layer or surface lift will be textured to reduce the potential for stormwater to accelerate on the side slopes. A shallow swale will be located at the toe of the final cover to capture stormwater and move it away from the landfill.

Appendix L

Materials Management Plan

MATERIALS MANAGEMENT PLAN

INTRODUCTION

The process of consolidating the landfill will require relocating wastes at the site. To ensure the materials uncovered during the consolidation process are properly handled and any materials uncovered that are determined to be hazardous or suspected of being hazardous are properly segregated and removed from the site for proper disposal, the following materials management plan has been developed.

RELOCATION PROCESS

The relocation process will involve: (1) removing the cover materials presently in place over the existing landfill; (2) consolidating the landfill material, using a compactor, within the limits of the consolidated landfill footprint; (3) excavating solid waste outside the footprint of the consolidated landfill; (4) observing the excavated materials and checking for unacceptable materials; (5) placing and compacting the excavated solid waste; and (6) placing a final cover over the consolidated landfill. This process will be accomplished in distinct phases.

The excavated solid waste will be removed utilizing either backhoes, scrapers, or large loaders. The solid waste that is excavated will be processed to remove soil from the solid waste. The solid waste will then be moved to the consolidation area utilizing trucks or loaders, depending on the distance to the consolidation area. The solid waste will be placed in the consolidation area and compacted. All solid waste that is excavated and processed will be placed in the consolidation area and, all solid waste placed and compacted during the day will be covered at the end of the work day.

OBSERVATION PROCEDURES

The solid waste that is excavated and processed will be observed throughout the process. Observations will be made by the equipment operators and on-site construction quality assurance personnel. Materials will be monitored as they are excavated and any anomalies (such as 55-gallon metal drums, discolored waste, any noxious or inconsistent odors, or the presence of liquids) will be cause the excavation process to stop and the identified problem waste will be segregated.

Problem waste will be collected in a loader bucket and sent to a designated retention area, outside of the consolidation limits and the excavation limits. The retention area will be fenced and will have a minimum two-foot berm around it to control any liquids. Further, the area will be gated, and the gate will be locked at all times except when problem waste is brought to the retention area or when the problem waste is inspected and/or tested by trained personnel.

Once a problem waste is inspected and/or tested and its characteristics are determined, removal of the waste material will be coordinated with a company specializing in the handling of the specific waste. If it is determined the problem waste is not hazardous and it is acceptable, it will be removed from the retention area and placed in the reconsolidation area.

A record of observed materials will be made on a daily basis. The location of the excavation will be noted each day. In addition, an estimate of the quantity of material removed will be determined.

Observations will also be conducted at the processing area. Any material that is determined to be a problem waste will be removed from the area and sent to the retention area. If a problem waste is identified all processing activities will stop until the problem waste is removed.

PROBLEM SOLID WASTE PROCESSING

As noted in the previous sections, problem solid waste will be placed in a retention area for assessment and final disposition. Problem wastes will be tested for their characteristics and the materials that comprise the problem solid waste. If the material is determined to be hazardous, a company that specializes in disposing the specific material will be contacted. This company will come to the site, stabilize the material for transport, and remove it from the site. A list of companies that specialize in determining the type of waste and/or processing and disposing of the waste will be assembled for use during the consolidation process. Companies specializing in handling the following types of materials will be compiled.

- Asbestos
- Petroleum Contaminated Soils
- PCBs
- Acids and Alkaline
- Hazardous Chemicals
- Animal Waste
- Tires and Contaminated White Goods

If it is determined that the problem waste can be disposed within the consolidation area, it will be moved to the consolidated area for final disposal. No problem solid waste will remain on-site for more than 24 hours unless it is stabilized and controlled to eliminate its potential of becoming air borne or liquid is not being discharged from the problem waste.

SITE PROTECTION

To protect the site and surrounding properties from potential contamination, a number of steps will be taken including:

1. The area around the landfill will be graded to keep all run-off within the landfill limits throughout the consolidation process.

2. The problem waste area soil will be compacted to minimize any absorption of liquids into the soil. When the consolidation project is complete, the retention area will be excavated to a depth of at least five feet or as deep as any liquids may have penetrated and this soil will be removed from the site and sent to a disposal facility that can process this material.

3. The retention area will be fenced and bermed. The fence will be utilized to segregate the site and also control blowing debris. The berming will be utilized to keep all liquids and stormwater within the retention area. The soil that comprises the berm will be removed from the site when the consolidation efforts are complete and taken to a facility that can treat contaminated soils.

4. The area around the consolidated landfill will be fenced to control access to the site by animals and non-authorized personnel. The fence will also be utilized to capture any blowing debris.

5. Daily cover, either temporary or permanent, will be placed over the exposed solid waste in the consolidated area as well as exposed solid waste in the excavation area.

Implementing these steps will address site controls as well as reduce the impact to surrounding properties. The measures taken will be checked on a daily basis to ensure each step is functioning properly. Corrections will be instituted as soon as corrective action is needed or if improvements are warranted. All of the site protection measures will remain in place until the final cover is installed, the cover is vegetated, and the long-term erosion controls are in place.

Appendix M

Response to Discovery of Asbestos Plan

RESPONSE TO DISCOVERY OF ASBESTOS

INTRODUCTION

This project involves excavating waste from an abandon landfill site that was utilized during the 1950's and 1960's. A list of materials that may contain asbestos that may have been disgarded at the landfill site follows.

- Cement Pipes
- Elevator Brake Shoes
- Cement Wallboard
- Cement Siding
- Boiler Insulation
- Asphalt Floor Tile
- Breaching Insulation
- Vinyl Floor Tile
- Vinyl Sheet Flooring
- Flooring Backing
- Acoustical Plaster
- Decorative Plaster
- Textured Paints/Coatings Ceiling
- Tiles and Lay-in Panels
- Spray-Applied Insulation
- Blown-in Insulation
- Fireproofing Materials
- Taping Compounds (thermal)
- Thermal Paper Products
- Fire Doors
- High Temperature Gaskets
- Caulking/Putties
- Table Tops
- Adhesives
- Laboratory Gloves
- Wallboard
- Fire Blankets
- Joint Compounds
- Fire Curtains
- Vinyl Wall Coverings
- Elevator Equipment Panels
- Spackling Compounds
- Electrical Panel
- Partitions
- Electrical Cloth
- Electric Wiring Insulation
- Chalkboards
- Roofing Shingles
- Roofing Felt
- Base Flashing

- Ductwork Flexible Fabric Connections
- Pipe Insulation (corrugated air-cell, block, etc.)
- Construction Mastics (floor tile, carpet, ceiling, heating and electrical ducts, tile)
- Packing Materials (for wall/floor penetrations)

This project involves excavating an exisitng landfill which includes the exposure and processing of solid waste. Although the various site investigaitons conducted during the past 32 years have not discovered any asbestos at the site (see Appendix A, B, C, D, E, and F), it is possible that asbestos may be discovered during the excavation project.

DISCOVERY OF SUSPECT MATERIAL

It is important to observe the current condition of any suspected asbestos materials encountered to determine whether they are friable or non-friable. Determinations regarding the type of asbestos material encountered and its friability must be made by a Certified Asbestos Building Inspector.

More specific efforts to be taken when sbestos is discovered during active construction activities is presented below. Further, the information presented below outlines procedures for minimizing the potential release of airborne asbestos when suspect asbestos material is discovered.

1. Stop work when discovering material that is suspected of containing asbestos.

2. Segregate the area suspected of containing asbestos with barrier tape, or other means, and provide site access control.

3. Disturb soil as little as possible to perform any initial characterization activities.

4. Water area immediately prior to performing any characterization activity that will disturb the material. Maintain wet conditions throughout site characterization activities.

5. Cover the disturbed soil with a layer of 6-mil polyethylene material, tarps, or spray with magnesium chloride solution in sufficient amounts to wet the soil to prevent drying and dust generation.

6. Utilize a layer of 6-mil polyethylene material to prevent contamination to clean soils during initial characterization activity. This can be accomplished by placing the 6-mil polyethylene material on the ground and then placing the contaminated soil on the material.

7. Maintain complete dust control to eliminate any emissions.

8. Have a list of asbestos Building Inspectors (with a minimum of six (6) months experience conducting asbestos-contaminated soil inspections and certified in accordance with Colorado Department of Public Health and Environment Air Regulation No. 8, Part B) on site in order to ensure prompt response to any asbestos issue. Allow Building Inspector to properly conduct on-site assessmsnet as described in the "Asbestos-Contaminated Soil Guidance Document" prepared by the Colorado Department of Public Health and Environment, dated April 2007.

9. Decontaminate workers by removing any visible soil and dust with damp wipes or cloths, or by the use of a HEPA (high efficiency particulate air) filter equipped vacuum. Place wipes and cloths in a plastic bag and label as "Investigative waste" along with the date, company name, and your name. If additional clothing is available, clothes should be changed and potentially contaminated clothes should be bagged separately from wipes and cloths (it may be possible to clean these clothes if it is determined that asbestos is not present).

10. Decontaminate equipment by removal of gross soils and dust, then washing the equipment. Decontamination of equipment should be conducted by a certified asbestos worker wearing proper personal protective equipment (PPE). Materials used for decontamination should be bagged and labeled as above. Decontamination rinse water should be collected and filtered to 5 microns prior to disposal off site, or prior to use for wetting of asbestos contaminated areas that will be removed (this decontanination rinse water cannot be used for worker decontamination).

If areas where decontamination water has been applied are not going to be excavated prior to drying, the surface must be covered or stabilized until excavation occurs to prevent the emissions of any asbestos fibers that were not removed during filtration. If disposal of decontamination water to the sanitary sewer is anticipated, rinse water should be filtered to 5 microns, or in accordance with local requirements if such requirements are more stringent.

11. Based upon analytical results of suspect materials, if asbestos is present (or assumed to be present if sampling is not conducted), dispose of bags by double bagging and disposing of as asbestos waste in a properly permitted landfill. If analytical results indicate that no asbestos is present, bags can be disposed of as non-asbestos solid waste.

12. Notify the Colorado Department of Public Health and Enviornmentt, Hazardous Materials and Waste Management Division (Division) by calling (303) 692-3320 as soon as possible, but no later than 24 hours after discovery of visible material containing asbestos in the soils or asbestos-contaminated soil. In accordance with Colorado Departmrnt of Public Health and Environment Air Regulation No. 8, Part B the notification must, at a minimum, include:

    - Property location
    - General site description
    - Description of activities involved in discovering asbestos
    - Description of type and amount of material containing asbestos
    - Description of any access and emission controls implemented at the site
    - Property representative's name and phone numbe.
    - Contact name and phone number for the party performing soil-disturbing activities

    All verbal notifications must be followed up by a written notification. Written notification can be submitted via e-mail to comments.hmwmd@state.co.us or by any other means that will ensure that the notification is received by the Division within 24 hours.

13. Submit a Soil Characterization and Management Plan, in accordance with Section 5.5.4(B) of the Colorado Departmrnt of Public Health and Environment Air Regulation No. 8, Part B, to the Division for review and approval.

INTERIM PROCEDURES

Depending on the goals of the project and the nature of the asbestos material encountered, site characterization may be as simple as determining the extent of visible material and its friability, or may involve a more thorough investigation of the nature and extent of material present. Prior to and during the site characterization, and until final actions are taken in accordance with an approved Soil Characterization and Management Plan or approved standard procedures, the following interim actions should be implemented, as necessary, based on the nature and friability of material and the size and location of the project, to prevent release of and/or exposure to asbestos fibers.

1. Maintain adequately wet conditions on the site until the material is stabilized.

2. Apply stabilizing agents to the material as needed.

3. Take measures, as necessary, to address asbestos-contaminated soil that may have been tracked to other areas by contaminated equipment. These measures include stabilizing or covering these areas until they can be addressed under an approved Soil Characterization and Management Plan, or by conducting immediate spill response activities.

4. Construct wind fences or other wind barriers as appropriate.

5. Construct barriers around activity areas.

6. Cover soil with polyethylene, or similar material, or spray the soil with a stabilizer.

7. Reduce traffic speeds for equipment, trucks and cars through adjacent exposed soil areas.

8. Clothing and equipment that have come into contact with the asbestos-contaminated soils should be considered contaminated. Workers and equipment should be decontaminated on site, and dirt and debris should not leave the immediate work area. Decontaminate workers as described in Section 6 of the "Asbestos-Conyaminated Soil Guideance Document", preapred by Colorado Department of Public Health and Environment, dated April 2007.

9. Place equipment on a plastic barrier to collect decontamination water for filtering prior to disposal. Decontaminate equipment by removal of gross soils and dust, then wet wash equipment. Materials used for wiping should be bagged and labeled (see labeling specification as previously delineated).

10. Dispose of bagged decontamination waste materials as asbestos waste in a properly permitted landfill.

11. Decontamination water should be processed as described in Sections 5and 6 of the "Asbestos-Contaminated Soil Guidance Document" prepared by the Colorado Department of Public Health and Environment, dated April 2007.

Appendix N

Landfill Gas Generation Analysis

LANDFILL GAS GENERATION ANALYSIS

POTENTIAL FOR LANDFILL GAS GENERATION

The generation of gas by a landfill results from the decomposition of organic materials deposited in the landfill. Organics decomposition is most frequently through anaerobic digestion. The rate of gas generation as well as the period of the time gas will be generated is dependent upon a number of factors, including the:

- Amount of liquid entering the landfill;
- Quantity of organics;
- Daily cover characteristics; and
- Final cover characteristics.

For the abandoned landfill located on the MVS property, it is very likely landfill gas has been and may continue to be generated. The materials covering the waste are comprised of local soils that vary in depth from less than 1 foot to over 5 feet. There are numerous cracks and gouges in the cover materials that allow for liquids to enter the landfill. Because the landfill was not operated by anyone, but rather was a local dumping area, if any daily cover was placed at the landfill it was placed infrequently and haphazardly.

It is difficult to exactly determine the quantity of solid waste that was placed in the landfill; however, given the time period in which the site was utilized as a landfill (1950’s to 1966), it is likely there are organic materials in the landfill. This assessment is based on the limited waste characterization studies conducted during this time period as well as the lack of a number of household appliances, garbage disposals, and large refrigerators available during this time period that would either capture organic wastes or reduce the number of organics that spoiled.

COMPUTER MODELING

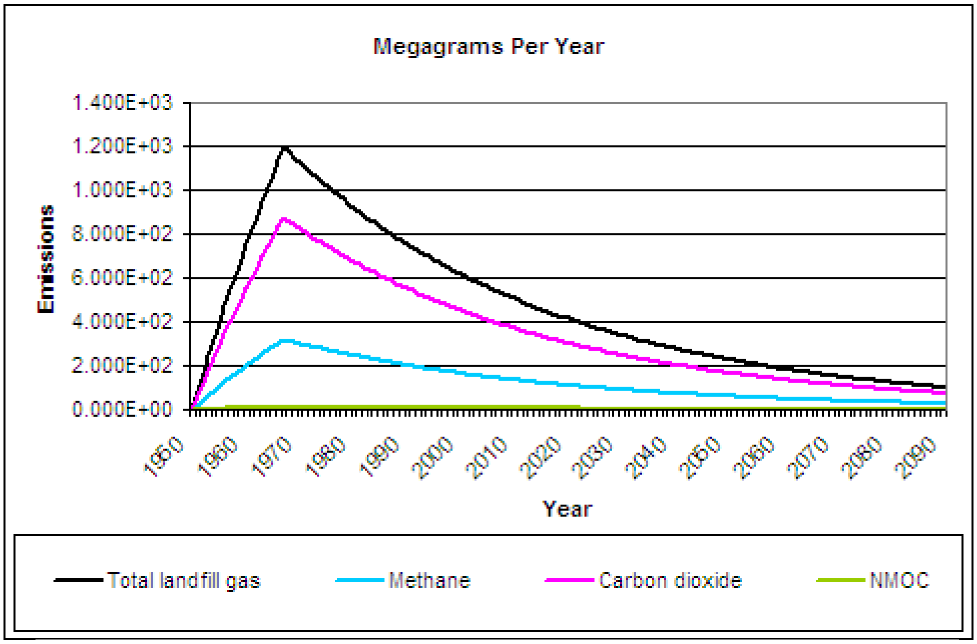
The potential for landfill gas generation exists at this site. The LandGEM computer model was utilized to determine the amount of landfill gas that would possibly be generated as well as the time period over which the landfill would generate this gas. This computer model was selected for use because it allows for maximum flexibility when determining the characteristics of the landfill and its waste components.

The LandGEM model is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate.

The model was run three times to identify various characteristics of the landfill. The first run was based on the climate that occurs at the landfill site. The Methane Generation Rate and the Potential Methane Generation Capacity were selected based on a dry climate. For the second run the Methane Generation Rate and the Potential Methane Generation Capacity were selected based on a wetter climate. This wetter climate was selected given the bottom of the landfill was a creek bed and that a significant portion of the waste was likely in contact with water during various times of the year. The final computer model run was a composite of the first two runs. This composite allowed for a slightly higher Methane Generation Rate and lower Potential Methane Generation Capacity. The results of all three runs are provided in Appendix 1, 2, and 3 respectively, at the end of this analysis report. Based on the computer model runs, it appears the landfill will be generating some landfill gas for at least the next 25 to 70 years.

First Computer Model Run

The following chart provides the results of the first computer model run. As can be seen, the landfill gas generation peaked in 1970 and has decreased significantly. Based on the model results the landfill is estimated to be generating 198,500 cubic meters of methane a year and 1,588 cubic meters of Non-Methane Organic Compounds (NMOC).

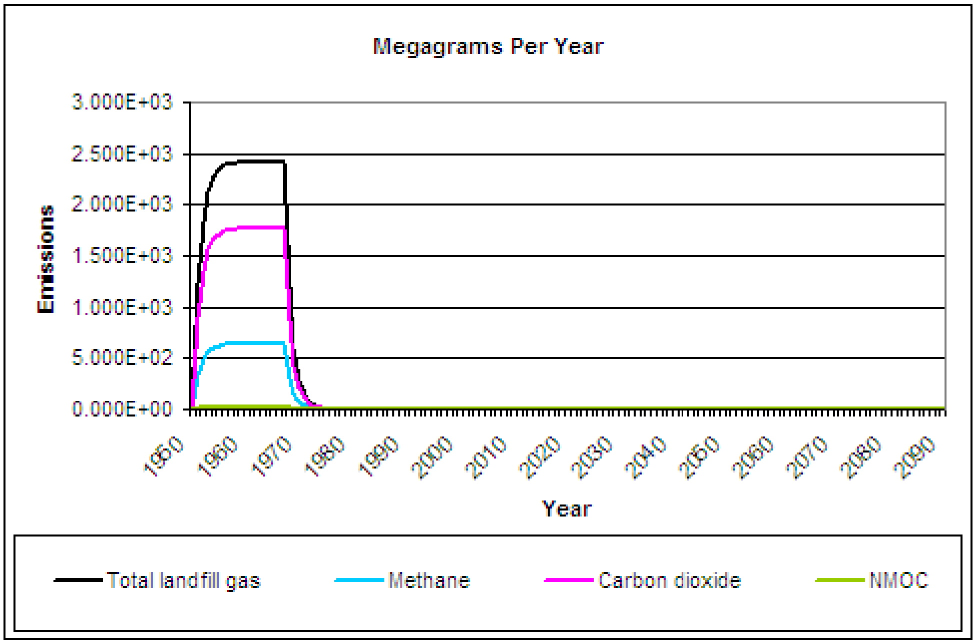


RESULTS OF FIRST COMPUTER MODEL RUN

Second Computer Run

This second computer model run reflects a much wetter environment which may have happened with this landfill given that the landfill bottom was an active creek bed. The following chart presents the results of this model run. In this run, the landfill gas generation peaked in the late 1950's and sustained that peak until the mid 1960's. This extended peak results in a larger amount of gas being generated over a short period of time. With the extended peak, the fall-off of the amount of landfill gas generated is abrupt and quite significant.

For methane, the peak period ended in 1967 with an annual estimated generation rate of 970,000 cubic meters of landfill gas. By 2011 it is estimated the landfill is generating 0.00000004079 cubic meters of gas annually. The amount of NMOC generated in 2011 is estimated to be 0.0000000003263 cubic meters per year. This model run indicates that a minimal amount of gas is being generated and likely little gas is being discharged from the landfill.

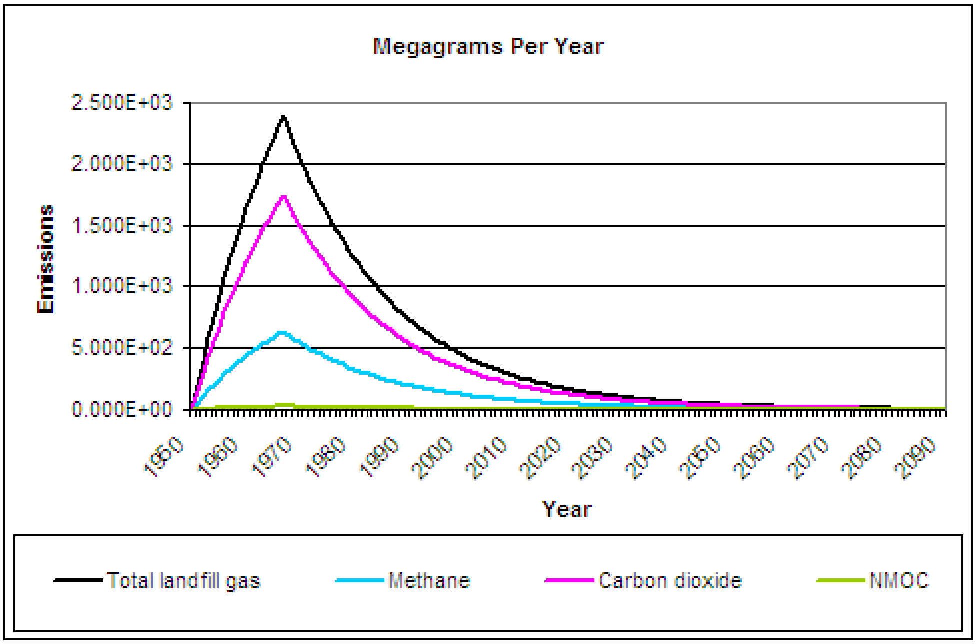


RESULTS OF SECOND COMPUATER MODEL RUN

Third Computer Model Run

As indicated previously, it is unlikely that neither of the first two computer model runs accurately reflect the actual conditions within the landfill. That is why the third computer model run combines elements of the two previous runs. The chart below presents the results of the third computer model run. The peak of landfill gas generation occurs in or about 1970, similar to the first computer model run, and the amount of gas generated decreases more rapidly, similar to the second computer model run.

For methane, the peak period ended in 1968 with an annual generation of 952,300 cubic meters of landfill gas. By 2018 the landfill is estimated to be generating 75,500 cubic meters of gas annually.



RESULTS OF THIRD COMPUTER MODEL RUN

POTENTIAL LANDFILL GAS MIGRATION AND METHODS TO MITIGATE LANDFILL GAS

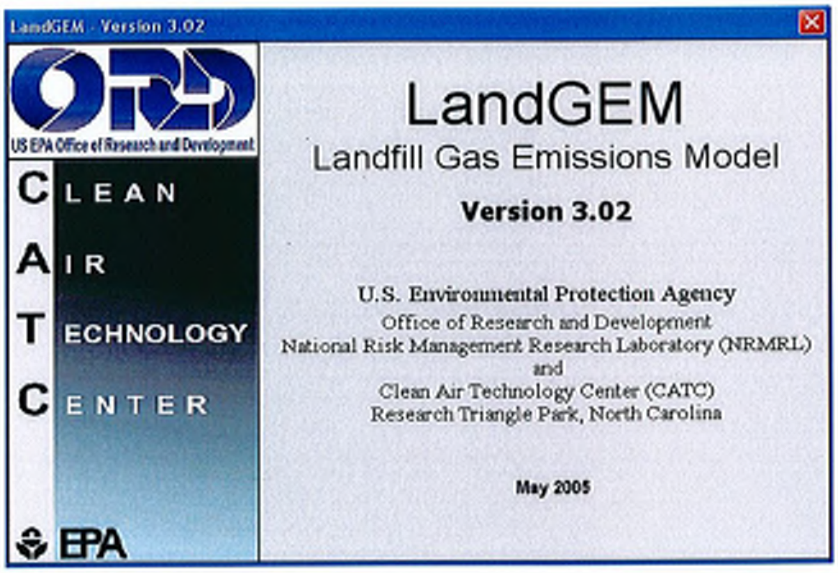
As indicated in the Final Cover Analysis, Appendix I of this application package, the final cover for the consolidated landfill will be designed to control the infiltration of liquids into the landfill and will act as a deterrent for landfill gas to migrate from the landfill area. In addition, the Remediation Plan Section of the Final Cover Analysis describes how the landfill will be consolidated, any water that is still following the old creek bed will be removed, and a soil barrier will be installed to deter water from continuing to flow along this creek bed. Thus, significantly reducing the amount of moisture in the solid waste. In addition, soils at the site are mostly lean, silty, slightly sandy clay. This soil type, when properly compacted, can become very dense and limit the migration of gases through the soil. Finally, the amount of methane estimated to be generated in 2018 is 198,500 cubic meters. This is a very small quantity of methane and would likely not be capable of migrating through compacted clayey soils.

Because a completely impervious liner or final cover is not practical for this situation, there is a limited potential for landfill gas to migrate from the landfill. Although, as described previously, the possibility of the landfill gas migrating through the on-site soils is relatively small and added measure of precaution will be utilized.

A passive landfill gas monitoring system will be installed to detect any landfill gases generated by the consolidated landfill. The system will incorporate a series of perforated PVC pipe laid along the side of the consolidated landfill at strategic locations. Each pipe will have a sampling port which will be utilized to test for landfill gas. These perforated PVC pipes can be fitted with wind turbines to vent the landfill gas is it is detected. If significant quantities of landfill gas are detected over a significant duration, the wind turbines can be removed and the perforated PVC can be connected to a blower system that will collect the gas and transport it to a flare system.

Appendix 1

First Computer Model Run



LandGEM

Landfill Gas Emissions Model

Version 3.02

U.S. Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory (NRMRL)
and
Clean Air Technology Center (CATC)
Research Triangle Park, North Carolina

May 2005

Summary Report

Landfill Name or Identifier: MVS Landfill Colorado Springs, CO

Date: Monday, March 07, 2011

Description/Comments:

This computer run considers climate conditions at the site

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate *($year^{-1}$)*
L_o = potential methane generation capacity *(m^3/Mg)*
M_i = mass of waste accepted in the i^{th} year *(Mg)*
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year *(decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1950**	
Landfill Closure Year (with 80-year limit)	**1966**	
Actual Closure Year (without limit)	***1966***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**182,500**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.020**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**170**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1950	9,759	10,735	0	0
1951	9,759	10,735	9,759	10,735
1952	9,759	10,735	19,518	21,470
1953	9,759	10,735	29,277	32,205
1954	9,759	10,735	39,036	42,940
1955	9,759	10,735	48,795	53,675
1956	9,759	10,735	58,555	64,410
1957	9,759	10,735	68,314	75,145
1958	9,759	10,735	78,073	85,880
1959	9,759	10,735	87,832	96,615
1960	9,759	10,735	97,591	107,350
1961	9,759	10,735	107,350	118,085
1962	9,759	10,735	117,109	128,820
1963	9,759	10,735	126,868	139,555
1964	9,759	10,735	136,627	150,290
1965	9,759	10,735	146,386	161,025
1966	9,759	10,735	156,145	171,760
1967	0	0	165,905	182,495
1968	0	0	165,905	182,495
1969	0	0	165,905	182,495
1970	0	0	165,905	182,495
1971	0	0	165,905	182,495
1972	0	0	165,905	182,495
1973	0	0	165,905	182,495
1974	0	0	165,905	182,495
1975	0	0	165,905	182,495
1976	0	0	165,905	182,495
1977	0	0	165,905	182,495
1978	0	0	165,905	182,495
1979	0	0	165,905	182,495
1980	0	0	165,905	182,495
1981	0	0	165,905	182,495
1982	0	0	165,905	182,495
1983	0	0	165,905	182,495
1984	0	0	165,905	182,495
1985	0	0	165,905	182,495
1986	0	0	165,905	182,495
1987	0	0	165,905	182,495
1988	0	0	165,905	182,495
1989	0	0	165,905	182,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1990	0	0	165,905	182,495
1991	0	0	165,905	182,495
1992	0	0	165,905	182,495
1993	0	0	165,905	182,495
1994	0	0	165,905	182,495
1995	0	0	165,905	182,495
1996	0	0	165,905	182,495
1997	0	0	165,905	182,495
1998	0	0	165,905	182,495
1999	0	0	165,905	182,495
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2006	0	0	165,905	182,495
2007	0	0	165,905	182,495
2008	0	0	165,905	182,495
2009	0	0	165,905	182,495
2010	0	0	165,905	182,495
2011	0	0	165,905	182,495
2012	0	0	165,905	182,495
2013	0	0	165,905	182,495
2014	0	0	165,905	182,495
2015	0	0	165,905	182,495
2016	0	0	165,905	182,495
2017	0	0	165,905	182,495
2018	0	0	165,905	182,495
2019	0	0	165,905	182,495
2020	0	0	165,905	182,495
2021	0	0	165,905	182,495
2022	0	0	165,905	182,495
2023	0	0	165,905	182,495
2024	0	0	165,905	182,495
2025	0	0	165,905	182,495
2026	0	0	165,905	182,495
2027	0	0	165,905	182,495
2028	0	0	165,905	182,495
2029	0	0	165,905	182,495

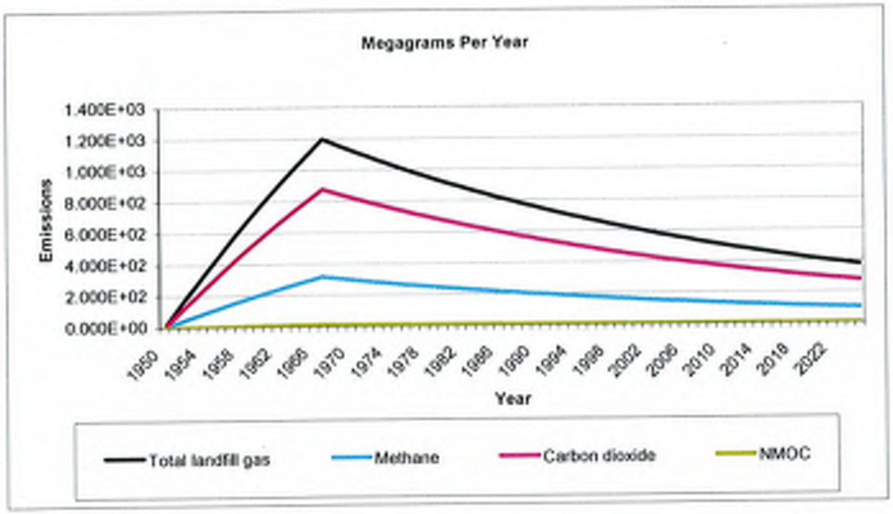
Pollutant Parameters

	Gas / Pollutant Default Parameters:			*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
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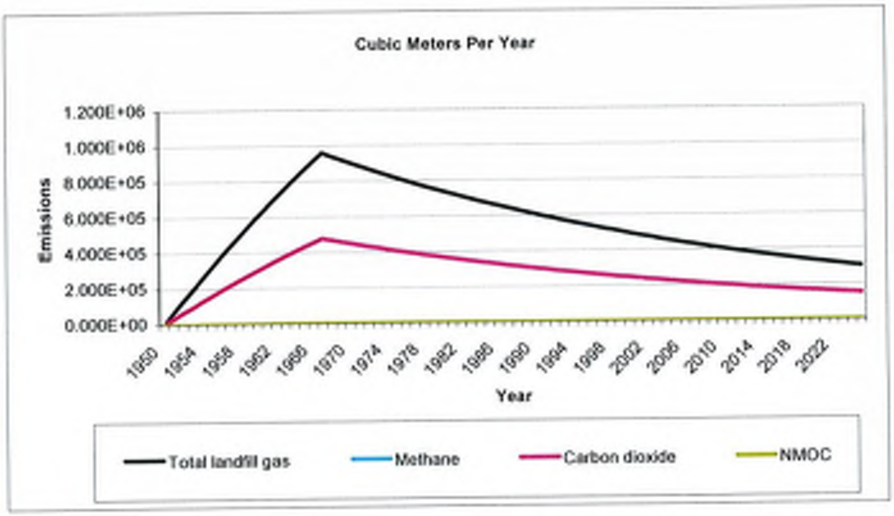
1.200E+03
1.000E+03
8.000E+02
6.000E+02
4.000E+02
2.000E+02
0.000E+00
Emissions
1950 1954 1958 1962 1966 1970 1974 1978 1982 1986 1990 1994 1998 2002 2006 2010 2014 2018 2022
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
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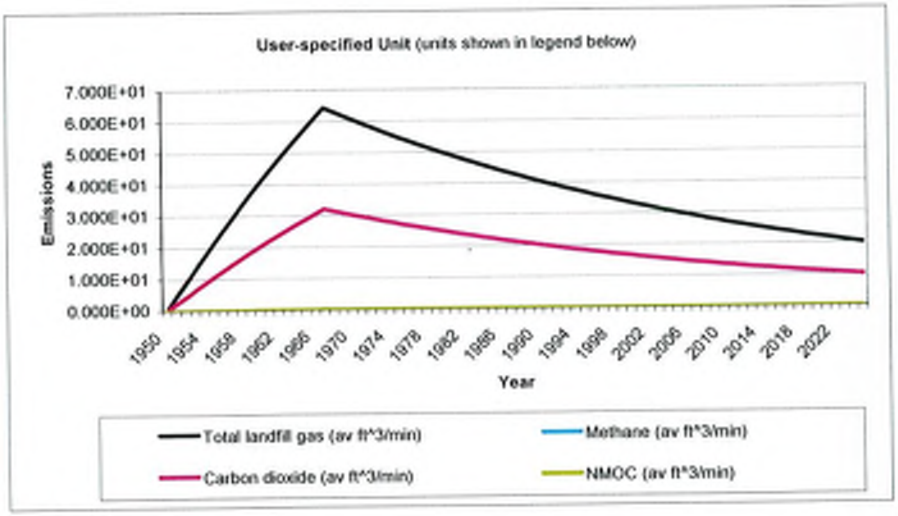
1.000E+06
8.000E+05
6.000E+05
4.000E+05
2.000E+05
0.000E+00
Emissions
1950 1954 1958 1962 1966 1970 1974 1978 1982 1986 1990 1994 1998 2002 2006 2010 2014 2018 2022
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
7.000E+01
6.000E+01
5.000E+01
4.000E+01
3.000E+01
2.000E+01
1.000E+01
0.000E+00
Emissions
1950 1954 1958 1962 1966 1970 1974 1978 1982 1986 1990 1994 1998 2002 2006 2010 2014 2018 2022
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	8.213E+01	6.577E+04	4.419E+00	2.194E+01	3.288E+04	2.209E+00
1952	1.626E+02	1.302E+05	8.750E+00	4.344E+01	6.512E+04	4.375E+00
1953	2.416E+02	1.934E+05	1.300E+01	6.452E+01	9.671E+04	6.498E+00
1954	3.189E+02	2.554E+05	1.716E+01	8.518E+01	1.277E+05	8.579E+00
1955	3.947E+02	3.161E+05	2.124E+01	1.054E+02	1.580E+05	1.062E+01
1956	4.690E+02	3.756E+05	2.524E+01	1.253E+02	1.878E+05	1.262E+01
1957	5.419E+02	4.339E+05	2.915E+01	1.447E+02	2.170E+05	1.458E+01
1958	6.133E+02	4.911E+05	3.300E+01	1.638E+02	2.455E+05	1.650E+01
1959	6.833E+02	5.471E+05	3.676E+01	1.825E+02	2.736E+05	1.838E+01
1960	7.519E+02	6.021E+05	4.045E+01	2.008E+02	3.010E+05	2.023E+01
1961	8.191E+02	6.559E+05	4.407E+01	2.188E+02	3.280E+05	2.204E+01
1962	8.850E+02	7.087E+05	4.762E+01	2.364E+02	3.543E+05	2.381E+01
1963	9.496E+02	7.604E+05	5.109E+01	2.537E+02	3.802E+05	2.555E+01
1964	1.013E+03	8.111E+05	5.450E+01	2.706E+02	4.056E+05	2.725E+01
1965	1.075E+03	8.608E+05	5.784E+01	2.872E+02	4.304E+05	2.892E+01
1966	1.136E+03	9.096E+05	6.111E+01	3.034E+02	4.548E+05	3.056E+01
1967	1.196E+03	9.573E+05	6.432E+01	3.193E+02	4.787E+05	3.216E+01
1968	1.172E+03	9.384E+05	6.305E+01	3.130E+02	4.692E+05	3.152E+01
1969	1.149E+03	9.198E+05	6.180E+01	3.068E+02	4.599E+05	3.090E+01
1970	1.126E+03	9.016E+05	6.058E+01	3.007E+02	4.508E+05	3.029E+01
1971	1.104E+03	8.837E+05	5.938E+01	2.948E+02	4.419E+05	2.969E+01
1972	1.082E+03	8.662E+05	5.820E+01	2.890E+02	4.331E+05	2.910E+01
1973	1.060E+03	8.491E+05	5.705E+01	2.832E+02	4.245E+05	2.852E+01
1974	1.039E+03	8.323E+05	5.592E+01	2.776E+02	4.161E+05	2.796E+01
1975	1.019E+03	8.158E+05	5.481E+01	2.721E+02	4.079E+05	2.741E+01
1976	9.986E+02	7.996E+05	5.373E+01	2.667E+02	3.998E+05	2.686E+01
1977	9.788E+02	7.838E+05	5.266E+01	2.615E+02	3.919E+05	2.633E+01
1978	9.594E+02	7.683E+05	5.162E+01	2.563E+02	3.841E+05	2.581E+01
1979	9.404E+02	7.531E+05	5.060E+01	2.512E+02	3.765E+05	2.530E+01
1980	9.218E+02	7.382E+05	4.960E+01	2.462E+02	3.691E+05	2.480E+01
1981	9.036E+02	7.235E+05	4.861E+01	2.414E+02	3.618E+05	2.431E+01
1982	8.857E+02	7.092E+05	4.765E+01	2.366E+02	3.546E+05	2.383E+01
1983	8.681E+02	6.952E+05	4.671E+01	2.319E+02	3.476E+05	2.335E+01
1984	8.509E+02	6.814E+05	4.578E+01	2.273E+02	3.407E+05	2.289E+01
1985	8.341E+02	6.679E+05	4.488E+01	2.228E+02	3.340E+05	2.244E+01
1986	8.176E+02	6.547E+05	4.399E+01	2.184E+02	3.273E+05	2.199E+01
1987	8.014E+02	6.417E+05	4.312E+01	2.141E+02	3.209E+05	2.156E+01
1988	7.855E+02	6.290E+05	4.226E+01	2.098E+02	3.145E+05	2.113E+01
1989	7.700E+02	6.166E+05	4.143E+01	2.057E+02	3.083E+05	2.071E+01
1990	7.547E+02	6.043E+05	4.061E+01	2.016E+02	3.022E+05	2.030E+01
1991	7.398E+02	5.924E+05	3.980E+01	1.976E+02	2.962E+05	1.990E+01
1992	7.251E+02	5.806E+05	3.901E+01	1.937E+02	2.903E+05	1.951E+01
1993	7.108E+02	5.692E+05	3.824E+01	1.899E+02	2.846E+05	1.912E+01
1994	6.967E+02	5.579E+05	3.748E+01	1.861E+02	2.789E+05	1.874E+01
1995	6.829E+02	5.468E+05	3.674E+01	1.824E+02	2.734E+05	1.837E+01
1996	6.694E+02	5.360E+05	3.601E+01	1.788E+02	2.680E+05	1.801E+01
1997	6.561E+02	5.254E+05	3.530E+01	1.753E+02	2.627E+05	1.765E+01
1998	6.431E+02	5.150E+05	3.460E+01	1.718E+02	2.575E+05	1.730E+01
1999	6.304E+02	5.048E+05	3.392E+01	1.684E+02	2.524E+05	1.696E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2000	6.179E+02	4.948E+05	3.325E+01	1.651E+02	2.474E+05	1.662E+01
2001	6.057E+02	4.850E+05	3.259E+01	1.618E+02	2.425E+05	1.629E+01
2002	5.937E+02	4.754E+05	3.194E+01	1.586E+02	2.377E+05	1.597E+01
2003	5.819E+02	4.660E+05	3.131E+01	1.554E+02	2.330E+05	1.565E+01
2004	5.704E+02	4.568E+05	3.069E+01	1.524E+02	2.284E+05	1.534E+01
2005	5.591E+02	4.477E+05	3.008E+01	1.493E+02	2.239E+05	1.504E+01
2006	5.480E+02	4.388E+05	2.949E+01	1.464E+02	2.194E+05	1.474E+01
2007	5.372E+02	4.302E+05	2.890E+01	1.435E+02	2.151E+05	1.445E+01
2008	5.266E+02	4.216E+05	2.833E+01	1.406E+02	2.108E+05	1.416E+01
2009	5.161E+02	4.133E+05	2.777E+01	1.379E+02	2.066E+05	1.388E+01
2010	5.059E+02	4.051E+05	2.722E+01	1.351E+02	2.026E+05	1.361E+01
2011	4.959E+02	3.971E+05	2.668E+01	1.325E+02	1.985E+05	1.334E+01
2012	4.861E+02	3.892E+05	2.615E+01	1.298E+02	1.946E+05	1.308E+01
2013	4.764E+02	3.815E+05	2.563E+01	1.273E+02	1.908E+05	1.282E+01
2014	4.670E+02	3.740E+05	2.513E+01	1.247E+02	1.870E+05	1.256E+01
2015	4.578E+02	3.666E+05	2.463E+01	1.223E+02	1.833E+05	1.231E+01
2016	4.487E+02	3.593E+05	2.414E+01	1.199E+02	1.796E+05	1.207E+01
2017	4.398E+02	3.522E+05	2.366E+01	1.175E+02	1.761E+05	1.183E+01
2018	4.311E+02	3.452E+05	2.319E+01	1.152E+02	1.726E+05	1.160E+01
2019	4.226E+02	3.384E+05	2.274E+01	1.129E+02	1.692E+05	1.137E+01
2020	4.142E+02	3.317E+05	2.229E+01	1.106E+02	1.658E+05	1.114E+01
2021	4.060E+02	3.251E+05	2.184E+01	1.084E+02	1.626E+05	1.092E+01
2022	3.980E+02	3.187E+05	2.141E+01	1.063E+02	1.593E+05	1.071E+01
2023	3.901E+02	3.124E+05	2.099E+01	1.042E+02	1.562E+05	1.049E+01
2024	3.824E+02	3.062E+05	2.057E+01	1.021E+02	1.531E+05	1.029E+01
2025	3.748E+02	3.001E+05	2.016E+01	1.001E+02	1.501E+05	1.008E+01
2026	3.674E+02	2.942E+05	1.977E+01	9.813E+01	1.471E+05	9.883E+00
2027	3.601E+02	2.883E+05	1.937E+01	9.618E+01	1.442E+05	9.687E+00
2028	3.530E+02	2.826E+05	1.899E+01	9.428E+01	1.413E+05	9.495E+00
2029	3.460E+02	2.770E+05	1.861E+01	9.241E+01	1.385E+05	9.307E+00
2030	3.391E+02	2.716E+05	1.825E+01	9.058E+01	1.358E+05	9.123E+00
2031	3.324E+02	2.662E+05	1.788E+01	8.879E+01	1.331E+05	8.942E+00
2032	3.258E+02	2.609E+05	1.753E+01	8.703E+01	1.305E+05	8.765E+00
2033	3.194E+02	2.557E+05	1.718E+01	8.531E+01	1.279E+05	8.591E+00
2034	3.130E+02	2.507E+05	1.684E+01	8.362E+01	1.253E+05	8.421E+00
2035	3.068E+02	2.457E+05	1.651E+01	8.196E+01	1.229E+05	8.255E+00
2036	3.008E+02	2.408E+05	1.618E+01	8.034E+01	1.204E+05	8.091E+00
2037	2.948E+02	2.361E+05	1.586E+01	7.875E+01	1.180E+05	7.931E+00
2038	2.890E+02	2.314E+05	1.555E+01	7.719E+01	1.157E+05	7.774E+00
2039	2.833E+02	2.268E+05	1.524E+01	7.566E+01	1.134E+05	7.620E+00
2040	2.776E+02	2.223E+05	1.494E+01	7.416E+01	1.112E+05	7.469E+00
2041	2.721E+02	2.179E+05	1.464E+01	7.269E+01	1.090E+05	7.321E+00
2042	2.668E+02	2.136E+05	1.435E+01	7.125E+01	1.068E+05	7.176E+00
2043	2.615E+02	2.094E+05	1.407E+01	6.984E+01	1.047E+05	7.034E+00
2044	2.563E+02	2.052E+05	1.379E+01	6.846E+01	1.026E+05	6.895E+00
2045	2.512E+02	2.012E+05	1.352E+01	6.710E+01	1.006E+05	6.758E+00
2046	2.463E+02	1.972E+05	1.325E+01	6.578E+01	9.859E+04	6.624E+00
2047	2.414E+02	1.933E+05	1.299E+01	6.447E+01	9.664E+04	6.493E+00
2048	2.366E+02	1.895E+05	1.273E+01	6.320E+01	9.473E+04	6.365E+00
2049	2.319E+02	1.857E+05	1.248E+01	6.195E+01	9.285E+04	6.239E+00
2050	2.273E+02	1.820E+05	1.223E+01	6.072E+01	9.101E+04	6.115E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	2.228E+02	1.784E+05	1.199E+01	5.952E+01	8.921E+04	5.994E+00
2052	2.184E+02	1.749E+05	1.175E+01	5.834E+01	8.744E+04	5.875E+00
2053	2.141E+02	1.714E+05	1.152E+01	5.718E+01	8.571E+04	5.759E+00
2054	2.098E+02	1.680E+05	1.129E+01	5.605E+01	8.402E+04	5.645E+00
2055	2.057E+02	1.647E+05	1.107E+01	5.494E+01	8.235E+04	5.533E+00
2056	2.016E+02	1.614E+05	1.085E+01	5.385E+01	8.072E+04	5.424E+00
2057	1.976E+02	1.582E+05	1.063E+01	5.279E+01	7.912E+04	5.316E+00
2058	1.937E+02	1.551E+05	1.042E+01	5.174E+01	7.756E+04	5.211E+00
2059	1.899E+02	1.520E+05	1.022E+01	5.072E+01	7.602E+04	5.108E+00
2060	1.861E+02	1.490E+05	1.001E+01	4.971E+01	7.451E+04	5.007E+00
2061	1.824E+02	1.461E+05	9.815E+00	4.873E+01	7.304E+04	4.908E+00
2062	1.788E+02	1.432E+05	9.621E+00	4.776E+01	7.159E+04	4.810E+00
2063	1.753E+02	1.404E+05	9.430E+00	4.682E+01	7.018E+04	4.715E+00
2064	1.718E+02	1.376E+05	9.243E+00	4.589E+01	6.879E+04	4.622E+00
2065	1.684E+02	1.348E+05	9.060E+00	4.498E+01	6.742E+04	4.530E+00
2066	1.651E+02	1.322E+05	8.881E+00	4.409E+01	6.609E+04	4.441E+00
2067	1.618E+02	1.296E+05	8.705E+00	4.322E+01	6.478E+04	4.353E+00
2068	1.586E+02	1.270E+05	8.533E+00	4.236E+01	6.350E+04	4.266E+00
2069	1.555E+02	1.245E+05	8.364E+00	4.152E+01	6.224E+04	4.182E+00
2070	1.524E+02	1.220E+05	8.198E+00	4.070E+01	6.101E+04	4.099E+00
2071	1.494E+02	1.196E+05	8.036E+00	3.990E+01	5.980E+04	4.018E+00
2072	1.464E+02	1.172E+05	7.877E+00	3.911E+01	5.862E+04	3.938E+00
2073	1.435E+02	1.149E+05	7.721E+00	3.833E+01	5.745E+04	3.860E+00
2074	1.407E+02	1.126E+05	7.568E+00	3.757E+01	5.632E+04	3.784E+00
2075	1.379E+02	1.104E+05	7.418E+00	3.683E+01	5.520E+04	3.709E+00
2076	1.351E+02	1.082E+05	7.271E+00	3.610E+01	5.411E+04	3.636E+00
2077	1.325E+02	1.061E+05	7.127E+00	3.538E+01	5.304E+04	3.564E+00
2078	1.298E+02	1.040E+05	6.986E+00	3.468E+01	5.199E+04	3.493E+00
2079	1.273E+02	1.019E+05	6.848E+00	3.400E+01	5.096E+04	3.424E+00
2080	1.248E+02	9.990E+04	6.712E+00	3.332E+01	4.995E+04	3.356E+00
2081	1.223E+02	9.792E+04	6.579E+00	3.266E+01	4.896E+04	3.290E+00
2082	1.199E+02	9.598E+04	6.449E+00	3.202E+01	4.799E+04	3.224E+00
2083	1.175E+02	9.408E+04	6.321E+00	3.138E+01	4.704E+04	3.161E+00
2084	1.152E+02	9.222E+04	6.196E+00	3.076E+01	4.611E+04	3.098E+00
2085	1.129E+02	9.039E+04	6.073E+00	3.015E+01	4.520E+04	3.037E+00
2086	1.106E+02	8.860E+04	5.953E+00	2.956E+01	4.430E+04	2.977E+00
2087	1.085E+02	8.685E+04	5.835E+00	2.897E+01	4.342E+04	2.918E+00
2088	1.063E+02	8.513E+04	5.720E+00	2.840E+01	4.256E+04	2.860E+00
2089	1.042E+02	8.344E+04	5.606E+00	2.783E+01	4.172E+04	2.803E+00
2090	1.021E+02	8.179E+04	5.495E+00	2.728E+01	4.089E+04	2.748E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	6.019E+01	3.288E+04	2.209E+00	9.430E-01	2.631E+02	1.768E-02
1952	1.192E+02	6.512E+04	4.375E+00	1.867E+00	5.209E+02	3.500E-02
1953	1.770E+02	9.671E+04	6.498E+00	2.773E+00	7.737E+02	5.198E-02
1954	2.337E+02	1.277E+05	8.579E+00	3.661E+00	1.021E+03	6.863E-02
1955	2.893E+02	1.580E+05	1.062E+01	4.532E+00	1.264E+03	8.495E-02
1956	3.438E+02	1.878E+05	1.262E+01	5.385E+00	1.502E+03	1.009E-01
1957	3.971E+02	2.170E+05	1.458E+01	6.221E+00	1.736E+03	1.166E-01
1958	4.495E+02	2.455E+05	1.650E+01	7.041E+00	1.964E+03	1.320E-01
1959	5.008E+02	2.736E+05	1.838E+01	7.845E+00	2.189E+03	1.470E-01
1960	5.510E+02	3.010E+05	2.023E+01	8.632E+00	2.408E+03	1.618E-01
1961	6.003E+02	3.280E+05	2.204E+01	9.404E+00	2.624E+03	1.763E-01
1962	6.486E+02	3.543E+05	2.381E+01	1.016E+01	2.835E+03	1.905E-01
1963	6.960E+02	3.802E+05	2.555E+01	1.090E+01	3.042E+03	2.044E-01
1964	7.424E+02	4.056E+05	2.725E+01	1.163E+01	3.245E+03	2.180E-01
1965	7.879E+02	4.304E+05	2.892E+01	1.234E+01	3.443E+03	2.314E-01
1966	8.325E+02	4.548E+05	3.056E+01	1.304E+01	3.638E+03	2.445E-01
1967	8.762E+02	4.787E+05	3.216E+01	1.373E+01	3.829E+03	2.573E-01
1968	8.588E+02	4.692E+05	3.152E+01	1.345E+01	3.753E+03	2.522E-01
1969	8.418E+02	4.599E+05	3.090E+01	1.319E+01	3.679E+03	2.472E-01
1970	8.252E+02	4.508E+05	3.029E+01	1.293E+01	3.606E+03	2.423E-01
1971	8.088E+02	4.419E+05	2.969E+01	1.267E+01	3.535E+03	2.375E-01
1972	7.928E+02	4.331E+05	2.910E+01	1.242E+01	3.465E+03	2.328E-01
1973	7.771E+02	4.245E+05	2.852E+01	1.217E+01	3.396E+03	2.282E-01
1974	7.617E+02	4.161E+05	2.796E+01	1.193E+01	3.329E+03	2.237E-01
1975	7.466E+02	4.079E+05	2.741E+01	1.170E+01	3.263E+03	2.192E-01
1976	7.319E+02	3.998E+05	2.686E+01	1.146E+01	3.199E+03	2.149E-01
1977	7.174E+02	3.919E+05	2.633E+01	1.124E+01	3.135E+03	2.107E-01
1978	7.032E+02	3.841E+05	2.581E+01	1.102E+01	3.073E+03	2.065E-01
1979	6.892E+02	3.765E+05	2.530E+01	1.080E+01	3.012E+03	2.024E-01
1980	6.756E+02	3.691E+05	2.480E+01	1.058E+01	2.953E+03	1.984E-01
1981	6.622E+02	3.618E+05	2.431E+01	1.037E+01	2.894E+03	1.945E-01
1982	6.491E+02	3.546E+05	2.383E+01	1.017E+01	2.837E+03	1.906E-01
1983	6.362E+02	3.476E+05	2.335E+01	9.967E+00	2.781E+03	1.868E-01
1984	6.236E+02	3.407E+05	2.289E+01	9.770E+00	2.726E+03	1.831E-01
1985	6.113E+02	3.340E+05	2.244E+01	9.576E+00	2.672E+03	1.795E-01
1986	5.992E+02	3.273E+05	2.199E+01	9.387E+00	2.619E+03	1.760E-01
1987	5.873E+02	3.209E+05	2.156E+01	9.201E+00	2.567E+03	1.725E-01
1988	5.757E+02	3.145E+05	2.113E+01	9.019E+00	2.516E+03	1.691E-01
1989	5.643E+02	3.083E+05	2.071E+01	8.840E+00	2.466E+03	1.657E-01
1990	5.531E+02	3.022E+05	2.030E+01	8.665E+00	2.417E+03	1.624E-01
1991	5.422E+02	2.962E+05	1.990E+01	8.493E+00	2.370E+03	1.592E-01
1992	5.314E+02	2.903E+05	1.951E+01	8.325E+00	2.323E+03	1.561E-01
1993	5.209E+02	2.846E+05	1.912E+01	8.160E+00	2.277E+03	1.530E-01
1994	5.106E+02	2.789E+05	1.874E+01	7.999E+00	2.232E+03	1.499E-01
1995	5.005E+02	2.734E+05	1.837E+01	7.840E+00	2.187E+03	1.470E-01
1996	4.906E+02	2.680E+05	1.801E+01	7.685E+00	2.144E+03	1.441E-01
1997	4.809E+02	2.627E+05	1.765E+01	7.533E+00	2.102E+03	1.412E-01
1998	4.713E+02	2.575E+05	1.730E+01	7.384E+00	2.060E+03	1.384E-01
1999	4.620E+02	2.524E+05	1.696E+01	7.238E+00	2.019E+03	1.357E-01

Results (Continued)

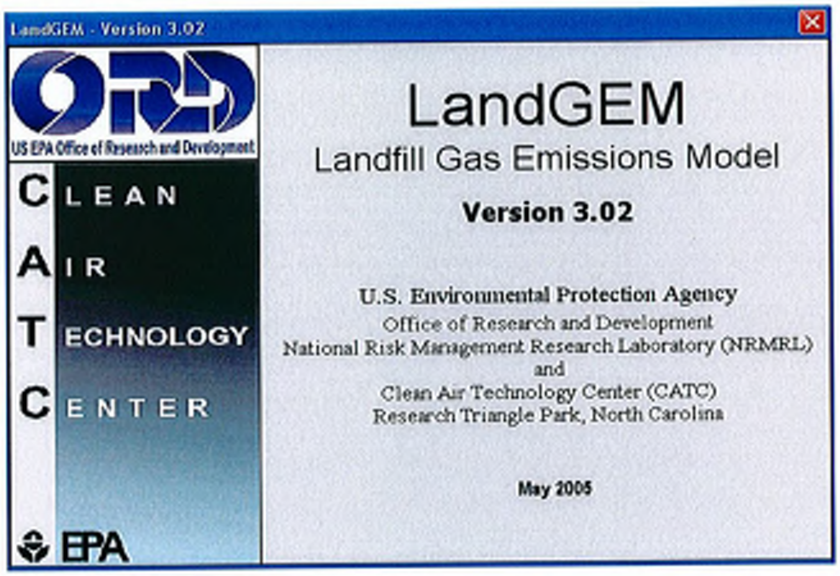
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2000	4.529E+02	2.474E+05	1.662E+01	7.094E+00	1.979E+03	1.330E-01
2001	4.439E+02	2.425E+05	1.629E+01	6.954E+00	1.940E+03	1.303E-01
2002	4.351E+02	2.377E+05	1.597E+01	6.816E+00	1.902E+03	1.278E-01
2003	4.265E+02	2.330E+05	1.565E+01	6.681E+00	1.864E+03	1.252E-01
2004	4.180E+02	2.284E+05	1.534E+01	6.549E+00	1.827E+03	1.228E-01
2005	4.098E+02	2.239E+05	1.504E+01	6.419E+00	1.791E+03	1.203E-01
2006	4.017E+02	2.194E+05	1.474E+01	6.292E+00	1.755E+03	1.179E-01
2007	3.937E+02	2.151E+05	1.445E+01	6.168E+00	1.721E+03	1.156E-01
2008	3.859E+02	2.108E+05	1.416E+01	6.045E+00	1.687E+03	1.133E-01
2009	3.783E+02	2.066E+05	1.388E+01	5.926E+00	1.653E+03	1.111E-01
2010	3.708E+02	2.026E+05	1.361E+01	5.808E+00	1.620E+03	1.089E-01
2011	3.634E+02	1.985E+05	1.334E+01	5.693E+00	1.588E+03	1.087E-01
2012	3.562E+02	1.946E+05	1.308E+01	5.581E+00	1.557E+03	1.046E-01
2013	3.492E+02	1.908E+05	1.282E+01	5.470E+00	1.526E+03	1.025E-01
2014	3.423E+02	1.870E+05	1.256E+01	5.362E+00	1.496E+03	1.005E-01
2015	3.355E+02	1.833E+05	1.231E+01	5.256E+00	1.466E+03	9.851E-02
2016	3.288E+02	1.796E+05	1.207E+01	5.152E+00	1.437E+03	9.656E-02
2017	3.223E+02	1.761E+05	1.183E+01	5.050E+00	1.409E+03	9.465E-02
2018	3.160E+02	1.726E+05	1.160E+01	4.950E+00	1.381E+03	9.278E-02
2019	3.097E+02	1.692E+05	1.137E+01	4.852E+00	1.353E+03	9.094E-02
2020	3.036E+02	1.658E+05	1.114E+01	4.755E+00	1.327E+03	8.914E-02
2021	2.976E+02	1.626E+05	1.092E+01	4.661E+00	1.300E+03	8.737E-02
2022	2.917E+02	1.593E+05	1.071E+01	4.569E+00	1.275E+03	8.564E-02
2023	2.859E+02	1.562E+05	1.049E+01	4.479E+00	1.249E+03	8.395E-02
2024	2.802E+02	1.531E+05	1.029E+01	4.390E+00	1.225E+03	8.229E-02
2025	2.747E+02	1.501E+05	1.008E+01	4.303E+00	1.200E+03	8.066E-02
2026	2.692E+02	1.471E+05	9.883E+00	4.218E+00	1.177E+03	7.906E-02
2027	2.639E+02	1.442E+05	9.687E+00	4.134E+00	1.153E+03	7.749E-02
2028	2.587E+02	1.413E+05	9.495E+00	4.052E+00	1.131E+03	7.596E-02
2029	2.536E+02	1.385E+05	9.307E+00	3.972E+00	1.108E+03	7.446E-02
2030	2.485E+02	1.358E+05	9.123E+00	3.893E+00	1.086E+03	7.298E-02
2031	2.436E+02	1.331E+05	8.942E+00	3.816E+00	1.065E+03	7.154E-02
2032	2.388E+02	1.305E+05	8.765E+00	3.741E+00	1.044E+03	7.012E-02
2033	2.341E+02	1.279E+05	8.591E+00	3.667E+00	1.023E+03	6.873E-02
2034	2.294E+02	1.253E+05	8.421E+00	3.594E+00	1.003E+03	6.737E-02
2035	2.249E+02	1.229E+05	8.255E+00	3.523E+00	9.828E+02	6.604E-02
2036	2.204E+02	1.204E+05	8.091E+00	3.453E+00	9.634E+02	6.473E-02
2037	2.161E+02	1.180E+05	7.931E+00	3.385E+00	9.443E+02	6.345E-02
2038	2.118E+02	1.157E+05	7.774E+00	3.318E+00	9.256E+02	6.219E-02
2039	2.076E+02	1.134E+05	7.620E+00	3.252E+00	9.073E+02	6.096E-02
2040	2.035E+02	1.112E+05	7.469E+00	3.188E+00	8.893E+02	5.975E-02
2041	1.995E+02	1.090E+05	7.321E+00	3.125E+00	8.717E+02	5.857E-02
2042	1.955E+02	1.068E+05	7.176E+00	3.063E+00	8.544E+02	5.741E-02
2043	1.916E+02	1.047E+05	7.034E+00	3.002E+00	8.375E+02	5.627E-02
2044	1.878E+02	1.026E+05	6.895E+00	2.943E+00	8.209E+02	5.516E-02
2045	1.841E+02	1.006E+05	6.758E+00	2.884E+00	8.047E+02	5.407E-02
2046	1.805E+02	9.859E+04	6.624E+00	2.827E+00	7.887E+02	5.300E-02
2047	1.769E+02	9.664E+04	6.493E+00	2.771E+00	7.731E+02	5.195E-02
2048	1.734E+02	9.473E+04	6.365E+00	2.716E+00	7.578E+02	5.092E-02
2049	1.700E+02	9.285E+04	6.239E+00	2.663E+00	7.428E+02	4.991E-02
2050	1.666E+02	9.101E+04	6.115E+00	2.610E+00	7.281E+02	4.892E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.633E+02	8.921E+04	5.994E+00	2.558E+00	7.137E+02	4.795E-02
2052	1.601E+02	8.744E+04	5.875E+00	2.508E+00	6.996E+02	4.700E-02
2053	1.569E+02	8.571E+04	5.759E+00	2.458E+00	6.857E+02	4.607E-02
2054	1.538E+02	8.402E+04	5.645E+00	2.409E+00	6.721E+02	4.516E-02
2055	1.507E+02	8.235E+04	5.533E+00	2.361E+00	6.588E+02	4.427E-02
2056	1.478E+02	8.072E+04	5.424E+00	2.315E+00	6.458E+02	4.339E-02
2057	1.448E+02	7.912E+04	5.316E+00	2.269E+00	6.330E+02	4.253E-02
2058	1.420E+02	7.756E+04	5.211E+00	2.224E+00	6.204E+02	4.169E-02
2059	1.392E+02	7.602E+04	5.108E+00	2.180E+00	6.082E+02	4.086E-02
2060	1.364E+02	7.451E+04	5.007E+00	2.137E+00	5.961E+02	4.005E-02
2061	1.337E+02	7.304E+04	4.908E+00	2.094E+00	5.843E+02	3.926E-02
2062	1.311E+02	7.159E+04	4.810E+00	2.053E+00	5.727E+02	3.848E-02
2063	1.285E+02	7.018E+04	4.715E+00	2.012E+00	5.614E+02	3.772E-02
2064	1.259E+02	6.879E+04	4.622E+00	1.972E+00	5.503E+02	3.697E-02
2065	1.234E+02	6.742E+04	4.530E+00	1.933E+00	5.394E+02	3.624E-02
2066	1.210E+02	6.609E+04	4.441E+00	1.895E+00	5.287E+02	3.552E-02
2067	1.186E+02	6.478E+04	4.353E+00	1.858E+00	5.182E+02	3.482E-02
2068	1.162E+02	6.350E+04	4.266E+00	1.821E+00	5.080E+02	3.413E-02
2069	1.139E+02	6.224E+04	4.182E+00	1.785E+00	4.979E+02	3.346E-02
2070	1.117E+02	6.101E+04	4.099E+00	1.749E+00	4.881E+02	3.279E-02
2071	1.095E+02	5.980E+04	4.018E+00	1.715E+00	4.784E+02	3.214E-02
2072	1.073E+02	5.862E+04	3.938E+00	1.681E+00	4.689E+02	3.151E-02
2073	1.052E+02	5.745E+04	3.860E+00	1.648E+00	4.596E+02	3.088E-02
2074	1.031E+02	5.632E+04	3.784E+00	1.615E+00	4.505E+02	3.027E-02
2075	1.010E+02	5.520E+04	3.709E+00	1.583E+00	4.416E+02	2.967E-02
2076	9.905E+01	5.411E+04	3.636E+00	1.552E+00	4.329E+02	2.908E-02
2077	9.709E+01	5.304E+04	3.564E+00	1.521E+00	4.243E+02	2.851E-02
2078	9.516E+01	5.199E+04	3.493E+00	1.491E+00	4.159E+02	2.794E-02
2079	9.328E+01	5.096E+04	3.424E+00	1.461E+00	4.077E+02	2.739E-02
2080	9.143E+01	4.995E+04	3.356E+00	1.432E+00	3.996E+02	2.685E-02
2081	8.962E+01	4.896E+04	3.290E+00	1.404E+00	3.917E+02	2.632E-02
2082	8.785E+01	4.799E+04	3.224E+00	1.376E+00	3.839E+02	2.580E-02
2083	8.611E+01	4.704E+04	3.161E+00	1.349E+00	3.763E+02	2.528E-02
2084	8.440E+01	4.611E+04	3.098E+00	1.322E+00	3.689E+02	2.478E-02
2085	8.273E+01	4.520E+04	3.037E+00	1.296E+00	3.616E+02	2.429E-02
2086	8.109E+01	4.430E+04	2.977E+00	1.270E+00	3.544E+02	2.381E-02
2087	7.949E+01	4.342E+04	2.918E+00	1.245E+00	3.474E+02	2.334E-02
2088	7.791E+01	4.256E+04	2.860E+00	1.221E+00	3.405E+02	2.288E-02
2089	7.637E+01	4.172E+04	2.803E+00	1.196E+00	3.338E+02	2.243E-02
2090	7.486E+01	4.089E+04	2.748E+00	1.173E+00	3.272E+02	2.198E-02

Appendix 2

Second Computer Model Run



LandGEM

Landfill Gas Emissions Model

Version 3.02

U.S. Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory (NRMRL)
and
Clean Air Technology Center (CATC)
Research Triangle Park, North Carolina

May 2005

Summary Report

Landfill Name or Identifier: MVS Landfill Colorado Springs, CO

Date: Monday, March 07, 2011

Description/Comments:

This computer run considers wet conditions based on creek as bottom of landfill

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n}\sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate *($year^{-1}$)*
L_o = potential methane generation capacity *(m^3/Mg)*

M_i = mass of waste accepted in the i^{th} year *(Mg)*
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year *(decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1950**	
Landfill Closure Year (with 80-year limit)	**1966**	
Actual Closure Year (without limit)	***1966***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**182,500**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.700**	*year^{-1}*
Potential Methane Generation Capacity, L_o	**96**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1950	9,759	10,735	0	0
1951	9,759	10,735	9,759	10,735
1952	9,759	10,735	19,518	21,470
1953	9,759	10,735	29,277	32,205
1954	9,759	10,735	39,036	42,940
1955	9,759	10,735	48,795	53,675
1956	9,759	10,735	58,555	64,410
1957	9,759	10,735	68,314	75,145
1958	9,759	10,735	78,073	85,880
1959	9,759	10,735	87,832	96,615
1960	9,759	10,735	97,591	107,350
1961	9,759	10,735	107,350	118,085
1962	9,759	10,735	117,109	128,820
1963	9,759	10,735	126,868	139,555
1964	9,759	10,735	136,627	150,290
1965	9,759	10,735	146,386	161,025
1966	9,759	10,735	156,145	171,760
1967	0	0	165,905	182,495
1968	0	0	165,905	182,495
1969	0	0	165,905	182,495
1970	0	0	165,905	182,495
1971	0	0	165,905	182,495
1972	0	0	165,905	182,495
1973	0	0	165,905	182,495
1974	0	0	165,905	182,495
1975	0	0	165,905	182,495
1976	0	0	165,905	182,495
1977	0	0	165,905	182,495
1978	0	0	165,905	182,495
1979	0	0	165,905	182,495
1980	0	0	165,905	182,495
1981	0	0	165,905	182,495
1982	0	0	165,905	182,495
1983	0	0	165,905	182,495
1984	0	0	165,905	182,495
1985	0	0	165,905	182,495
1986	0	0	165,905	182,495
1987	0	0	165,905	182,495
1988	0	0	165,905	182,495
1989	0	0	165,905	182,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1990	0	0	165,905	182,495
1991	0	0	165,905	182,495
1992	0	0	165,905	182,495
1993	0	0	165,905	182,495
1994	0	0	165,905	182,495
1995	0	0	165,905	182,495
1996	0	0	165,905	182,495
1997	0	0	165,905	182,495
1998	0	0	165,905	182,495
1999	0	0	165,905	182,495
2000	0	0	165,905	182,495
2001	0	0	165,905	182,495
2002	0	0	165,905	182,495
2003	0	0	165,905	182,495
2004	0	0	165,905	182,495
2005	0	0	165,905	182,495
2006	0	0	165,905	182,495
2007	0	0	165,905	182,495
2008	0	0	165,905	182,495
2009	0	0	165,905	182,495
2010	0	0	165,905	182,495
2011	0	0	165,905	182,495
2012	0	0	165,905	182,495
2013	0	0	165,905	182,495
2014	0	0	165,905	182,495
2015	0	0	165,905	182,495
2016	0	0	165,905	182,495
2017	0	0	165,905	182,495
2018	0	0	165,905	182,495
2019	0	0	165,905	182,495
2020	0	0	165,905	182,495
2021	0	0	165,905	182,495
2022	0	0	165,905	182,495
2023	0	0	165,905	182,495
2024	0	0	165,905	182,495
2025	0	0	165,905	182,495
2026	0	0	165,905	182,495
2027	0	0	165,905	182,495
2028	0	0	165,905	182,495
2029	0	0	165,905	182,495

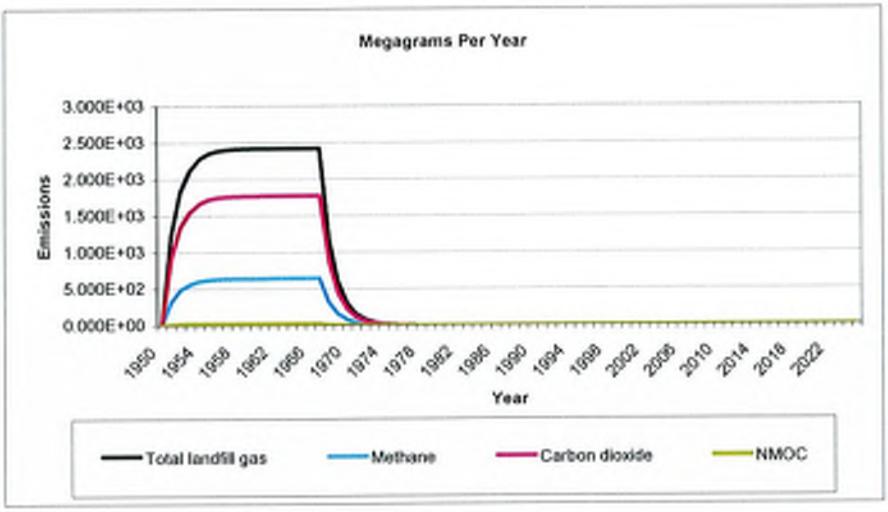
Pollutant Parameters

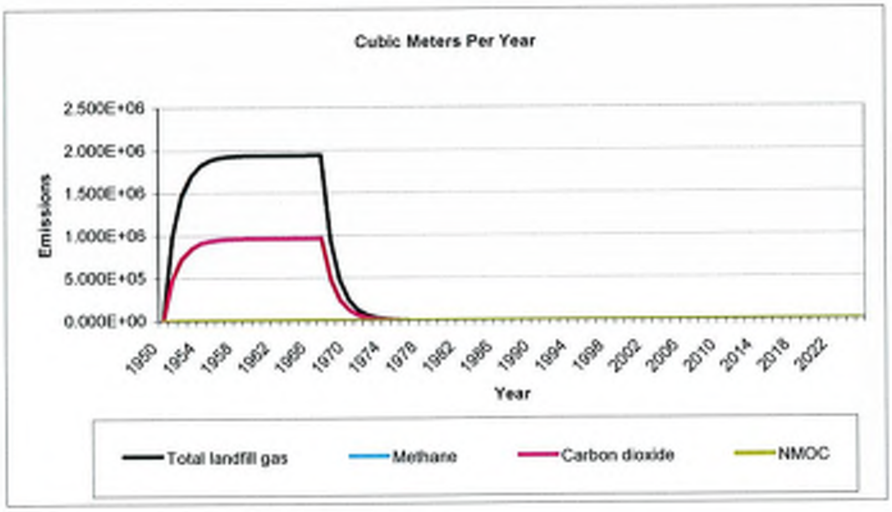
	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

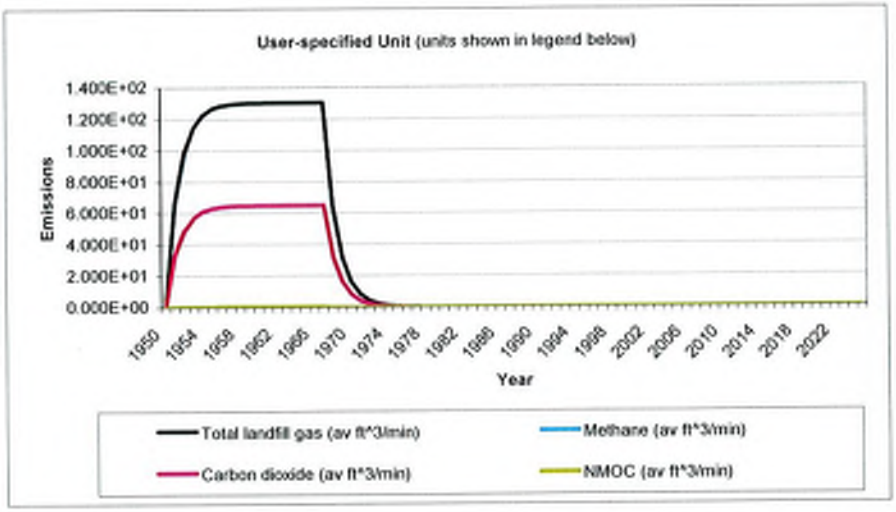
Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
Emissions
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
Emissions
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
1.400E+02
1.200E+02
1.000E+02
8.000E+01
6.000E+01
4.000E+01
2.000E+01
0.000E+00
Emissions
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	1.220E+03	9.767E+05	6.562E+01	3.258E+02	4.883E+05	3.281E+01
1952	1.825E+03	1.462E+06	9.821E+01	4.876E+02	7.308E+05	4.910E+01
1953	2.126E+03	1.703E+06	1.144E+02	5.679E+02	8.513E+05	5.720E+01
1954	2.275E+03	1.822E+06	1.224E+02	6.078E+02	9.111E+05	6.121E+01
1955	2.350E+03	1.882E+06	1.264E+02	6.276E+02	9.408E+05	6.321E+01
1956	2.387E+03	1.911E+06	1.284E+02	6.375E+02	9.555E+05	6.420E+01
1957	2.405E+03	1.926E+06	1.294E+02	6.423E+02	9.628E+05	6.469E+01
1958	2.414E+03	1.933E+06	1.299E+02	6.448E+02	9.665E+05	6.494E+01
1959	2.418E+03	1.937E+06	1.301E+02	6.460E+02	9.683E+05	6.506E+01
1960	2.421E+03	1.938E+06	1.302E+02	6.466E+02	9.692E+05	6.512E+01
1961	2.422E+03	1.939E+06	1.303E+02	6.469E+02	9.696E+05	6.515E+01
1962	2.422E+03	1.940E+06	1.303E+02	6.470E+02	9.698E+05	6.516E+01
1963	2.423E+03	1.940E+06	1.303E+02	6.471E+02	9.699E+05	6.517E+01
1964	2.423E+03	1.940E+06	1.303E+02	6.471E+02	9.700E+05	6.517E+01
1965	2.423E+03	1.940E+06	1.304E+02	6.471E+02	9.700E+05	6.518E+01
1966	2.423E+03	1.940E+06	1.304E+02	6.472E+02	9.700E+05	6.518E+01
1967	2.423E+03	1.940E+06	1.304E+02	6.472E+02	9.700E+05	6.518E+01
1968	1.203E+03	9.634E+05	6.473E+01	3.214E+02	4.817E+05	3.237E+01
1969	5.975E+02	4.784E+05	3.214E+01	1.596E+02	2.392E+05	1.607E+01
1970	2.967E+02	2.376E+05	1.596E+01	7.926E+01	1.188E+05	7.981E+00
1971	1.473E+02	1.180E+05	7.927E+00	3.935E+01	5.899E+04	3.963E+00
1972	7.316E+01	5.859E+04	3.936E+00	1.954E+01	2.929E+04	1.968E+00
1973	3.633E+01	2.909E+04	1.955E+00	9.705E+00	1.455E+04	9.774E-01
1974	1.804E+01	1.445E+04	9.707E-01	4.819E+00	7.223E+03	4.853E-01
1975	8.959E+00	7.174E+03	4.820E-01	2.393E+00	3.587E+03	2.410E-01
1976	4.449E+00	3.563E+03	2.394E-01	1.188E+00	1.781E+03	1.197E-01
1977	2.209E+00	1.769E+03	1.189E-01	5.901E-01	8.846E+02	5.943E-02
1978	1.097E+00	8.785E+02	5.903E-02	2.931E-01	4.393E+02	2.951E-02
1979	5.448E-01	4.363E+02	2.931E-02	1.455E-01	2.181E+02	1.466E-02
1980	2.705E-01	2.166E+02	1.456E-02	7.227E-02	1.083E+02	7.278E-03
1981	1.343E-01	1.076E+02	7.228E-03	3.589E-02	5.379E+01	3.614E-03
1982	6.672E-02	5.342E+01	3.589E-03	1.782E-02	2.671E+01	1.795E-03
1983	3.313E-02	2.653E+01	1.782E-03	8.849E-03	1.326E+01	8.912E-04
1984	1.645E-02	1.317E+01	8.852E-04	4.394E-03	6.587E+00	4.426E-04
1985	8.170E-03	6.542E+00	4.396E-04	2.182E-03	3.271E+00	2.198E-04
1986	4.057E-03	3.249E+00	2.183E-04	1.084E-03	1.624E+00	1.091E-04
1987	2.015E-03	1.613E+00	1.084E-04	5.381E-04	8.066E-01	5.420E-05
1988	1.000E-03	8.011E-01	5.383E-05	2.672E-04	4.006E-01	2.691E-05
1989	4.968E-04	3.978E-01	2.673E-05	1.327E-04	1.989E-01	1.336E-05
1990	2.467E-04	1.976E-01	1.327E-05	6.590E-05	9.878E-02	6.637E-06
1991	1.225E-04	9.810E-02	6.591E-06	3.272E-05	4.905E-02	3.296E-06
1992	6.084E-05	4.872E-02	3.273E-06	1.625E-05	2.436E-02	1.637E-06
1993	3.021E-05	2.419E-02	1.625E-06	8.070E-06	1.210E-02	8.127E-07
1994	1.500E-05	1.201E-02	8.072E-07	4.007E-06	6.007E-03	4.036E-07
1995	7.450E-06	5.966E-03	4.008E-07	1.990E-06	2.983E-03	2.004E-07
1996	3.699E-06	2.962E-03	1.990E-07	9.882E-07	1.481E-03	9.952E-08
1997	1.837E-06	1.471E-03	9.884E-08	4.907E-07	7.355E-04	4.942E-08
1998	9.123E-07	7.305E-04	4.908E-08	2.437E-07	3.653E-04	2.454E-08
1999	4.530E-07	3.628E-04	2.437E-08	1.210E-07	1.814E-04	1.219E-08

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2000	2.250E-07	1.801E-04	1.210E-08	6.009E-08	9.007E-05	6.052E-09
2001	1.117E-07	8.946E-05	6.011E-09	2.984E-08	4.473E-05	3.005E-09
2002	5.548E-08	4.442E-05	2.985E-09	1.482E-08	2.221E-05	1.492E-09
2003	2.755E-08	2.206E-05	1.482E-09	7.359E-09	1.103E-05	7.411E-10
2004	1.368E-08	1.095E-05	7.360E-10	3.654E-09	5.477E-06	3.680E-10
2005	6.793E-09	5.440E-06	3.655E-10	1.815E-09	2.720E-06	1.828E-10
2006	3.374E-09	2.701E-06	1.815E-10	9.011E-10	1.351E-06	9.075E-11
2007	1.675E-09	1.341E-06	9.013E-11	4.475E-10	6.707E-07	4.507E-11
2008	8.319E-10	6.661E-07	4.476E-11	2.222E-10	3.331E-07	2.238E-11
2009	4.131E-10	3.308E-07	2.223E-11	1.103E-10	1.654E-07	1.111E-11
2010	2.051E-10	1.643E-07	1.104E-11	5.480E-11	8.213E-08	5.519E-12
2011	1.019E-10	8.157E-08	5.481E-12	2.721E-11	4.079E-08	2.740E-12
2012	5.059E-11	4.051E-08	2.722E-12	1.351E-11	2.025E-08	1.361E-12
2013	2.512E-11	2.012E-08	1.352E-12	6.710E-12	1.006E-08	6.758E-13
2014	1.247E-11	9.989E-09	6.712E-13	3.332E-12	4.995E-09	3.356E-13
2015	6.195E-12	4.960E-09	3.333E-13	1.655E-12	2.480E-09	1.666E-13
2016	3.076E-12	2.463E-09	1.655E-13	8.217E-13	1.232E-09	8.275E-14
2017	1.528E-12	1.223E-09	8.219E-14	4.080E-13	6.116E-10	4.109E-14
2018	7.586E-13	6.074E-10	4.081E-14	2.026E-13	3.037E-10	2.041E-14
2019	3.767E-13	3.016E-10	2.027E-14	1.006E-13	1.508E-10	1.013E-14
2020	1.871E-13	1.498E-10	1.006E-14	4.997E-14	7.490E-11	5.032E-15
2021	9.289E-14	7.439E-11	4.998E-15	2.481E-14	3.719E-11	2.499E-15
2022	4.613E-14	3.694E-11	2.482E-15	1.232E-14	1.847E-11	1.241E-15
2023	2.291E-14	1.834E-11	1.232E-15	6.119E-15	9.172E-12	6.162E-16
2024	1.138E-14	9.109E-12	6.120E-16	3.039E-15	4.554E-12	3.060E-16
2025	5.649E-15	4.523E-12	3.039E-16	1.509E-15	2.262E-12	1.520E-16
2026	2.805E-15	2.246E-12	1.509E-16	7.493E-16	1.123E-12	7.546E-17
2027	1.393E-15	1.115E-12	7.495E-17	3.721E-16	5.577E-13	3.747E-17
2028	6.917E-16	5.539E-13	3.722E-17	1.848E-16	2.770E-13	1.861E-17
2029	3.435E-16	2.751E-13	1.848E-17	9.176E-17	1.375E-13	9.241E-18
2030	1.706E-16	1.366E-13	9.178E-18	4.556E-17	6.830E-14	4.589E-18
2031	8.471E-17	6.783E-14	4.558E-18	2.263E-17	3.392E-14	2.279E-18
2032	4.207E-17	3.368E-14	2.263E-18	1.124E-17	1.684E-14	1.132E-18
2033	2.089E-17	1.673E-14	1.124E-18	5.580E-18	8.363E-15	5.619E-19
2034	1.037E-17	8.306E-15	5.581E-19	2.771E-18	4.153E-15	2.790E-19
2035	5.151E-18	4.125E-15	2.771E-19	1.376E-18	2.062E-15	1.386E-19
2036	2.558E-18	2.048E-15	1.376E-19	6.833E-19	1.024E-15	6.881E-20
2037	1.270E-18	1.017E-15	6.834E-20	3.393E-19	5.086E-16	3.417E-20
2038	6.308E-19	5.051E-16	3.394E-20	1.685E-19	2.526E-16	1.697E-20
2039	3.132E-19	2.508E-16	1.685E-20	8.367E-20	1.254E-16	8.427E-21
2040	1.556E-19	1.246E-16	8.369E-21	4.155E-20	6.228E-17	4.185E-21
2041	7.724E-20	6.185E-17	4.156E-21	2.063E-20	3.093E-17	2.078E-21
2042	3.836E-20	3.072E-17	2.064E-21	1.025E-20	1.536E-17	1.032E-21
2043	1.905E-20	1.525E-17	1.025E-21	5.088E-21	7.626E-18	5.124E-22
2044	9.459E-21	7.574E-18	5.089E-22	2.527E-21	3.787E-18	2.545E-22
2045	4.697E-21	3.761E-18	2.527E-22	1.255E-21	1.881E-18	1.264E-22
2046	2.333E-21	1.868E-18	1.255E-22	6.231E-22	9.339E-19	6.275E-23
2047	1.158E-21	9.275E-19	6.232E-23	3.094E-22	4.638E-19	3.116E-23
2048	5.752E-22	4.606E-19	3.095E-23	1.536E-22	2.303E-19	1.547E-23
2049	2.856E-22	2.287E-19	1.537E-23	7.630E-23	1.144E-19	7.684E-24
2050	1.418E-22	1.136E-19	7.632E-24	3.789E-23	5.679E-20	3.816E-24

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2051	7.044E-23	5.640E-20	3.790E-24	1.881E-23	2.820E-20	1.895E-24
2052	3.498E-23	2.801E-20	1.882E-24	9.343E-24	1.400E-20	9.410E-25
2053	1.737E-23	1.391E-20	9.345E-25	4.640E-24	6.954E-21	4.673E-25
2054	8.626E-24	6.907E-21	4.641E-25	2.304E-24	3.453E-21	2.320E-25
2055	4.283E-24	3.430E-21	2.305E-25	1.144E-24	1.715E-21	1.152E-25
2056	2.127E-24	1.703E-21	1.144E-25	5.682E-25	8.516E-22	5.722E-26
2057	1.056E-24	8.458E-22	5.683E-26	2.821E-25	4.229E-22	2.841E-26
2058	5.245E-25	4.200E-22	2.822E-26	1.401E-25	2.100E-22	1.411E-26
2059	2.605E-25	2.086E-22	1.401E-26	6.957E-26	1.043E-22	7.007E-27
2060	1.293E-25	1.036E-22	6.959E-27	3.455E-26	5.179E-23	3.480E-27
2061	6.423E-26	5.143E-23	3.456E-27	1.716E-26	2.572E-23	1.728E-27
2062	3.190E-26	2.554E-23	1.716E-27	8.520E-27	1.277E-23	8.580E-28
2063	1.584E-26	1.268E-23	8.522E-28	4.231E-27	6.342E-24	4.261E-28
2064	7.865E-27	6.298E-24	4.232E-28	2.101E-27	3.149E-24	2.116E-28
2065	3.906E-27	3.128E-24	2.101E-28	1.043E-27	1.564E-24	1.051E-28
2066	1.940E-27	1.553E-24	1.044E-28	5.181E-28	7.766E-25	5.218E-29
2067	9.632E-28	7.713E-25	5.182E-29	2.573E-28	3.856E-25	2.591E-29
2068	4.783E-28	3.830E-25	2.573E-29	1.278E-28	1.915E-25	1.287E-29
2069	2.375E-28	1.902E-25	1.278E-29	6.344E-29	9.510E-26	6.390E-30
2070	1.179E-28	9.445E-26	6.346E-30	3.151E-29	4.722E-26	3.173E-30
2071	5.857E-29	4.690E-26	3.151E-30	1.564E-29	2.345E-26	1.576E-30
2072	2.909E-29	2.329E-26	1.565E-30	7.769E-30	1.165E-26	7.824E-31
2073	1.444E-29	1.157E-26	7.771E-31	3.858E-30	5.783E-27	3.885E-31
2074	7.172E-30	5.743E-27	3.859E-31	1.916E-30	2.872E-27	1.929E-31
2075	3.562E-30	2.852E-27	1.916E-31	9.514E-31	1.426E-27	9.581E-32
2076	1.769E-30	1.416E-27	9.516E-32	4.724E-31	7.081E-28	4.758E-32
2077	8.783E-31	7.033E-28	4.726E-32	2.346E-31	3.517E-28	2.363E-32
2078	4.362E-31	3.493E-28	2.347E-32	1.165E-31	1.746E-28	1.173E-32
2079	2.166E-31	1.734E-28	1.165E-32	5.785E-32	8.672E-29	5.826E-33
2080	1.076E-31	8.612E-29	5.787E-33	2.873E-32	4.306E-29	2.893E-33
2081	5.341E-32	4.277E-29	2.874E-33	1.427E-32	2.138E-29	1.437E-33
2082	2.652E-32	2.124E-29	1.427E-33	7.084E-33	1.062E-29	7.135E-34
2083	1.317E-32	1.055E-29	7.086E-34	3.518E-33	5.273E-30	3.543E-34
2084	6.540E-33	5.237E-30	3.519E-34	1.747E-33	2.619E-30	1.759E-34
2085	3.248E-33	2.601E-30	1.747E-34	8.675E-34	1.300E-30	8.737E-35
2086	1.613E-33	1.291E-30	8.677E-35	4.308E-34	6.457E-31	4.339E-35
2087	8.009E-34	6.413E-31	4.309E-35	2.139E-34	3.207E-31	2.155E-35
2088	3.977E-34	3.185E-31	2.140E-35	1.062E-34	1.592E-31	1.070E-35
2089	1.975E-34	1.582E-31	1.063E-35	5.275E-35	7.908E-32	5.313E-36
2090	9.808E-35	7.854E-32	5.277E-36	2.620E-35	3.927E-32	2.638E-36

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m ^{3} /year)*	*(av ft^3/min)*	*(Mg/year)*	*(m ^{3} /year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	8.939E+02	4.883E+05	3.281E+01	1.400E+01	3.907E+03	2.625E-01
1952	1.338E+03	7.308E+05	4.910E+01	2.096E+01	5.847E+03	3.928E-01
1953	1.558E+03	8.513E+05	5.720E+01	2.441E+01	6.810E+03	4.576E-01
1954	1.668E+03	9.111E+05	6.121E+01	2.613E+01	7.288E+03	4.897E-01
1955	1.722E+03	9.408E+05	6.321E+01	2.698E+01	7.526E+03	5.057E-01
1956	1.749E+03	9.555E+05	6.420E+01	2.740E+01	7.644E+03	5.136E-01
1957	1.762E+03	9.628E+05	6.469E+01	2.761E+01	7.703E+03	5.175E-01
1958	1.769E+03	9.665E+05	6.494E+01	2.771E+01	7.732E+03	5.195E-01
1959	1.772E+03	9.683E+05	6.506E+01	2.777E+01	7.746E+03	5.205E-01
1960	1.774E+03	9.692E+05	6.512E+01	2.779E+01	7.753E+03	5.209E-01
1961	1.775E+03	9.696E+05	6.515E+01	2.780E+01	7.757E+03	5.212E-01
1962	1.775E+03	9.698E+05	6.516E+01	2.781E+01	7.759E+03	5.213E-01
1963	1.775E+03	9.699E+05	6.517E+01	2.781E+01	7.759E+03	5.214E-01
1964	1.776E+03	9.700E+05	6.517E+01	2.782E+01	7.760E+03	5.214E-01
1965	1.776E+03	9.700E+05	6.518E+01	2.782E+01	7.760E+03	5.214E-01
1966	1.776E+03	9.700E+05	6.518E+01	2.782E+01	7.760E+03	5.214E-01
1967	1.776E+03	9.700E+05	6.518E+01	2.782E+01	7.760E+03	5.214E-01
1968	8.818E+02	4.817E+05	3.237E+01	1.381E+01	3.854E+03	2.589E-01
1969	4.379E+02	2.392E+05	1.607E+01	6.859E+00	1.914E+03	1.286E-01
1970	2.174E+02	1.188E+05	7.981E+00	3.406E+00	9.503E+02	6.385E-02
1971	1.080E+02	5.899E+04	3.963E+00	1.692E+00	4.719E+02	3.171E-02
1972	5.362E+01	2.929E+04	1.968E+00	8.400E-01	2.343E+02	1.575E-02
1973	2.663E+01	1.455E+04	9.774E-01	4.171E-01	1.164E+02	7.819E-03
1974	1.322E+01	7.223E+03	4.853E-01	2.071E-01	5.779E+01	3.883E-03
1975	6.566E+00	3.587E+03	2.410E-01	1.029E-01	2.870E+01	1.928E-03
1976	3.261E+00	1.781E+03	1.197E-01	5.108E-02	1.425E+01	9.575E-04
1977	1.619E+00	8.846E+02	5.943E-02	2.537E-02	7.076E+00	4.755E-04
1978	8.041E-01	4.393E+02	2.951E-02	1.260E-02	3.514E+00	2.361E-04
1979	3.993E-01	2.181E+02	1.466E-02	6.255E-03	1.745E+00	1.172E-04
1980	1.983E-01	1.083E+02	7.278E-03	3.106E-03	8.666E-01	5.822E-05
1981	9.846E-02	5.379E+01	3.614E-03	1.542E-03	4.303E-01	2.891E-05
1982	4.890E-02	2.671E+01	1.795E-03	7.660E-04	2.137E-01	1.436E-05
1983	2.428E-02	1.326E+01	8.912E-04	3.804E-04	1.061E-01	7.130E-06
1984	1.206E-02	6.587E+00	4.426E-04	1.889E-04	5.270E-02	3.541E-06
1985	5.988E-03	3.271E+00	2.198E-04	9.380E-05	2.617E-02	1.758E-06
1986	2.973E-03	1.624E+00	1.091E-04	4.658E-05	1.299E-02	8.731E-07
1987	1.477E-03	8.066E-01	5.420E-05	2.313E-05	6.453E-03	4.336E-07
1988	7.332E-04	4.006E-01	2.691E-05	1.149E-05	3.204E-03	2.153E-07
1989	3.641E-04	1.989E-01	1.336E-05	5.704E-06	1.591E-03	1.069E-07
1990	1.808E-04	9.878E-02	6.637E-06	2.832E-06	7.902E-04	5.309E-08
1991	8.979E-05	4.905E-02	3.296E-06	1.407E-06	3.924E-04	2.637E-08
1992	4.459E-05	2.436E-02	1.637E-06	6.985E-07	1.949E-04	1.309E-08
1993	2.214E-05	1.210E-02	8.127E-07	3.469E-07	9.677E-05	6.502E-09
1994	1.099E-05	6.007E-03	4.036E-07	1.722E-07	4.805E-05	3.229E-09
1995	5.460E-06	2.983E-03	2.004E-07	8.553E-08	2.386E-05	1.603E-09
1996	2.711E-06	1.481E-03	9.952E-08	4.247E-08	1.185E-05	7.962E-10
1997	1.346E-06	7.355E-04	4.942E-08	2.109E-08	5.884E-06	3.954E-10
1998	6.686E-07	3.653E-04	2.454E-08	1.047E-08	2.922E-06	1.963E-10
1999	3.320E-07	1.814E-04	1.219E-08	5.201E-09	1.451E-06	9.750E-11

Results (Continued)

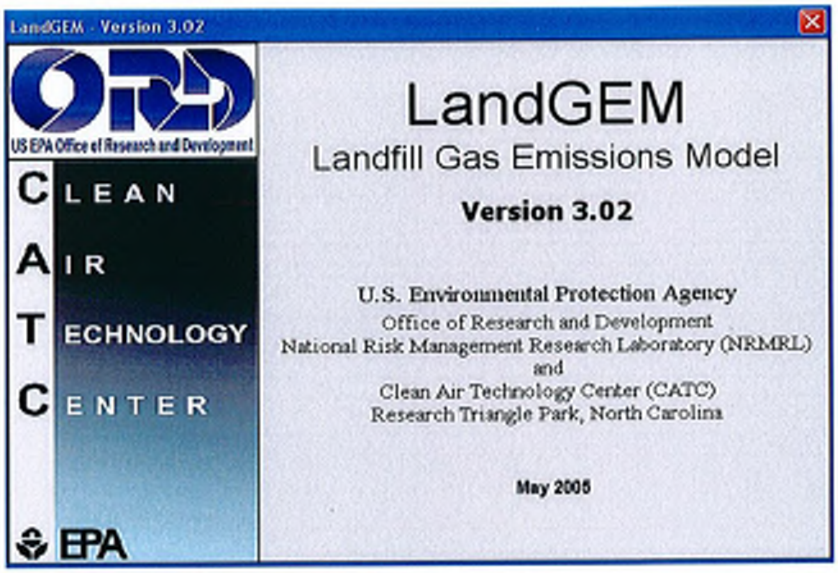
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2000	1.649E-07	9.007E-05	6.052E-09	2.583E-09	7.206E-07	4.842E-11
2001	8.187E-08	4.473E-05	3.005E-09	1.283E-09	3.578E-07	2.404E-11
2002	4.066E-08	2.221E-05	1.492E-09	6.369E-10	1.777E-07	1.194E-11
2003	2.019E-08	1.103E-05	7.411E-10	3.163E-10	8.824E-08	5.929E-12
2004	1.003E-08	5.477E-06	3.680E-10	1.571E-10	4.382E-08	2.944E-12
2005	4.979E-09	2.720E-06	1.828E-10	7.800E-11	2.176E-08	1.462E-12
2006	2.472E-09	1.351E-06	9.075E-11	3.873E-11	1.081E-08	7.260E-13
2007	1.228E-09	6.707E-07	4.507E-11	1.923E-11	5.366E-09	3.605E-13
2008	6.097E-10	3.331E-07	2.238E-11	9.551E-12	2.665E-09	1.790E-13
2009	3.028E-10	1.654E-07	1.111E-11	4.743E-12	1.323E-09	8.890E-14
2010	1.503E-10	8.213E-08	5.519E-12	2.355E-12	6.571E-10	4.415E-14
2011	7.466E-11	4.079E-08	2.740E-12	1.170E-12	3.263E-10	2.192E-14
2012	3.708E-11	2.025E-08	1.361E-12	5.808E-13	1.620E-10	1.089E-14
2013	1.841E-11	1.006E-08	6.758E-13	2.884E-13	8.046E-11	5.406E-15
2014	9.143E-12	4.995E-09	3.356E-13	1.432E-13	3.996E-11	2.685E-15
2015	4.540E-12	2.480E-09	1.666E-13	7.112E-14	1.984E-11	1.333E-15
2016	2.255E-12	1.232E-09	8.275E-14	3.532E-14	9.853E-12	6.620E-16
2017	1.120E-12	6.116E-10	4.109E-14	1.754E-14	4.893E-12	3.288E-16
2018	5.560E-13	3.037E-10	2.041E-14	8.709E-15	2.430E-12	1.633E-16
2019	2.761E-13	1.508E-10	1.013E-14	4.325E-15	1.207E-12	8.107E-17
2020	1.371E-13	7.490E-11	5.032E-15	2.148E-15	5.992E-13	4.026E-17
2021	6.808E-14	3.719E-11	2.499E-15	1.067E-15	2.975E-13	1.999E-17
2022	3.381E-14	1.847E-11	1.241E-15	5.296E-16	1.478E-13	9.928E-18
2023	1.679E-14	9.172E-12	6.162E-16	2.630E-16	7.337E-14	4.930E-18
2024	8.337E-15	4.554E-12	3.060E-16	1.306E-16	3.644E-14	2.448E-18
2025	4.140E-15	2.262E-12	1.520E-16	6.486E-17	1.809E-14	1.216E-18
2026	2.056E-15	1.123E-12	7.546E-17	3.221E-17	8.985E-15	6.037E-19
2027	1.021E-15	5.577E-13	3.747E-17	1.599E-17	4.462E-15	2.998E-19
2028	5.070E-16	2.770E-13	1.861E-17	7.942E-18	2.216E-15	1.489E-19
2029	2.518E-16	1.375E-13	9.241E-18	3.944E-18	1.100E-15	7.393E-20
2030	1.250E-16	6.830E-14	4.589E-18	1.958E-18	5.464E-16	3.671E-20
2031	6.208E-17	3.392E-14	2.279E-18	9.725E-19	2.713E-16	1.823E-20
2032	3.083E-17	1.684E-14	1.132E-18	4.830E-19	1.347E-16	9.053E-21
2033	1.531E-17	8.363E-15	5.619E-19	2.398E-19	6.691E-17	4.496E-21
2034	7.602E-18	4.153E-15	2.790E-19	1.191E-19	3.323E-17	2.232E-21
2035	3.775E-18	2.062E-15	1.386E-19	5.914E-20	1.650E-17	1.109E-21
2036	1.875E-18	1.024E-15	6.881E-20	2.937E-20	8.193E-18	5.505E-22
2037	9.310E-19	5.086E-16	3.417E-20	1.458E-20	4.069E-18	2.734E-22
2038	4.623E-19	2.526E-16	1.697E-20	7.242E-21	2.020E-18	1.358E-22
2039	2.296E-19	1.254E-16	8.427E-21	3.596E-21	1.003E-18	6.741E-23
2040	1.140E-19	6.228E-17	4.185E-21	1.786E-21	4.982E-19	3.348E-23
2041	5.661E-20	3.093E-17	2.078E-21	8.868E-22	2.474E-19	1.662E-23
2042	2.811E-20	1.536E-17	1.032E-21	4.404E-22	1.229E-19	8.255E-24
2043	1.396E-20	7.626E-18	5.124E-22	2.187E-22	6.101E-20	4.099E-24
2044	6.932E-21	3.787E-18	2.545E-22	1.086E-22	3.030E-20	2.036E-24
2045	3.443E-21	1.881E-18	1.264E-22	5.393E-23	1.505E-20	1.011E-24
2046	1.710E-21	9.339E-19	6.275E-23	2.678E-23	7.471E-21	5.020E-25
2047	8.489E-22	4.638E-19	3.116E-23	1.330E-23	3.710E-21	2.493E-25
2048	4.216E-22	2.303E-19	1.547E-23	6.604E-24	1.842E-21	1.238E-25
2049	2.093E-22	1.144E-19	7.684E-24	3.279E-24	9.149E-22	6.147E-26
2050	1.040E-22	5.679E-20	3.816E-24	1.629E-24	4.543E-22	3.053E-26

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2051	5.162E-23	2.820E-20	1.895E-24	8.087E-25	2.256E-22	1.516E-26
2052	2.564E-23	1.400E-20	9.410E-25	4.016E-25	1.120E-22	7.528E-27
2053	1.273E-23	6.954E-21	4.673E-25	1.994E-25	5.564E-23	3.738E-27
2054	6.322E-24	3.453E-21	2.320E-25	9.903E-26	2.763E-23	1.856E-27
2055	3.139E-24	1.715E-21	1.152E-25	4.918E-26	1.372E-23	9.218E-28
2056	1.559E-24	8.516E-22	5.722E-26	2.442E-26	6.813E-24	4.578E-28
2057	7.741E-25	4.229E-22	2.841E-26	1.213E-26	3.383E-24	2.273E-28
2058	3.844E-25	2.100E-22	1.411E-26	6.022E-27	1.680E-24	1.129E-28
2059	1.909E-25	1.043E-22	7.007E-27	2.990E-27	8.343E-25	5.606E-29
2060	9.480E-26	5.179E-23	3.480E-27	1.485E-27	4.143E-25	2.784E-29
2061	4.707E-26	2.572E-23	1.728E-27	7.374E-28	2.057E-25	1.382E-29
2062	2.338E-26	1.277E-23	8.580E-28	3.662E-28	1.022E-25	6.864E-30
2063	1.161E-26	6.342E-24	4.261E-28	1.819E-28	5.073E-26	3.409E-30
2064	5.765E-27	3.149E-24	2.116E-28	9.030E-29	2.519E-26	1.693E-30
2065	2.863E-27	1.564E-24	1.051E-28	4.484E-29	1.251E-26	8.406E-31
2066	1.422E-27	7.766E-25	5.218E-29	2.227E-29	6.213E-27	4.174E-31
2067	7.059E-28	3.856E-25	2.591E-29	1.106E-29	3.085E-27	2.073E-31
2068	3.505E-28	1.915E-25	1.287E-29	5.491E-30	1.532E-27	1.029E-31
2069	1.741E-28	9.510E-26	6.390E-30	2.727E-30	7.608E-28	5.112E-32
2070	8.644E-29	4.722E-26	3.173E-30	1.354E-30	3.778E-28	2.538E-32
2071	4.293E-29	2.345E-26	1.576E-30	6.725E-31	1.876E-28	1.261E-32
2072	2.132E-29	1.165E-26	7.824E-31	3.339E-31	9.316E-29	6.259E-33
2073	1.059E-29	5.783E-27	3.885E-31	1.658E-31	4.626E-29	3.108E-33
2074	5.257E-30	2.872E-27	1.929E-31	8.235E-32	2.297E-29	1.544E-33
2075	2.610E-30	1.426E-27	9.581E-32	4.089E-32	1.141E-29	7.665E-34
2076	1.296E-30	7.081E-28	4.758E-32	2.031E-32	5.665E-30	3.806E-34
2077	6.437E-31	3.517E-28	2.363E-32	1.008E-32	2.813E-30	1.890E-34
2078	3.197E-31	1.746E-28	1.173E-32	5.008E-33	1.397E-30	9.386E-35
2079	1.587E-31	8.672E-29	5.826E-33	2.487E-33	6.937E-31	4.661E-35
2080	7.883E-32	4.306E-29	2.893E-33	1.235E-33	3.445E-31	2.315E-35
2081	3.914E-32	2.138E-29	1.437E-33	6.132E-34	1.711E-31	1.149E-35
2082	1.944E-32	1.062E-29	7.135E-34	3.045E-34	8.495E-32	5.708E-36
2083	9.653E-33	5.273E-30	3.543E-34	1.512E-34	4.219E-32	2.834E-36
2084	4.793E-33	2.619E-30	1.759E-34	7.509E-35	2.095E-32	1.408E-36
2085	2.380E-33	1.300E-30	8.737E-35	3.729E-35	1.040E-32	6.990E-37
2086	1.182E-33	6.457E-31	4.339E-35	1.852E-35	5.166E-33	3.471E-37
2087	5.870E-34	3.207E-31	2.155E-35	9.195E-36	2.565E-33	1.724E-37
2088	2.915E-34	1.592E-31	1.070E-35	4.566E-36	1.274E-33	8.559E-38
2089	1.447E-34	7.908E-32	5.313E-36	2.268E-36	6.326E-34	4.250E-38
2090	7.188E-35	3.927E-32	2.638E-36	1.126E-36	3.141E-34	2.111E-38

Appendix 3

Third Computer Model Run



LandGEM - Version 3.02

LandGEM

Landfill Gas Emissions Model

Version 3.02

U.S. Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory (NRMRL)
and
Clean Air Technology Center (CATC)
Research Triangle Park, North Carolina

May 2005

Summary Report

Landfill Name or Identifier: MVS Landfill Colorado Springs, CO

Date: Monday, March 07, 2011

Description/Comments:

This computer run is median between wet and arid conditions at the site

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation (*m^3/year*)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate (*$year^{-1}$*)
L_o = potential methane generation capacity (*m^3/Mg*)
M_i = mass of waste accepted in the i^{th} year (*Mg*)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1950**	
Landfill Closure Year (with 80-year limit)	**1966**	
Actual Closure Year (without limit)	***1966***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**182,500**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.050**	*year^{-1}*
Potential Methane Generation Capacity, L_o	**170**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1950	9,759	10,735	0	0
1951	9,759	10,735	9,759	10,735
1952	9,759	10,735	19,518	21,470
1953	9,759	10,735	29,277	32,205
1954	9,759	10,735	39,036	42,940
1955	9,759	10,735	48,795	53,675
1956	9,759	10,735	58,555	64,410
1957	9,759	10,735	68,314	75,145
1958	9,759	10,735	78,073	85,880
1959	9,759	10,735	87,832	96,615
1960	9,759	10,735	97,591	107,350
1961	9,759	10,735	107,350	118,085
1962	9,759	10,735	117,109	128,820
1963	9,759	10,735	126,868	139,555
1964	9,759	10,735	136,627	150,290
1965	9,759	10,735	146,386	161,025
1966	9,759	10,735	156,145	171,760
1967	0	0	165,905	182,495
1968	0	0	165,905	182,495
1969	0	0	165,905	182,495
1970	0	0	165,905	182,495
1971	0	0	165,905	182,495
1972	0	0	165,905	182,495
1973	0	0	165,905	182,495
1974	0	0	165,905	182,495
1975	0	0	165,905	182,495
1976	0	0	165,905	182,495
1977	0	0	165,905	182,495
1978	0	0	165,905	182,495
1979	0	0	165,905	182,495
1980	0	0	165,905	182,495
1981	0	0	165,905	182,495
1982	0	0	165,905	182,495
1983	0	0	165,905	182,495
1984	0	0	165,905	182,495
1985	0	0	165,905	182,495
1986	0	0	165,905	182,495
1987	0	0	165,905	182,495
1988	0	0	165,905	182,495
1989	0	0	165,905	182,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1990	0	0	165,905	182,495
1991	0	0	165,905	182,495
1992	0	0	165,905	182,495
1993	0	0	165,905	182,495
1994	0	0	165,905	182,495
1995	0	0	165,905	182,495
1996	0	0	165,905	182,495
1997	0	0	165,905	182,495
1998	0	0	165,905	182,495
1999	0	0	165,905	182,495
2000	0	0	165,905	182,495
2001	0	0	165,905	182,495
2002	0	0	165,905	182,495
2003	0	0	165,905	182,495
2004	0	0	165,905	182,495
2005	0	0	165,905	182,495
2006	0	0	165,905	182,495
2007	0	0	165,905	182,495
2008	0	0	165,905	182,495
2009	0	0	165,905	182,495
2010	0	0	165,905	182,495
2011	0	0	165,905	182,495
2012	0	0	165,905	182,495
2013	0	0	165,905	182,495
2014	0	0	165,905	182,495
2015	0	0	165,905	182,495
2016	0	0	165,905	182,495
2017	0	0	165,905	182,495
2018	0	0	165,905	182,495
2019	0	0	165,905	182,495
2020	0	0	165,905	182,495
2021	0	0	165,905	182,495
2022	0	0	165,905	182,495
2023	0	0	165,905	182,495
2024	0	0	165,905	182,495
2025	0	0	165,905	182,495
2026	0	0	165,905	182,495
2027	0	0	165,905	182,495
2028	0	0	165,905	182,495
2029	0	0	165,905	182,495

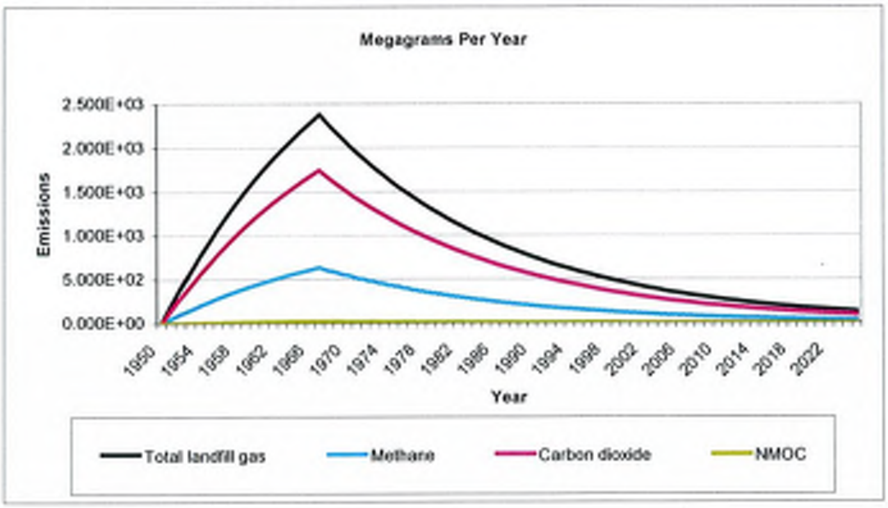
Pollutant Parameters

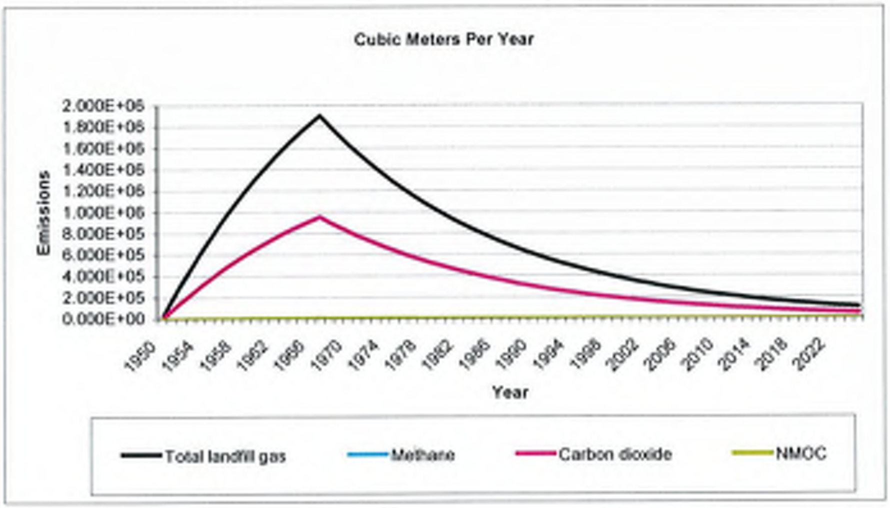
		Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

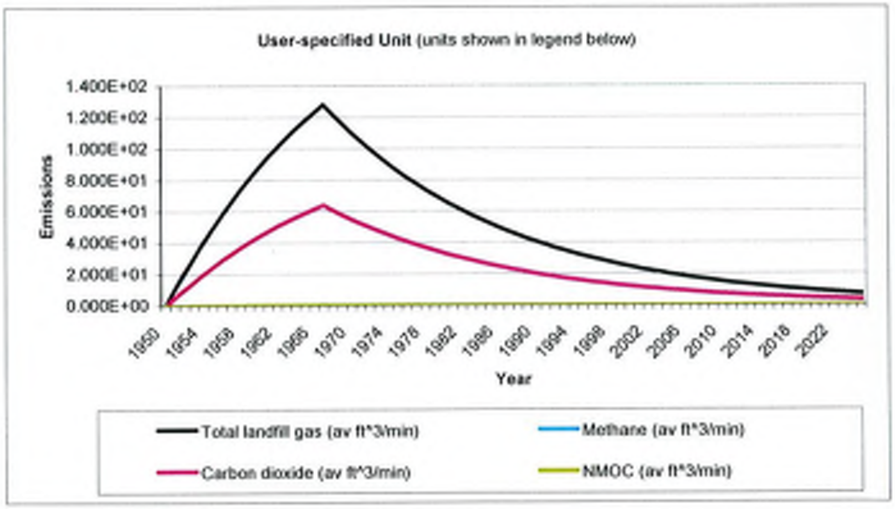
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
Emissions
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
2.000E+06
1.800E+06
1.600E+06
1.400E+06
1.200E+06
1.000E+06
8.000E+05
6.000E+05
4.000E+05
2.000E+05
0.000E+00
Emissions
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
1.400E+02
1.200E+02
1.000E+02
8.000E+01
6.000E+01
4.000E+01
2.000E+01
0.000E+00
Emissions
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	2.026E+02	1.622E+05	1.090E+01	5.412E+01	8.112E+04	5.450E+00
1952	3.953E+02	3.165E+05	2.127E+01	1.056E+02	1.583E+05	1.063E+01
1953	5.786E+02	4.633E+05	3.113E+01	1.546E+02	2.317E+05	1.557E+01
1954	7.530E+02	6.030E+05	4.051E+01	2.011E+02	3.015E+05	2.026E+01
1955	9.189E+02	7.358E+05	4.944E+01	2.454E+02	3.679E+05	2.472E+01
1956	1.077E+03	8.621E+05	5.793E+01	2.876E+02	4.311E+05	2.896E+01
1957	1.227E+03	9.823E+05	6.600E+01	3.277E+02	4.912E+05	3.300E+01
1958	1.370E+03	1.097E+06	7.368E+01	3.658E+02	5.483E+05	3.684E+01
1959	1.505E+03	1.205E+06	8.099E+01	4.021E+02	6.027E+05	4.050E+01
1960	1.635E+03	1.309E+06	8.794E+01	4.366E+02	6.544E+05	4.397E+01
1961	1.757E+03	1.407E+06	9.455E+01	4.694E+02	7.036E+05	4.728E+01
1962	1.874E+03	1.501E+06	1.008E+02	5.006E+02	7.504E+05	5.042E+01
1963	1.985E+03	1.590E+06	1.068E+02	5.303E+02	7.949E+05	5.341E+01
1964	2.091E+03	1.675E+06	1.125E+02	5.586E+02	8.373E+05	5.626E+01
1965	2.192E+03	1.755E+06	1.179E+02	5.855E+02	8.776E+05	5.896E+01
1966	2.288E+03	1.832E+06	1.231E+02	6.110E+02	9.159E+05	6.154E+01
1967	2.379E+03	1.905E+06	1.280E+02	6.353E+02	9.523E+05	6.399E+01
1968	2.263E+03	1.812E+06	1.217E+02	6.044E+02	9.059E+05	6.087E+01
1969	2.152E+03	1.723E+06	1.158E+02	5.749E+02	8.617E+05	5.790E+01
1970	2.047E+03	1.639E+06	1.101E+02	5.468E+02	8.197E+05	5.507E+01
1971	1.947E+03	1.559E+06	1.048E+02	5.202E+02	7.797E+05	5.239E+01
1972	1.852E+03	1.483E+06	9.967E+01	4.948E+02	7.417E+05	4.983E+01
1973	1.762E+03	1.411E+06	9.480E+01	4.707E+02	7.055E+05	4.740E+01
1974	1.676E+03	1.342E+06	9.018E+01	4.477E+02	6.711E+05	4.509E+01
1975	1.594E+03	1.277E+06	8.578E+01	4.259E+02	6.384E+05	4.289E+01
1976	1.517E+03	1.214E+06	8.160E+01	4.051E+02	6.072E+05	4.080E+01
1977	1.443E+03	1.155E+06	7.762E+01	3.854E+02	5.776E+05	3.881E+01
1978	1.372E+03	1.099E+06	7.383E+01	3.666E+02	5.494E+05	3.692E+01
1979	1.305E+03	1.045E+06	7.023E+01	3.487E+02	5.226E+05	3.512E+01
1980	1.242E+03	9.943E+05	6.681E+01	3.317E+02	4.972E+05	3.340E+01
1981	1.181E+03	9.458E+05	6.355E+01	3.155E+02	4.729E+05	3.177E+01
1982	1.124E+03	8.997E+05	6.045E+01	3.001E+02	4.498E+05	3.023E+01
1983	1.069E+03	8.558E+05	5.750E+01	2.855E+02	4.279E+05	2.875E+01
1984	1.017E+03	8.141E+05	5.470E+01	2.716E+02	4.070E+05	2.735E+01
1985	9.671E+02	7.744E+05	5.203E+01	2.583E+02	3.872E+05	2.601E+01
1986	9.199E+02	7.366E+05	4.949E+01	2.457E+02	3.683E+05	2.475E+01
1987	8.750E+02	7.007E+05	4.708E+01	2.337E+02	3.503E+05	2.354E+01
1988	8.323E+02	6.665E+05	4.478E+01	2.223E+02	3.333E+05	2.239E+01
1989	7.918E+02	6.340E+05	4.260E+01	2.115E+02	3.170E+05	2.130E+01
1990	7.531E+02	6.031E+05	4.052E+01	2.012E+02	3.015E+05	2.026E+01
1991	7.164E+02	5.737E+05	3.854E+01	1.914E+02	2.868E+05	1.927E+01
1992	6.815E+02	5.457E+05	3.666E+01	1.820E+02	2.728E+05	1.833E+01
1993	6.482E+02	5.191E+05	3.488E+01	1.732E+02	2.595E+05	1.744E+01
1994	6.166E+02	4.938E+05	3.318E+01	1.647E+02	2.469E+05	1.659E+01
1995	5.865E+02	4.697E+05	3.156E+01	1.567E+02	2.348E+05	1.578E+01
1996	5.579E+02	4.468E+05	3.002E+01	1.490E+02	2.234E+05	1.501E+01
1997	5.307E+02	4.250E+05	2.855E+01	1.418E+02	2.125E+05	1.428E+01
1998	5.048E+02	4.043E+05	2.716E+01	1.348E+02	2.021E+05	1.358E+01
1999	4.802E+02	3.845E+05	2.584E+01	1.283E+02	1.923E+05	1.292E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2000	4.568E+02	3.658E+05	2.458E+01	1.220E+02	1.829E+05	1.229E+01
2001	4.345E+02	3.479E+05	2.338E+01	1.161E+02	1.740E+05	1.169E+01
2002	4.133E+02	3.310E+05	2.224E+01	1.104E+02	1.655E+05	1.112E+01
2003	3.932E+02	3.148E+05	2.115E+01	1.050E+02	1.574E+05	1.058E+01
2004	3.740E+02	2.995E+05	2.012E+01	9.990E+01	1.497E+05	1.006E+01
2005	3.558E+02	2.849E+05	1.914E+01	9.503E+01	1.424E+05	9.570E+00
2006	3.384E+02	2.710E+05	1.821E+01	9.039E+01	1.355E+05	9.104E+00
2007	3.219E+02	2.578E+05	1.732E+01	8.598E+01	1.289E+05	8.660E+00
2008	3.062E+02	2.452E+05	1.647E+01	8.179E+01	1.226E+05	8.237E+00
2009	2.913E+02	2.332E+05	1.567E+01	7.780E+01	1.166E+05	7.836E+00
2010	2.771E+02	2.219E+05	1.491E+01	7.401E+01	1.109E+05	7.453E+00
2011	2.636E+02	2.110E+05	1.418E+01	7.040E+01	1.055E+05	7.090E+00
2012	2.507E+02	2.007E+05	1.349E+01	6.696E+01	1.004E+05	6.744E+00
2013	2.385E+02	1.910E+05	1.283E+01	6.370E+01	9.548E+04	6.415E+00
2014	2.268E+02	1.816E+05	1.220E+01	6.059E+01	9.082E+04	6.102E+00
2015	2.158E+02	1.728E+05	1.161E+01	5.764E+01	8.639E+04	5.805E+00
2016	2.053E+02	1.644E+05	1.104E+01	5.483E+01	8.218E+04	5.522E+00
2017	1.952E+02	1.563E+05	1.050E+01	5.215E+01	7.817E+04	5.252E+00
2018	1.857E+02	1.487E+05	9.992E+00	4.961E+01	7.436E+04	4.996E+00
2019	1.767E+02	1.415E+05	9.505E+00	4.719E+01	7.073E+04	4.752E+00
2020	1.680E+02	1.346E+05	9.041E+00	4.489E+01	6.728E+04	4.521E+00
2021	1.599E+02	1.280E+05	8.600E+00	4.270E+01	6.400E+04	4.300E+00
2022	1.521E+02	1.218E+05	8.181E+00	4.062E+01	6.088E+04	4.091E+00
2023	1.446E+02	1.158E+05	7.782E+00	3.864E+01	5.791E+04	3.891E+00
2024	1.376E+02	1.102E+05	7.402E+00	3.675E+01	5.509E+04	3.701E+00
2025	1.309E+02	1.048E+05	7.041E+00	3.496E+01	5.240E+04	3.521E+00
2026	1.245E+02	9.969E+04	6.698E+00	3.325E+01	4.984E+04	3.349E+00
2027	1.184E+02	9.483E+04	6.371E+00	3.163E+01	4.741E+04	3.186E+00
2028	1.126E+02	9.020E+04	6.061E+00	3.009E+01	4.510E+04	3.030E+00
2029	1.072E+02	8.580E+04	5.765E+00	2.862E+01	4.290E+04	2.883E+00
2030	1.019E+02	8.162E+04	5.484E+00	2.723E+01	4.081E+04	2.742E+00
2031	9.696E+01	7.764E+04	5.216E+00	2.590E+01	3.882E+04	2.608E+00
2032	9.223E+01	7.385E+04	4.962E+00	2.463E+01	3.693E+04	2.481E+00
2033	8.773E+01	7.025E+04	4.720E+00	2.343E+01	3.512E+04	2.360E+00
2034	8.345E+01	6.682E+04	4.490E+00	2.229E+01	3.341E+04	2.245E+00
2035	7.938E+01	6.356E+04	4.271E+00	2.120E+01	3.178E+04	2.135E+00
2036	7.551E+01	6.046E+04	4.063E+00	2.017E+01	3.023E+04	2.031E+00
2037	7.183E+01	5.752E+04	3.864E+00	1.919E+01	2.876E+04	1.932E+00
2038	6.832E+01	5.471E+04	3.676E+00	1.825E+01	2.736E+04	1.838E+00
2039	6.499E+01	5.204E+04	3.497E+00	1.736E+01	2.602E+04	1.748E+00
2040	6.182E+01	4.950E+04	3.326E+00	1.651E+01	2.475E+04	1.663E+00
2041	5.881E+01	4.709E+04	3.164E+00	1.571E+01	2.354E+04	1.582E+00
2042	5.594E+01	4.479E+04	3.010E+00	1.494E+01	2.240E+04	1.505E+00
2043	5.321E+01	4.261E+04	2.863E+00	1.421E+01	2.130E+04	1.431E+00
2044	5.062E+01	4.053E+04	2.723E+00	1.352E+01	2.027E+04	1.362E+00
2045	4.815E+01	3.855E+04	2.590E+00	1.286E+01	1.928E+04	1.295E+00
2046	4.580E+01	3.667E+04	2.464E+00	1.223E+01	1.834E+04	1.232E+00
2047	4.356E+01	3.488E+04	2.344E+00	1.164E+01	1.744E+04	1.172E+00
2048	4.144E+01	3.318E+04	2.230E+00	1.107E+01	1.659E+04	1.115E+00
2049	3.942E+01	3.157E+04	2.121E+00	1.053E+01	1.578E+04	1.060E+00
2050	3.750E+01	3.003E+04	2.017E+00	1.002E+01	1.501E+04	1.009E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	3.567E+01	2.856E+04	1.919E+00	9.527E+00	1.428E+04	9.595E-01
2052	3.393E+01	2.717E+04	1.825E+00	9.063E+00	1.358E+04	9.127E-01
2053	3.227E+01	2.584E+04	1.736E+00	8.621E+00	1.292E+04	8.682E-01
2054	3.070E+01	2.458E+04	1.652E+00	8.200E+00	1.229E+04	8.259E-01
2055	2.920E+01	2.338E+04	1.571E+00	7.800E+00	1.169E+04	7.856E-01
2056	2.778E+01	2.224E+04	1.495E+00	7.420E+00	1.112E+04	7.473E-01
2057	2.642E+01	2.116E+04	1.422E+00	7.058E+00	1.058E+04	7.108E-01
2058	2.513E+01	2.013E+04	1.352E+00	6.714E+00	1.006E+04	6.762E-01
2059	2.391E+01	1.915E+04	1.286E+00	6.386E+00	9.573E+03	6.432E-01
2060	2.274E+01	1.821E+04	1.224E+00	6.075E+00	9.106E+03	6.118E-01
2061	2.163E+01	1.732E+04	1.164E+00	5.779E+00	8.662E+03	5.820E-01
2062	2.058E+01	1.648E+04	1.107E+00	5.497E+00	8.239E+03	5.536E-01
2063	1.957E+01	1.567E+04	1.053E+00	5.229E+00	7.837E+03	5.266E-01
2064	1.862E+01	1.491E+04	1.002E+00	4.974E+00	7.455E+03	5.009E-01
2065	1.771E+01	1.418E+04	9.530E-01	4.731E+00	7.092E+03	4.765E-01
2066	1.685E+01	1.349E+04	9.065E-01	4.500E+00	6.746E+03	4.532E-01
2067	1.603E+01	1.283E+04	8.623E-01	4.281E+00	6.417E+03	4.311E-01
2068	1.525E+01	1.221E+04	8.202E-01	4.072E+00	6.104E+03	4.101E-01
2069	1.450E+01	1.161E+04	7.802E-01	3.874E+00	5.806E+03	3.901E-01
2070	1.379E+01	1.105E+04	7.422E-01	3.685E+00	5.523E+03	3.711E-01
2071	1.312E+01	1.051E+04	7.060E-01	3.505E+00	5.254E+03	3.530E-01
2072	1.248E+01	9.995E+03	6.715E-01	3.334E+00	4.997E+03	3.358E-01
2073	1.187E+01	9.507E+03	6.388E-01	3.171E+00	4.754E+03	3.194E-01
2074	1.129E+01	9.044E+03	6.076E-01	3.017E+00	4.522E+03	3.038E-01
2075	1.074E+01	8.602E+03	5.780E-01	2.870E+00	4.301E+03	2.890E-01
2076	1.022E+01	8.183E+03	5.498E-01	2.730E+00	4.091E+03	2.749E-01
2077	9.721E+00	7.784E+03	5.230E-01	2.596E+00	3.892E+03	2.615E-01
2078	9.247E+00	7.404E+03	4.975E-01	2.470E+00	3.702E+03	2.487E-01
2079	8.796E+00	7.043E+03	4.732E-01	2.349E+00	3.522E+03	2.366E-01
2080	8.367E+00	6.700E+03	4.501E-01	2.235E+00	3.350E+03	2.251E-01
2081	7.959E+00	6.373E+03	4.282E-01	2.126E+00	3.186E+03	2.141E-01
2082	7.570E+00	6.062E+03	4.073E-01	2.022E+00	3.031E+03	2.037E-01
2083	7.201E+00	5.766E+03	3.874E-01	1.924E+00	2.883E+03	1.937E-01
2084	6.850E+00	5.485E+03	3.685E-01	1.830E+00	2.743E+03	1.843E-01
2085	6.516E+00	5.218E+03	3.506E-01	1.740E+00	2.609E+03	1.753E-01
2086	6.198E+00	4.963E+03	3.335E-01	1.656E+00	2.482E+03	1.667E-01
2087	5.896E+00	4.721E+03	3.172E-01	1.575E+00	2.361E+03	1.586E-01
2088	5.608E+00	4.491E+03	3.017E-01	1.498E+00	2.245E+03	1.509E-01
2089	5.335E+00	4.272E+03	2.870E-01	1.425E+00	2.136E+03	1.435E-01
2090	5.075E+00	4.064E+03	2.730E-01	1.355E+00	2.032E+03	1.365E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	1.485E+02	8.112E+04	5.450E+00	2.326E+00	6.489E+02	4.360E-02
1952	2.897E+02	1.583E+05	1.063E+01	4.539E+00	1.266E+03	8.508E-02
1953	4.241E+02	2.317E+05	1.557E+01	6.643E+00	1.853E+03	1.245E-01
1954	5.519E+02	3.015E+05	2.026E+01	8.645E+00	2.412E+03	1.621E-01
1955	6.734E+02	3.679E+05	2.472E+01	1.055E+01	2.943E+03	1.978E-01
1956	7.891E+02	4.311E+05	2.896E+01	1.236E+01	3.449E+03	2.317E-01
1957	8.991E+02	4.912E+05	3.300E+01	1.408E+01	3.929E+03	2.640E-01
1958	1.004E+03	5.483E+05	3.684E+01	1.572E+01	4.387E+03	2.947E-01
1959	1.103E+03	6.027E+05	4.050E+01	1.728E+01	4.822E+03	3.240E-01
1960	1.198E+03	6.544E+05	4.397E+01	1.877E+01	5.235E+03	3.518E-01
1961	1.288E+03	7.036E+05	4.728E+01	2.018E+01	5.629E+03	3.782E-01
1962	1.374E+03	7.504E+05	5.042E+01	2.152E+01	6.003E+03	4.034E-01
1963	1.455E+03	7.949E+05	5.341E+01	2.280E+01	6.359E+03	4.273E-01
1964	1.533E+03	8.373E+05	5.626E+01	2.401E+01	6.698E+03	4.501E-01
1965	1.606E+03	8.776E+05	5.896E+01	2.516E+01	7.020E+03	4.717E-01
1966	1.677E+03	9.159E+05	6.154E+01	2.626E+01	7.327E+03	4.923E-01
1967	1.743E+03	9.523E+05	6.399E+01	2.731E+01	7.619E+03	5.119E-01
1968	1.658E+03	9.059E+05	6.087E+01	2.598E+01	7.247E+03	4.869E-01
1969	1.577E+03	8.617E+05	5.790E+01	2.471E+01	6.894E+03	4.632E-01
1970	1.500E+03	8.197E+05	5.507E+01	2.350E+01	6.557E+03	4.406E-01
1971	1.427E+03	7.797E+05	5.239E+01	2.236E+01	6.238E+03	4.191E-01
1972	1.358E+03	7.417E+05	4.983E+01	2.127E+01	5.933E+03	3.987E-01
1973	1.291E+03	7.055E+05	4.740E+01	2.023E+01	5.644E+03	3.792E-01
1974	1.228E+03	6.711E+05	4.509E+01	1.924E+01	5.369E+03	3.607E-01
1975	1.169E+03	6.384E+05	4.289E+01	1.831E+01	5.107E+03	3.431E-01
1976	1.112E+03	6.072E+05	4.080E+01	1.741E+01	4.858E+03	3.264E-01
1977	1.057E+03	5.776E+05	3.881E+01	1.656E+01	4.621E+03	3.105E-01
1978	1.006E+03	5.494E+05	3.692E+01	1.576E+01	4.396E+03	2.953E-01
1979	9.567E+02	5.226E+05	3.512E+01	1.499E+01	4.181E+03	2.809E-01
1980	9.100E+02	4.972E+05	3.340E+01	1.426E+01	3.977E+03	2.672E-01
1981	8.657E+02	4.729E+05	3.177E+01	1.356E+01	3.783E+03	2.542E-01
1982	8.234E+02	4.498E+05	3.023E+01	1.290E+01	3.599E+03	2.418E-01
1983	7.833E+02	4.279E+05	2.875E+01	1.227E+01	3.423E+03	2.300E-01
1984	7.451E+02	4.070E+05	2.735E+01	1.167E+01	3.256E+03	2.188E-01
1985	7.087E+02	3.872E+05	2.601E+01	1.110E+01	3.097E+03	2.081E-01
1986	6.742E+02	3.683E+05	2.475E+01	1.056E+01	2.946E+03	1.980E-01
1987	6.413E+02	3.503E+05	2.354E+01	1.005E+01	2.803E+03	1.883E-01
1988	6.100E+02	3.333E+05	2.239E+01	9.556E+00	2.666E+03	1.791E-01
1989	5.803E+02	3.170E+05	2.130E+01	9.090E+00	2.536E+03	1.704E-01
1990	5.520E+02	3.015E+05	2.026E+01	8.647E+00	2.412E+03	1.621E-01
1991	5.250E+02	2.868E+05	1.927E+01	8.225E+00	2.295E+03	1.542E-01
1992	4.994E+02	2.728E+05	1.833E+01	7.824E+00	2.183E+03	1.467E-01
1993	4.751E+02	2.595E+05	1.744E+01	7.442E+00	2.076E+03	1.395E-01
1994	4.519E+02	2.469E+05	1.659E+01	7.079E+00	1.975E+03	1.327E-01
1995	4.299E+02	2.348E+05	1.578E+01	6.734E+00	1.879E+03	1.262E-01
1996	4.089E+02	2.234E+05	1.501E+01	6.406E+00	1.787E+03	1.201E-01
1997	3.890E+02	2.125E+05	1.428E+01	6.093E+00	1.700E+03	1.142E-01
1998	3.700E+02	2.021E+05	1.358E+01	5.796E+00	1.617E+03	1.086E-01
1999	3.520E+02	1.923E+05	1.292E+01	5.513E+00	1.538E+03	1.033E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^{3}/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^{3}/year)*	*(av ft^3/min)*
2000	3.348E+02	1.829E+05	1.229E+01	5.245E+00	1.463E+03	9.831E-02
2001	3.185E+02	1.740E+05	1.169E+01	4.989E+00	1.392E+03	9.351E-02
2002	3.029E+02	1.655E+05	1.112E+01	4.746E+00	1.324E+03	8.895E-02
2003	2.882E+02	1.574E+05	1.058E+01	4.514E+00	1.259E+03	8.462E-02
2004	2.741E+02	1.497E+05	1.006E+01	4.294E+00	1.198E+03	8.049E-02
2005	2.607E+02	1.424E+05	9.570E+00	4.084E+00	1.139E+03	7.656E-02
2006	2.480E+02	1.355E+05	9.104E+00	3.885E+00	1.084E+03	7.283E-02
2007	2.359E+02	1.289E+05	8.660E+00	3.696E+00	1.031E+03	6.928E-02
2008	2.244E+02	1.226E+05	8.237E+00	3.516E+00	9.808E+02	6.590E-02
2009	2.135E+02	1.166E+05	7.836E+00	3.344E+00	9.329E+02	6.268E-02
2010	2.031E+02	1.109E+05	7.453E+00	3.181E+00	8.874E+02	5.963E-02
2011	1.932E+02	1.055E+05	7.090E+00	3.026E+00	8.442E+02	5.672E-02
2012	1.837E+02	1.004E+05	6.744E+00	2.878E+00	8.030E+02	5.395E-02
2013	1.748E+02	9.548E+04	6.415E+00	2.738E+00	7.638E+02	5.132E-02
2014	1.662E+02	9.082E+04	6.102E+00	2.604E+00	7.266E+02	4.882E-02
2015	1.581E+02	8.639E+04	5.805E+00	2.477E+00	6.911E+02	4.644E-02
2016	1.504E+02	8.218E+04	5.522E+00	2.357E+00	6.574E+02	4.417E-02
2017	1.431E+02	7.817E+04	5.252E+00	2.242E+00	6.254E+02	4.202E-02
2018	1.361E+02	7.436E+04	4.996E+00	2.132E+00	5.949E+02	3.997E-02
2019	1.295E+02	7.073E+04	4.752E+00	2.028E+00	5.659E+02	3.802E-02
2020	1.232E+02	6.728E+04	4.521E+00	1.929E+00	5.383E+02	3.617E-02
2021	1.172E+02	6.400E+04	4.300E+00	1.835E+00	5.120E+02	3.440E-02
2022	1.114E+02	6.088E+04	4.091E+00	1.746E+00	4.870E+02	3.272E-02
2023	1.060E+02	5.791E+04	3.891E+00	1.661E+00	4.633E+02	3.113E-02
2024	1.008E+02	5.509E+04	3.701E+00	1.580E+00	4.407E+02	2.961E-02
2025	9.592E+01	5.240E+04	3.521E+00	1.503E+00	4.192E+02	2.817E-02
2026	9.124E+01	4.984E+04	3.349E+00	1.429E+00	3.988E+02	2.679E-02
2027	8.679E+01	4.741E+04	3.186E+00	1.360E+00	3.793E+02	2.549E-02
2028	8.256E+01	4.510E+04	3.030E+00	1.293E+00	3.608E+02	2.424E-02
2029	7.853E+01	4.290E+04	2.883E+00	1.230E+00	3.432E+02	2.306E-02
2030	7.470E+01	4.081E+04	2.742E+00	1.170E+00	3.265E+02	2.194E-02
2031	7.106E+01	3.882E+04	2.608E+00	1.113E+00	3.105E+02	2.087E-02
2032	6.759E+01	3.693E+04	2.481E+00	1.059E+00	2.954E+02	1.985E-02
2033	6.430E+01	3.512E+04	2.360E+00	1.007E+00	2.810E+02	1.888E-02
2034	6.116E+01	3.341E+04	2.245E+00	9.581E-01	2.673E+02	1.796E-02
2035	5.818E+01	3.178E+04	2.135E+00	9.114E-01	2.543E+02	1.708E-02
2036	5.534E+01	3.023E+04	2.031E+00	8.669E-01	2.419E+02	1.625E-02
2037	5.264E+01	2.876E+04	1.932E+00	8.246E-01	2.301E+02	1.546E-02
2038	5.007E+01	2.736E+04	1.838E+00	7.844E-01	2.188E+02	1.470E-02
2039	4.763E+01	2.602E+04	1.748E+00	7.462E-01	2.082E+02	1.399E-02
2040	4.531E+01	2.475E+04	1.663E+00	7.098E-01	1.980E+02	1.330E-02
2041	4.310E+01	2.354E+04	1.582E+00	6.752E-01	1.884E+02	1.266E-02
2042	4.100E+01	2.240E+04	1.505E+00	6.422E-01	1.792E+02	1.204E-02
2043	3.900E+01	2.130E+04	1.431E+00	6.109E-01	1.704E+02	1.145E-02
2044	3.710E+01	2.027E+04	1.362E+00	5.811E-01	1.621E+02	1.089E-02
2045	3.529E+01	1.928E+04	1.295E+00	5.528E-01	1.542E+02	1.036E-02
2046	3.357E+01	1.834E+04	1.232E+00	5.258E-01	1.467E+02	9.856E-03
2047	3.193E+01	1.744E+04	1.172E+00	5.002E-01	1.395E+02	9.376E-03
2048	3.037E+01	1.659E+04	1.115E+00	4.758E-01	1.327E+02	8.918E-03
2049	2.889E+01	1.578E+04	1.060E+00	4.526E-01	1.263E+02	8.483E-03
2050	2.748E+01	1.501E+04	1.009E+00	4.305E-01	1.201E+02	8.070E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	2.614E+01	1.428E+04	9.595E-01	4.095E-01	1.142E+02	7.676E-03
2052	2.487E+01	1.358E+04	9.127E-01	3.895E-01	1.087E+02	7.302E-03
2053	2.365E+01	1.292E+04	8.682E-01	3.705E-01	1.034E+02	6.946E-03
2054	2.250E+01	1.229E+04	8.259E-01	3.525E-01	9.833E+01	6.607E-03
2055	2.140E+01	1.169E+04	7.856E-01	3.353E-01	9.354E+01	6.285E-03
2056	2.036E+01	1.112E+04	7.473E-01	3.189E-01	8.897E+01	5.978E-03
2057	1.937E+01	1.058E+04	7.108E-01	3.034E-01	8.463E+01	5.687E-03
2058	1.842E+01	1.006E+04	6.762E-01	2.886E-01	8.051E+01	5.409E-03
2059	1.752E+01	9.573E+03	6.432E-01	2.745E-01	7.658E+01	5.145E-03
2060	1.667E+01	9.106E+03	6.118E-01	2.611E-01	7.285E+01	4.894E-03
2061	1.586E+01	8.662E+03	5.820E-01	2.484E-01	6.929E+01	4.656E-03
2062	1.508E+01	8.239E+03	5.536E-01	2.363E-01	6.591E+01	4.429E-03
2063	1.435E+01	7.837E+03	5.266E-01	2.247E-01	6.270E+01	4.213E-03
2064	1.365E+01	7.455E+03	5.009E-01	2.138E-01	5.964E+01	4.007E-03
2065	1.298E+01	7.092E+03	4.765E-01	2.034E-01	5.673E+01	3.812E-03
2066	1.235E+01	6.746E+03	4.532E-01	1.934E-01	5.397E+01	3.626E-03
2067	1.175E+01	6.417E+03	4.311E-01	1.840E-01	5.133E+01	3.449E-03
2068	1.117E+01	6.104E+03	4.101E-01	1.750E-01	4.883E+01	3.281E-03
2069	1.063E+01	5.806E+03	3.901E-01	1.665E-01	4.645E+01	3.121E-03
2070	1.011E+01	5.523E+03	3.711E-01	1.584E-01	4.418E+01	2.969E-03
2071	9.617E+00	5.254E+03	3.530E-01	1.506E-01	4.203E+01	2.824E-03
2072	9.148E+00	4.997E+03	3.358E-01	1.433E-01	3.998E+01	2.686E-03
2073	8.701E+00	4.754E+03	3.194E-01	1.363E-01	3.803E+01	2.555E-03
2074	8.277E+00	4.522E+03	3.038E-01	1.297E-01	3.617E+01	2.431E-03
2075	7.873E+00	4.301E+03	2.890E-01	1.233E-01	3.441E+01	2.312E-03
2076	7.489E+00	4.091E+03	2.749E-01	1.173E-01	3.273E+01	2.199E-03
2077	7.124E+00	3.892E+03	2.615E-01	1.116E-01	3.114E+01	2.092E-03
2078	6.777E+00	3.702E+03	2.487E-01	1.062E-01	2.962E+01	1.990E-03
2079	6.446E+00	3.522E+03	2.366E-01	1.010E-01	2.817E+01	1.893E-03
2080	6.132E+00	3.350E+03	2.251E-01	9.606E-02	2.680E+01	1.801E-03
2081	5.833E+00	3.186E+03	2.141E-01	9.137E-02	2.549E+01	1.713E-03
2082	5.548E+00	3.031E+03	2.037E-01	8.692E-02	2.425E+01	1.629E-03
2083	5.278E+00	2.883E+03	1.937E-01	8.268E-02	2.307E+01	1.550E-03
2084	5.020E+00	2.743E+03	1.843E-01	7.865E-02	2.194E+01	1.474E-03
2085	4.775E+00	2.609E+03	1.753E-01	7.481E-02	2.087E+01	1.402E-03
2086	4.543E+00	2.482E+03	1.667E-01	7.116E-02	1.985E+01	1.334E-03
2087	4.321E+00	2.361E+03	1.586E-01	6.769E-02	1.888E+01	1.269E-03
2088	4.110E+00	2.245E+03	1.509E-01	6.439E-02	1.796E+01	1.207E-03
2089	3.910E+00	2.136E+03	1.435E-01	6.125E-02	1.709E+01	1.148E-03
2090	3.719E+00	2.032E+03	1.365E-01	5.826E-02	1.625E+01	1.092E-03

Appendix O

Stormwater Detention Pond

STORMWATER DETENTION POND

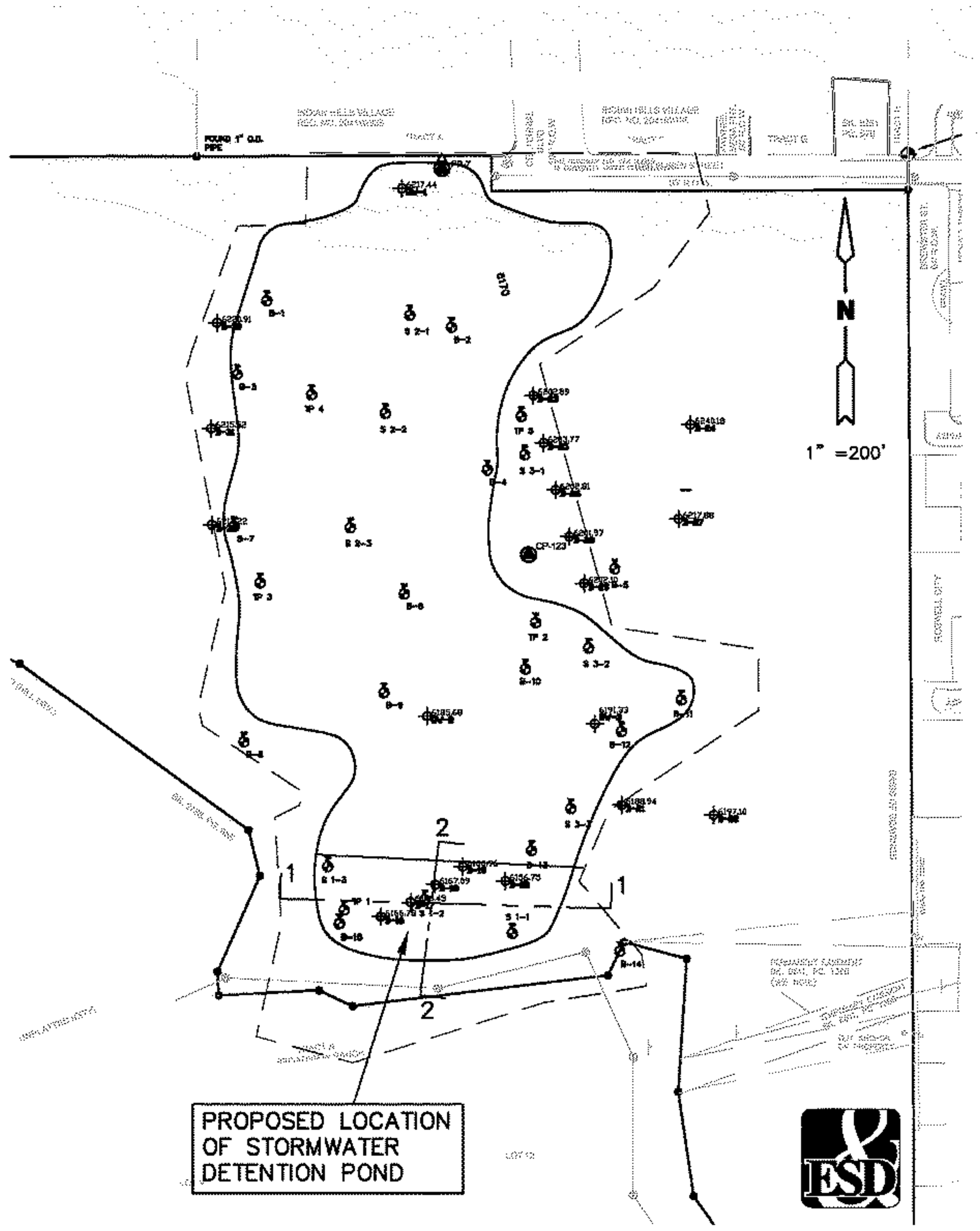
SITE CONDITIONS

The property that encompasses the abandoned landfill slopes from northwest to southeast. This natural slope has resulted in a series of channels that direct stormwater flow to the southwestern and southeastern portion of the site. Specifically, these channels direct stormwater to the streams that border the western and southern portions of the property. These streams have allowed soils as well as other materials to discharge randomly from the property.

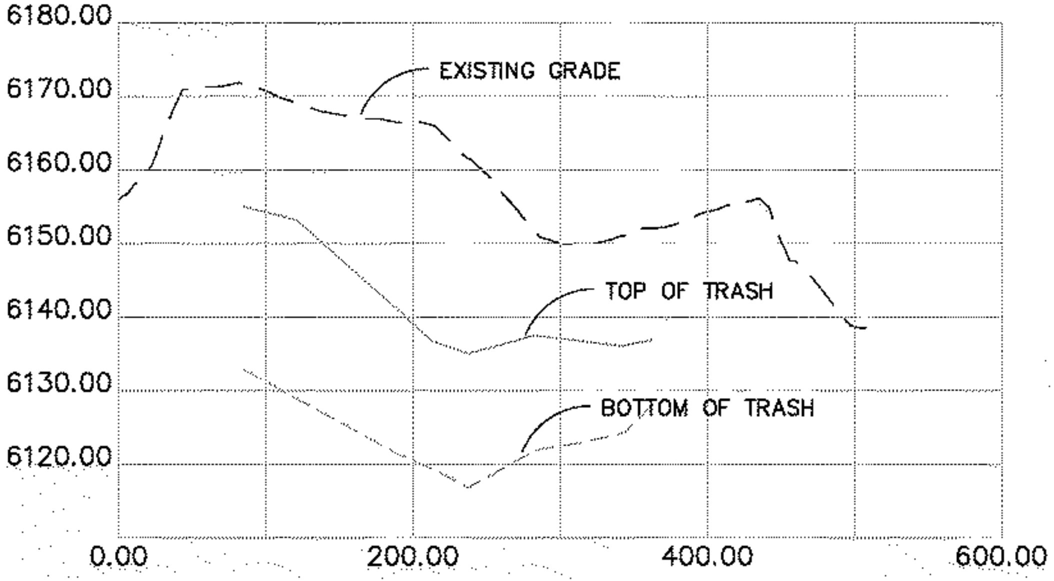
As a part of the voluntary clean-up efforts, drainage on the site will be refined to allow for better control of stormwater. An integral part of this will be to establish a stormwater detention pond at the southeastern end of the property. As can be seen in the site plan on the following page, the area in the southeastern portion of the property is contoured to accommodate a possible detention pond. There is solid waste in this area that is buried at depths varying from 5 feet to more than 25 feet. Given this circumstance, it is proposed to accommodate both the stormwater detention pond and the solid waste that is at depth in this area.

PRESENT SOLID WASTE PLACEMENT

As can be seen on the drawing on page 3, solid waste in the southeastern portion of the site at two levels. As noted in cross-section 1 there is a layer of solid waste that is located at depths as shallow as a few feet and in cross-section 2 there is solid waste located at depths of 25 feet or more. These two conditions create difficulties in removing the waste. First, the shallow waste varies in location and thickness. This will likely result in an over-excavation of soil which will impact the capacity of the consolidated landfill and could require a higher or wider landfill footprint. Solid waste buried at depths of 25 feet or more will result in the extensive excavation of soil to reach the solid waste. Developing a stormwater detention pond in this area will address these issues.

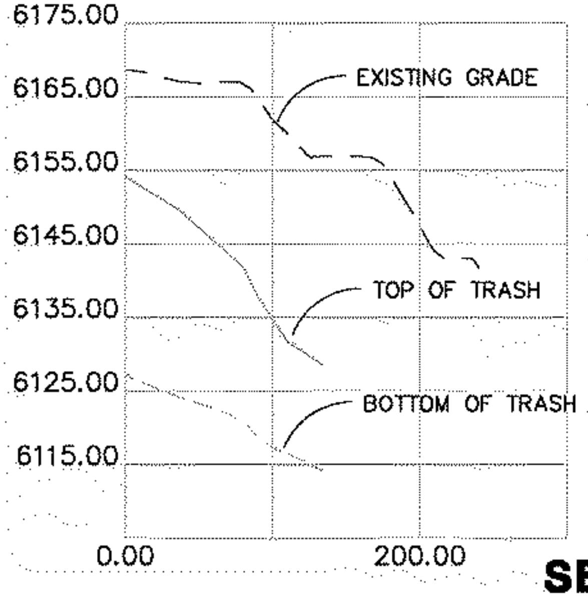

FOUND 1" O.D. PIPE
6217.44
6170
N
1" =200'
6220.91
B-1
S 2-1
B-2
B-3
TP 4
S 2-2
6215.52
6202.89
TP 5
6213.77
S 3-1
B-4
6240.18
6202.81
6217.88
6201.97
B-7
S 2-3
CP-123
TP 3
B-6
B-5
TP 2
S 3-2
B-10
B-9
6185.68
6191.33
B-11
B-12
B-8
6188.94
S 3-3
6197.10
2
1
B-13
S 1-3
6167.09
6156.73
TP 1
S 1-2
6155.79
S 1-1
B-15
B-14
2
PROPOSED LOCATION
OF STORMWATER
DETENTION POND

SITE MAP



SECTION 1

HORIZ 1"=100'



SECTION 2

HORIZ 1"=100'

CROSS SECTIONS

STORMWATER DETENTION POND DEVELOPMENT

A stormwater detention pond, by description, is designed to receive and contain stormwater from a prescribed area. For this site, the stormwater detention pond will be sized to receive all the stormwater that falls on the site plus a portion of the stormwater that is generated by the future Centennial Boulevard. This stormwater detention pond will have a liner system designed to contain the stormwater until it evaporates, is discharged from the pond, or is pumped into a truck that takes the water for use in the construction of buildings, roadways, parking areas, or similar activities. The area around the pond will be vegetated to reduce erosion and any outlet from the pond will be armored with rocks and an impervious sublayer.

SOLID WASTE LOCATED AT THE PROPOSED DETENTION POND SITE

As noted previously, the location of the proposed stormwater detention pond is situated over solid waste. Those portions of solid waste that are relatively shallow will be excavated and placed in the consolidated landfill. The portion of the solid waste that is at depth will be left in place. The stormwater detention pond will be excavated to a depth that accommodates the stormwater flow from a predetermined stormwater frequency.

As the pond is excavated, it is anticipated that some solid waste may be encountered. If solid waste is encountered, it will be relocated to the consolidated landfill. When excavation reaches its prescribed depth, if any solid waste is exposed it will be covered with soil and compacted in acceptable lifts that result in a permeability of 1×10^{-7} cm/sec or greater. Once the soil is properly compacted, a synthetic liner will be placed over the compacted soil liner and a protective layer of soil will be placed over the synthetic liner. This liner system will contain the stormwater stored and protect the solid waste below the pond.

QUALITY CONTROL OF THE POND LINER

The compacted soil liner and the synthetic liner installation will be overseen by on-site quality assurance personnel who will monitor the operation and record all activities related to the liner system installation. This individual will report to the Site Engineer, who will have overall responsibility for the stormwater detention pond. In addition, the liner system will be inspected annually.