Huddleston-Berry
Engineering & Testing, LLC

GEOTECHNICAL AND GEOLOGIC HAZARDS INVESTIGATION
GENERATOR SYSTEM FOUNDATION
V.A. MEDICAL CENTER
GRAND JUNCTION, COLORADO
PROJECT#00993-0003

V.A. MEDICAL CENTER
2121 NORTH AVENUE, BUILDING 7
GRAND JUNCTION, COLORADO 81501

MARCH 29, 2011

Huddleston-Berry Engineering and Testing, LLC
640 White Avenue, Unit B
Grand Junction, Colorado 81501

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A geologic hazards and geotechnical investigation was conducted for a proposed new generator system at the VA Medical Center in Grand Junction, Colorado. The project location is shown on Figure 1 – Site Location Map. The purpose of the investigation was to evaluate the surface and subsurface conditions at the site with respect to geologic hazards, foundation design, and earthwork for the proposed construction. This summary has been prepared to include the information required by civil engineers, structural engineers, and contractors involved in the project.

Subsurface Conditions (p. 2)

The subsurface investigation consisted of three borings, drilled on March 4th, 2011. The borings generally encountered fill or topsoil materials above native clay soils to a depth of 40.0 feet where dense gravel soils were encountered. Groundwater was encountered in the borings at depths of between 7.8 and 9.0 feet below the existing ground surface at the time of the investigation. The native clay soils were shown to be slightly plastic and are anticipated to tend to consolidate under loading.

Geologic Hazards and Constraints (p. 3)

No geologic hazards were identified which would preclude construction. However, shallow groundwater is present at the site. The primary constraint to construction is the presence of shallow groundwater and associated soft soils.

Summary of Foundation Recommendations

- *Foundation Type* – Mat or Raft. (p. 4)
- *Structural Fill* – Minimum of 24-inches below foundations. Imported structural fill should consist of pit-run, crusher fines, CDOT Class 6 base course, or other granular material approved by the engineer. (p. 4)
- *Maximum Allowable Bearing Capacity* – 1,500 psf. (p. 4)
- *Subgrade Modulus* – 250 pci for pit-run, crusher fines, or CDOT Class 6 base course. (p. 4)
- *Lateral Earth Pressure* – 50 pcf (p. 5)
- *Seismic Site Class* – Site Class D (p. 5)

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1.0 INTRODUCTION

As part of improvements to education infrastructure in Western Colorado, the Department of Veterans Affairs proposes to add a new backup generator system to the Grand Junction medical center facility. As part of the design development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by the Department of Veterans Affairs Medical Center to conduct a geologic hazards and geotechnical investigation at the location of the proposed new generator system.

1.1 Scope

As discussed above, a geologic hazards and geotechnical investigation was conducted for a proposed new backup generator at the VA Medical Center in Grand Junction, Colorado. The scope of the investigation included the following components:

- Conducting a subsurface investigation to evaluate the subsurface conditions at the site.
- Collecting soil samples and conducting laboratory testing to determine the engineering properties of the soils at the site.
- Providing recommendations for foundation type and subgrade preparation.
- Providing recommendations for bearing capacity.
- Providing recommendations for lateral earth pressure.
- Providing recommendations for drainage, grading, and general earthwork.
- Evaluating potential geologic hazards at the site.

The investigation and report were completed by a Colorado registered professional engineer in accordance with generally accepted geotechnical and geological engineering practices. This report has been prepared for the exclusive use of the Department of Veterans Affairs.

1.2 Site Location and Description

The site is located at 2121 North Avenue in Grand Junction, Colorado. The project location is shown on Figure 1 – Site Location Map.

At the time of the investigation, the site was generally open and fairly level with a slight slope up from the existing pavement to where the existing lawns were located. Vegetation consisted of short lawn grasses and numerous small to large sized trees located throughout the campus. The main hospital building was located east of the area of the proposed generator system. The campus was bordered to the north by North Avenue, to the east by N. 23rd Street and to the south and west by Lincoln Park Golf Course.

1.3 Proposed Construction

The proposed construction is anticipated to consist of an approximately 625 square feet concrete mat foundation supporting a diesel generator, above ground fuel storage tank, and protective concrete walls.

2.0 GEOLOGIC SETTING

2.1 Soils

Soils data was obtained from the USDA Natural Resource Conservation Service Web Soil Survey. The data indicates that the soils at the site consist of Sagers-Urban land complex, 0 to 2 percent slopes. Soil survey data, including a description of the soil unit, is included in Appendix A.

The Sagers-Urban land complex soils have a low potential for frost action and high risk of corrosion of steel. The Sagers-Urban land complex soils are described as having a moderate risk of corrosion of concrete.

2.2 Geology

According to the *Geologic Map of Colorado* by Ogden Tweto (1979), the site is underlain by Quaternary gravels and alluvium. The gravels and alluvium are underlain by Mancos shale bedrock. The Mancos shale unit is thick in Western Colorado and has a low to moderate potential for expansion.

2.3 Groundwater

Groundwater was encountered in the borings at depths of between 7.8 and 9.0 feet below the existing ground surface at the time of the investigation.

3.0 FIELD INVESTIGATION

3.1 Subsurface Investigation

The subsurface investigation was conducted on March 4th, 2011 and included three geotechnical borings. The locations of the borings are shown on Figure 2 – Site Plan. Typed boring logs are included in Appendix B. Samples of the native soils were collected during Standard Penetration Testing (SPT) and using bulk sampling methods at the locations shown on the logs.

As shown on the logs, the subsurface conditions were slightly variable. However, the borings generally encountered 1.5 to 5.0 feet of fill or topsoil above brown to gray, moist to wet, very soft to hard lean clay with thin sand lenses. The clay extended to the bottom of B-3 and extended to a depth of 40.0 feet in B-1 and B-2. Below the clay, brown, wet, dense to very dense sandy gravel extended to the bottoms of B-1 and B-2. Groundwater was encountered in the borings at depths of between 7.8 and 9.0 feet below the existing ground surface at the time of the investigation.

4.0 LABORATORY TESTING

Selected native soil samples collected from the borings were tested in the Huddleston-Berry Engineering and Testing LLC geotechnical laboratory for natural moisture content, grain size analysis, Atterberg limits, maximum dry density and optimum moisture (Proctor), and soluble sulfates content. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that the native clay soils are slightly plastic. The clay soils are anticipated to tend to consolidate under loading. Water soluble sulfates were encountered in the site soils in a concentration of 0.2%.

5.0 GEOLOGIC INTERPRETATION

5.1 Geologic Hazards

The primary geologic hazard identified on the site is the presence of shallow groundwater.

5.2 Geologic Constraints

The primary geologic constraint at this site is the presence of shallow groundwater and the associated soft soils. The soft soils will likely impact excavation and foundation subgrade preparation.

5.3 Mineral Resources

Potential mineral resources in western Colorado generally include gravel, uranium ore, and commercial rock products such as flagstone. No significant gravel, uranium bearing bedrock, or other mineable bedrock units were encountered on the subject site at the time of the investigation, nor was any literary or cartographic information discovered that indicate the existence or potential existence of commercial quality mineral deposits.

6.0 CONCLUSIONS

Based upon the available data sources, field investigation, and nature of the proposed construction, HBET does not believe that there are any geologic conditions which should preclude construction at this site. However, foundations and earthwork at the site will have to consider the impacts of shallow groundwater and associated soft soils.

7.0 RECOMMENDATIONS

7.1 Foundations

As discussed previously, a mat or raft foundation is proposed to support the new generator system. A mat or raft foundation is appropriate; however, soft soils were present at the site. Therefore, in order to provide a uniform bearing stratum and reduce the risk of excessive differential settlements, it is recommended that the foundations be constructed above a minimum of 24-inches of structural fill.

In general, it is recommended that the topsoil, native clay soils, and existing fill materials not be reused as structural fill. Imported structural fill should consist of a granular, non-expansive, non-free draining material such as pit run, crusher fines, or CDOT Class 6 base course. However, if pit-run is used as structural fill, a minimum of six inches of Class 6 base course or crusher fines should be placed on top of the pit-run to prevent large point stresses on the bottoms of the foundations due to large particles in the pit-run.

Prior to placement of structural fill, it is recommended that the bottom of the foundation excavation be scarified to a depth of 6 to 8-inches, moisture conditioned, and re-compacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of the optimum moisture content as determined in accordance with ASTM D698. However, soft subgrade conditions may interfere with compaction and stabilization of the subgrade may be required utilizing geotextile and/or geogrid within the structural fill. Additional thickness of structural fill may also be required. Specific recommendations for subgrade stabilization can be provided by HBET based upon the actual conditions in the bottom of the foundation excavation.

Structural fill should extend laterally beyond the edges of the foundation a distance equal to the thickness of structural fill. Structural fill should be moisture conditioned, placed in maximum 8-inch loose lifts, and compacted to a minimum of 95% of the standard Proctor maximum dry density for fine grained materials or 90% of the modified Proctor maximum dry density for coarse grained materials, within ±2% of the optimum moisture content as determined in accordance with ASTM D698 or D1557C, respectively. Pit-run should be proofrolled to the Engineer's satisfaction.

For foundation building pad preparation as recommended with structural fill consisting of imported granular materials, a maximum allowable bearing capacity of 1,500 psf may be used. In addition, a modulus of subgrade reaction of 250 pci may be used for structural fill consisting of pit-run, crusher fines, or base course. It is recommended that the bottoms of exterior foundations be at least 18-inches below the final grade for frost protection.

7.2 Corrosion of Concrete

As discussed previously, water soluble sulfates were detected in the site soils in a concentration of 0.2%. This concentration of sulfates represents a severe degree of potential sulfate attack on concrete exposed to these materials. Therefore, Type V sulfate resistant cement is recommended in accordance with the International Building Code (IBC). However, Type V cement can be difficult to obtain in western Colorado. Where Type V cement is unavailable, Type I-II cement is recommended.

7.3 Flatwork

As mentioned previously, the shallow native soils are anticipated to consolidate under loading. Therefore, to reduce the potential for excessive settlement of slabs-on-grade, it is recommended that flatwork be constructed above a minimum of 12-inches of structural fill with subgrade preparation and structural fill placement in accordance with the *Foundations* section of this report.

7.4 Lateral Earth Pressures

Any retaining structures should be designed to resist lateral earth pressures. For backfill consisting of the native soils or imported granular, non-free draining, non-expansive material, we recommend that the walls be designed for an equivalent fluid unit weight of 50 pcf in areas where no surcharge loads are present. Lateral earth pressures should be increased as necessary to reflect any surcharge loading behind the walls.

7.5 Seismic Site Classification

As discussed above, the subsurface profile at the site generally consists of soft clay soils above dense gravel and cobble soils. Based upon the results of the subsurface investigation and upon our experience in the vicinity of the subject site, HBET recommends that the site be classified as Site Class D in accordance with the *International Building Code*. The classification of the site may be revised depending on the results of a seismic shear wave velocity survey of the site. However, HBET does not believe that a seismic shear wave velocity survey at the site will result in a Site Class better than D.

7.6 Drainage

In order to improve the long-term performance of the foundations, grading around the structure should be designed to carry precipitation and runoff away from the structure. It is recommended that the finished ground surface drop at least two inches within the first ten feet away from the structure where impermeable materials (i.e. sidewalks, pavements, etc.) are adjacent to the structure. Where permeable surfaces are adjacent to the structure, a drop of twelve inches within the first ten feet away from the structure is recommended. It is recommended that landscaping within three feet of the structure include primarily desert plants with low water requirements. In addition, it is recommended that automatic irrigation within ten feet of foundation be minimized or controlled with automatic shut off valves.

7.7 Excavations

Excavations in the soils at the site may stand for short periods of time but should not be considered to be stable. The native soils generally classify as Type C soil with regard to OSHA's *Construction Standards for Excavations*. In general, for Type C soils, the maximum allowable slope in temporary cuts is 1.5H:1V.

8.0 GENERAL

The recommendations included above are based upon the results of the subsurface investigation and on our local experience. These conclusions and recommendations are valid only for the proposed construction.

As discussed previously, the subsurface conditions at the site were slightly variable. Although HBET believes that the investigation was sufficient to adequately characterize the range of subsurface conditions at the site, the precise nature and extent of subsurface variability may not become evident until construction. Therefore, it is recommended that a representative of HBET be retained to provide engineering oversight and construction materials testing services during the foundation and earthwork phases of the construction. This is to verify compliance with the recommendations included in this report or permit identification of significant variations in the subsurface conditions which may require modification of the recommendations.

Huddleston-Berry Engineering and Testing, LLC is pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this report.

Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC

COLORADO REGISTERED PROFESSIONAL ENGINEER
MICHAEL ALLAN BERRY
39010
03/29/11

Michael A. Berry, P.E.
Vice President of Engineering

FIGURES

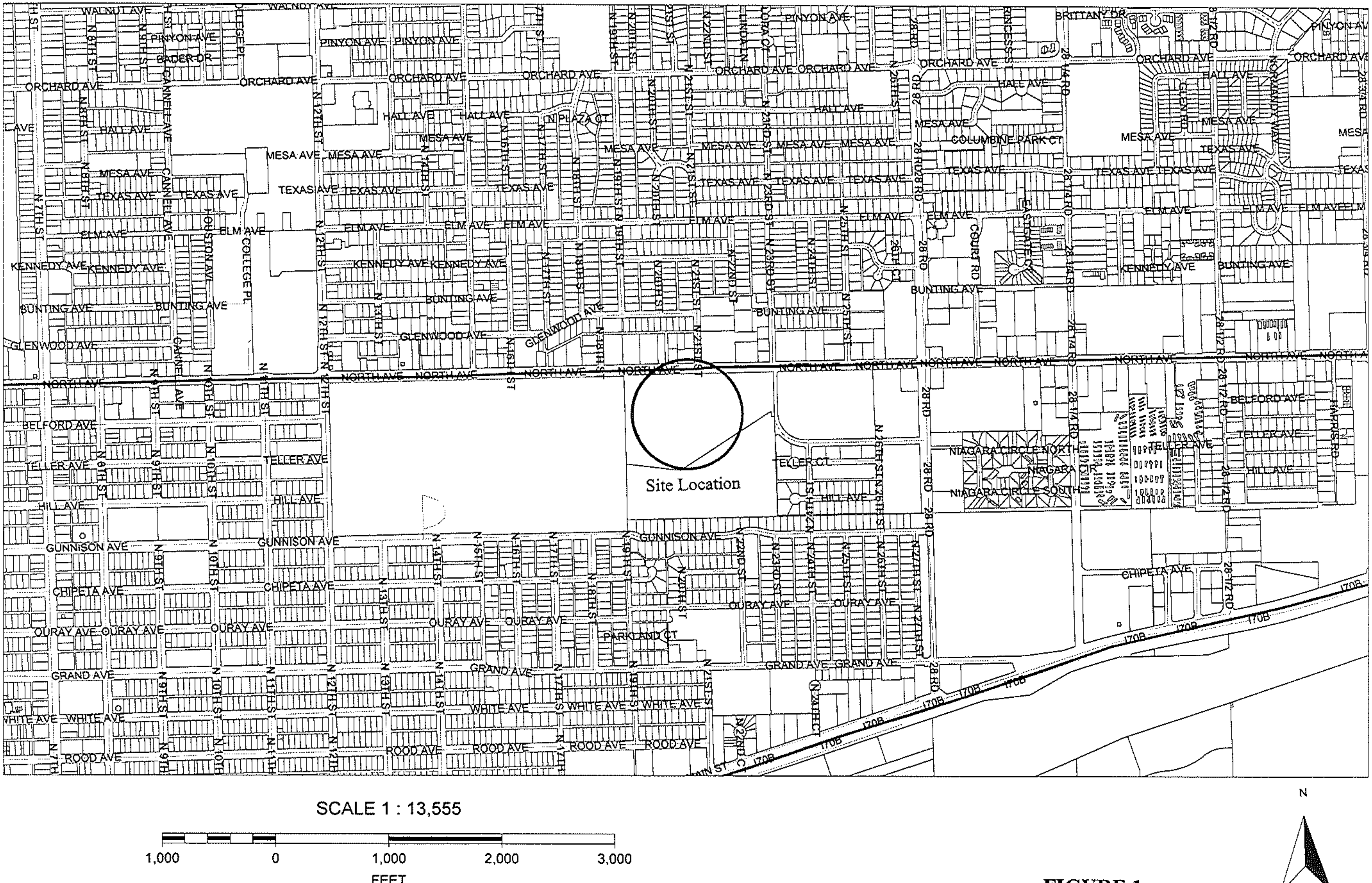
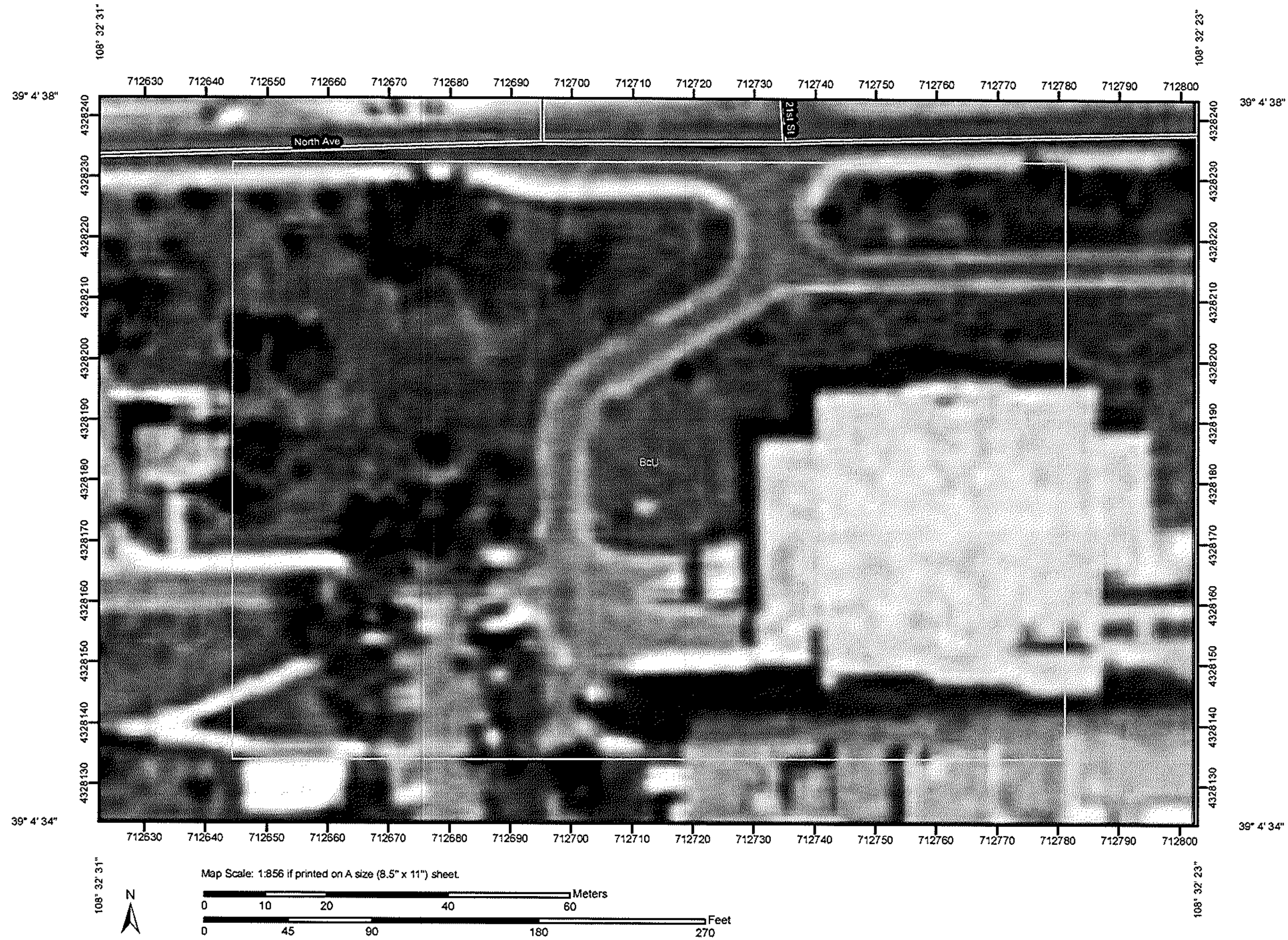


FIGURE 1
Site Location Map

FIGURE 2
Site Plan

APPENDIX A
Soil Survey Data


108° 32' 31"
108° 32' 23"
39° 4' 38"
39° 4' 34"
712630
712640
712650
712660
712670
712680
712690
712700
712710
712720
712730
712740
712750
712760
712770
712780
712790
712800
4328240
4328230
4328220
4328210
4328200
4328190
4328180
4328170
4328160
4328150
4328140
4328130
North Ave
21st St
BcU
Map Scale: 1:856 if printed on A size (8.5" x 11") sheet.
N
Meters
0
10
20
40
60
Feet
0
45
90
180
270

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:856 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 8/3/1993

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Mesa County Area, Colorado (CO680)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
BcU	Sagers-Urban land complex, 0 to 2 percent slopes	3.3	100.0%
Totals for Area of Interest		**3.3**	**100.0%**

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Mesa County Area, Colorado

BcU—Sagers-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition

Sagers and similar soils: 55 percent
Urbanland: 40 percent

Description of Sagers

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium and slope alluvium derived from calcareous shale and sandstone

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Available water capacity: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c

Typical profile

0 to 12 inches: Silty clay loam
12 to 25 inches: Silty clay loam
25 to 60 inches: Silty clay loam

Description of Urbanland

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium and slope alluvium derived from calcareous shale and sandstone

Properties and qualities

Slope: 0 to 2 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to very high (0.00 to 14.17 in/hr)
Depth to water table: About 24 to 42 inches

Interpretive groups

Land capability (nonirrigated): 8s

Typical profile
0 to 60 inches: Variable

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Report—Soil Features

Soil Features– Mesa County Area, Colorado									
Map symbol and soil name	Restrictive Layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		In	*In*		*In*	*In*			
BcU—Sagers-Urban land complex, 0 to 2 percent slopes									
Sagers		—	—		0	0	Low	High	Moderate
Urbanland		—	—		—	—		High	Moderate

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

APPENDIX B
Typed Boring Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-1

CLIENT Department of Veteran Affairs
PROJECT NAME New Generator Foundation
PROJECT NUMBER 00993-0003
PROJECT LOCATION Grand Junction, CO
DATE STARTED 3/4/11 **COMPLETED** 3/4/11
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
▽ **AT TIME OF DRILLING** 9.0 ft
LOGGED BY AS **CHECKED BY** MAB
▼ **AT END OF DRILLING** 9.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Silty CLAY with Organics (TOPSOIL), brown, moist										
		LEAN CLAY (CL), with thin sand lenses, brown to gray, moist to wet, very soft to very stiff, abundant sulfates										
5			MC 1	67	0-0-1 (1)							
10	▼	SS1: Lab Classified	SS 1	75	0-1-0-1 (1)			26	29	16	13	93
15			SS 2	78	1-1-2 (3)							
20												
25												
30												
35												
40		Sandy GRAVEL (gw), brown, wet, dense										
		Bottom of hole at 41.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

BORING NUMBER B-2

CLIENT Department of Veteran Affairs
PROJECT NAME New Generator Foundation
PROJECT NUMBER 00993-0003
PROJECT LOCATION Grand Junction, CO
DATE STARTED 3/4/11 **COMPLETED** 3/4/11
GROUND ELEVATION ______ **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
∇ **AT TIME OF DRILLING** 7.8 ft
LOGGED BY AS **CHECKED BY** MAB
▼ **AT END OF DRILLING** 7.8 ft
NOTES ______
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		Silty CLAY with Gravel and Organics (FILL), brown, gray and black, moist, stiff										
				78	5-7-7 (14)							
		LEAN CLAY (CL), with thin sand lenses, brown to gray, moist to wet, soft to hard, abundant sulfates GB1: Lab Classified	GB 1					4	28	17	11	88
5			MC 1	89	1-1-2 (3)							
	▼											
10			SS 1	79	0-1-1-1 (2)							
15			SS 2	79	1-2-2-2 (4)							
20												
25												
30												
35												
40		Sandy GRAVEL (gw), brown, wet, very dense										
		Bottom of hole at 40.5 feet.										

New Generator Foundation
Project #00993-0003

Continuous Blow Counts
Boring B-2
3/4/2011

Depth (ft)	N-Value
20	5
21	4
22	5
23	5
24	7
25	9
26	10
27	10
28	12
29	12
30	11
31	13
32	15
33	14
34	15
35	19
36	23
37	27
38	29
39	34
40	42
40.5	51

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970-255-6818

BORING NUMBER B-3

CLIENT Department of Veteran Affairs
PROJECT NAME New Generator Foundation
PROJECT NUMBER 00993-0003
PROJECT LOCATION Grand Junction, CO
DATE STARTED 3/4/11 COMPLETED 3/4/11
GROUND ELEVATION
HOLE SIZE 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
▽ AT TIME OF DRILLING 7.8 ft
LOGGED BY AS CHECKED BY MAB
▼ AT END OF DRILLING 7.8 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		GRAVEL to Sandy GRAVEL (FILL), red to brown, moist, medium dense										
			MC 1	63	1-1-2-2 (3)							
5		LEAN CLAY (cl), with sand lenses, brown to gray, moist to wet, very soft to medium stiff, abundant sulfates										
10			SS 1	46	0-1-0-1 (1)							
15			SS 2	78	2-2-3 (5)							
		Bottom of hole at 17.5 feet.										

GEOTECH BH COLUMNS 00993-0003 NEW GENERATOR FOUNDATION.GPJ GINT US LAB.GDT 3/22/11

APPENDIX C
Laboratory Testing Results

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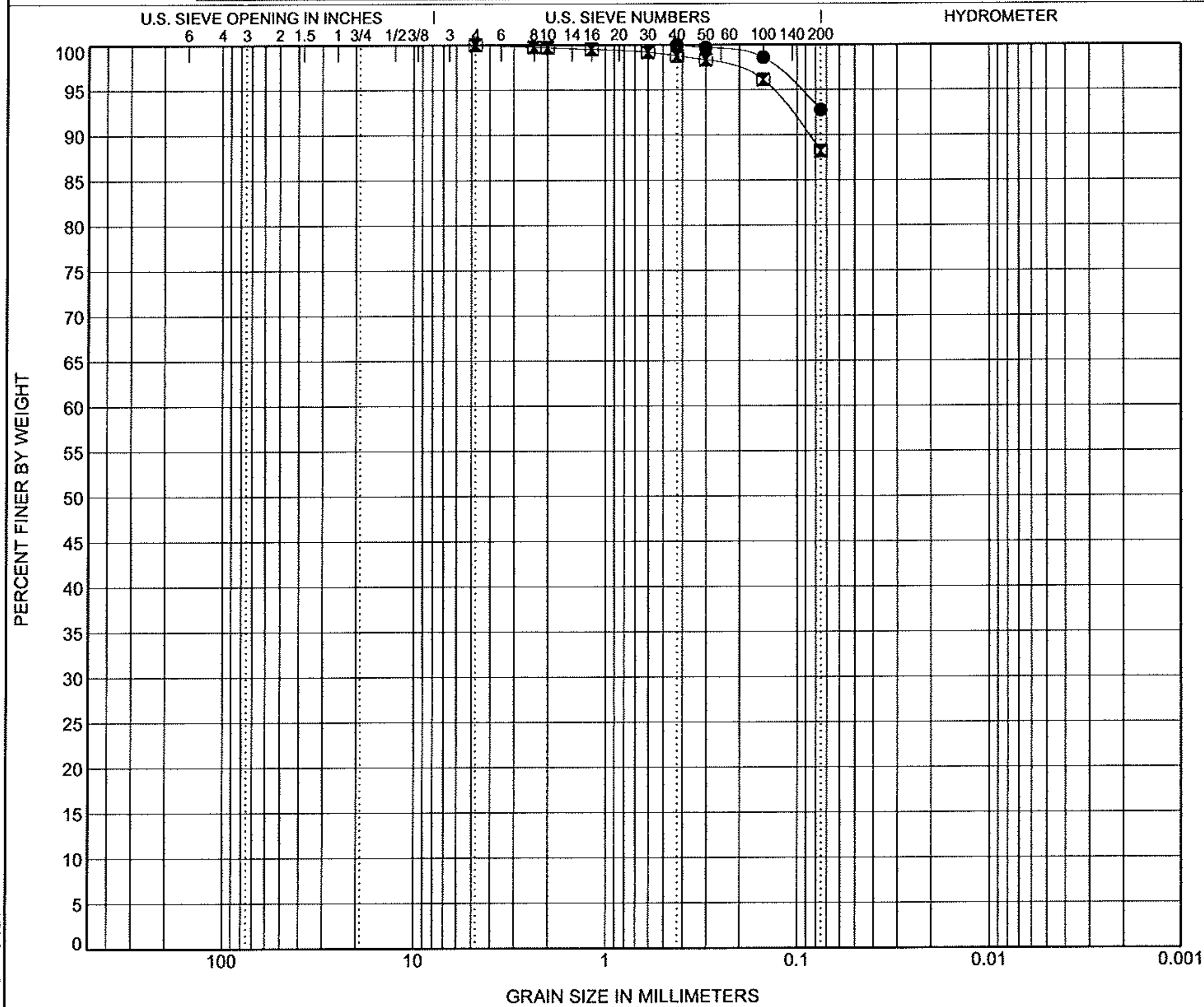
GRAIN SIZE DISTRIBUTION

CLIENT Department of Veteran Affairs **PROJECT NAME** New Generator Foundation

PROJECT NUMBER 00993-0003 **PROJECT LOCATION** Grand Junction, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-1 SS-1	3/2011	LEAN CLAY(CL)	29	16	13		
⊠	B-2 GB-1	3/2011	LEAN CLAY(CL)	28	17	11		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1 SS-1	3/2011	0.425				0.0	7.2	92.8	
⊠	B-2 GB-1	3/2011	4.75				0.0	11.8	88.2	

GRAIN SIZE 00993-0003 NEW GENERATOR FOUNDATION.GPJ GINT US LAB.GDT 3/22/11

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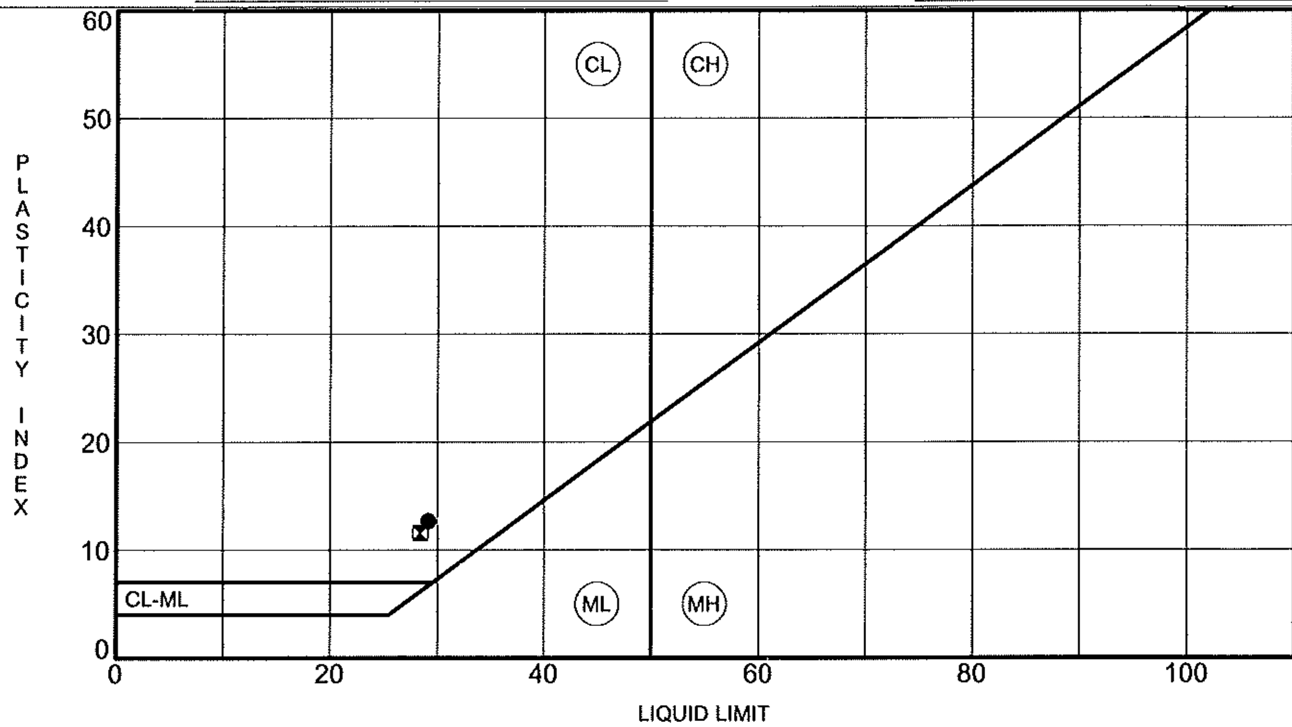
ATTERBERG LIMITS' RESULTS

CLIENT Department of Veteran Affairs
PROJECT NAME New Generator Foundation
PROJECT NUMBER 00993-0003
PROJECT LOCATION Grand Junction, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	B-1 SS-1	3/2011	29	16	13	93	LEAN CLAY(CL)
⊠	B-2 GB-1	3/2011	28	17	11	88	LEAN CLAY(CL)

ATTERBERG LIMITS 00993-0003 NEW GENERATOR FOUNDATION.GPJ GINT US LAB.GDT 3/22/11

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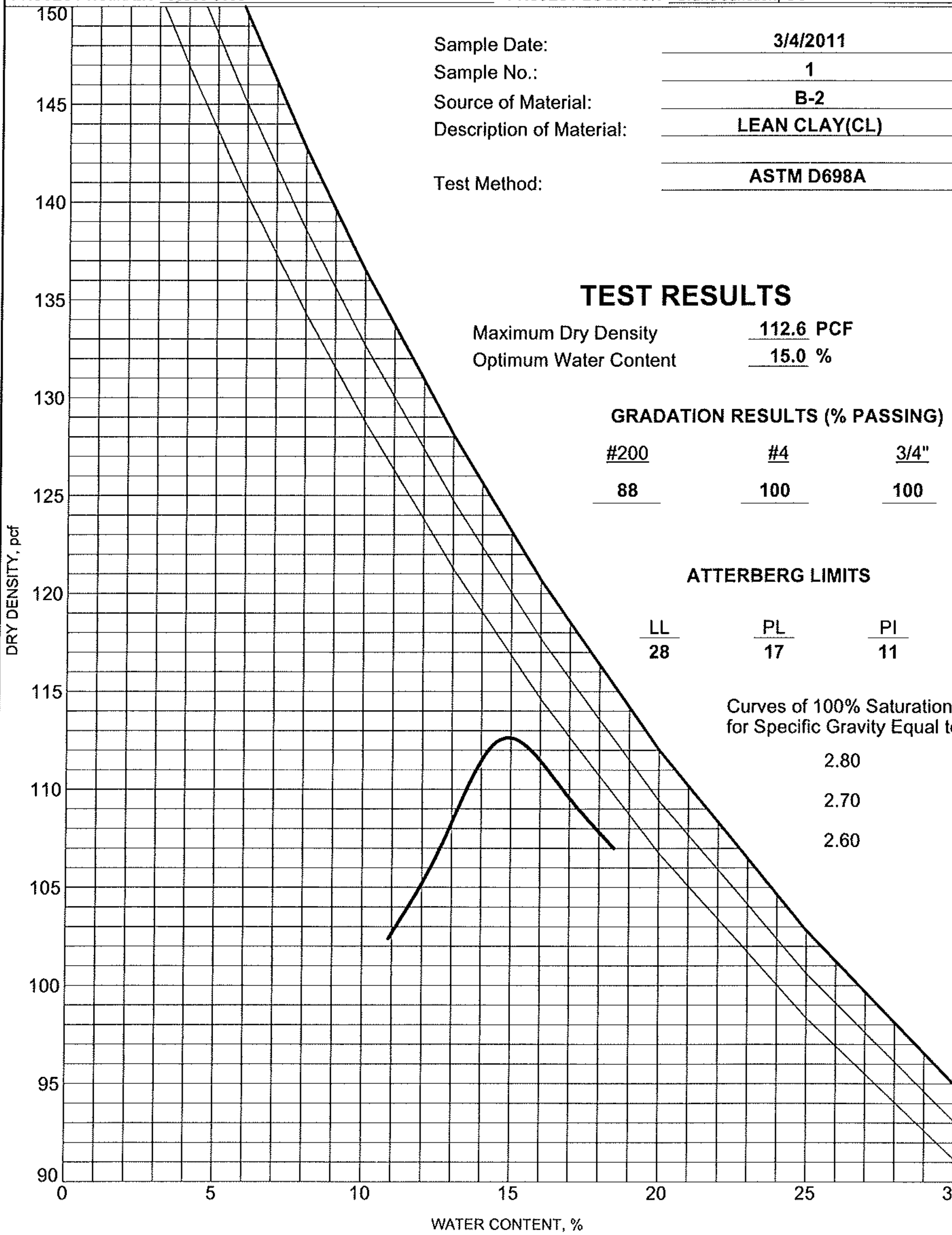
MOISTURE-DENSITY RELATIONSHIP

CLIENT Department of Veteran Affairs
PROJECT NAME New Generator Foundation
PROJECT NUMBER 00993-0003
PROJECT LOCATION Grand Junction, CO



Sample Date:	3/4/2011
Sample No.:	1
Source of Material:	B-2
Description of Material:	LEAN CLAY(CL)
Test Method:	ASTM D698A

TEST RESULTS

Maximum Dry Density 112.6 PCF
Optimum Water Content 15.0 %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
88	100	100

ATTERBERG LIMITS

LL	PL	PI
28	17	11

Curves of 100% Saturation
for Specific Gravity Equal to:

2.80
2.70
2.60