Huddleston-Berry
Engineering & Testing, LLC

GEOLOGIC HAZARDS AND GEOTECHNICAL INVESTIGATION
LAS COLONIAS PARK
GRAND JUNCTION, COLORADO
PROJECT#00208-0044

CITY OF GRAND JUNCTION
250 NORTH 5TH STREET
GRAND JUNCTION, COLORADO 81501

OCTOBER 17, 2014

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

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1.0 INTRODUCTION

As part of continued development in Western Colorado, the City of Grand Junction proposes to improve Las Colonias Park in Grand Junction. As part of the design development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by the City of Grand Junction to conduct a geologic hazards and geotechnical investigation at the site.

1.1 Scope

As discussed above, a geologic hazards and geotechnical investigation was conducted for Las Colonias Park 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 types and subgrade preparation.
- Providing recommendations for bearing capacity.
- Providing recommendations for lateral earth pressure.
- Providing recommendations for drainage, grading, and general earthwork.
- Providing recommendations for pavements.
- 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 City of Grand Junction.

1.2 Site Location and Description

The site is located between Struthers Avenue and the Colorado River in Grand Junction, Colorado. The project location is shown on Figure 1 – Site Location Map.

At the time of the investigation, the majority of the site was open and nearly level. Vegetation consisted primarily of scattered weeds and trees. The site was bordered to the north by Struthers Avenue, vacant lots, and existing commercial/industrial properties. The site was bordered to the east by open land. The site was bordered to the south by open land and the Colorado River. The site was bordered to the west by existing commercial/industrial property.

1.3 Proposed Construction

The proposed construction is anticipated to include new structures, new utilities, and new pavements.

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 site is underlain by Massadona silty clay loam, 0 to 2 percent slopes. Soil survey data is included in Appendix A.

2.2 Geology

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

2.3 Groundwater

Groundwater was encountered in three of the borings at depths of between 5.0 and 5.5 feet below the ground surface at the time of the investigation.

3.0 FIELD INVESTIGATION

3.1 Subsurface Investigation

The subsurface investigation was conducted on September 12th, 2014 and consisted of six geotechnical borings. The borings were drilled to depths of between 4.0 and 9.0 feet below the existing ground surface. Boring locations 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. Borings B-1, B-2, and B-4, conducted in the southeastern portion of the site, generally encountered 3.5 to 7.5 feet of brown, moist to wet, soft to stiff lean clay with sand above brown, moist to wet, dense sandy gravel to the bottoms of the borings. Groundwater was encountered in these borings at depths of between 5.0 and 5.5 feet.

Boring B-3 encountered brown, moist, dense sandy gravel from the ground surface to the bottom of the boring. Groundwater was not encountered in B-3 in the boring at the time of the investigation.

Boring B-5 encountered 1.5 feet of concrete above brown, moist, stiff lean clay with sand to a depth of 2.5 feet. The clay was underlain by brown, moist, dense sandy gravel to the bottom of the boring. Groundwater as not encountered in B-5 at the time of the investigation.

Boring B-6 encountered 4.5 feet of brown, moist, very loose silty, clayey sand above brown moist, dense sandy gravel to the bottom of the boring. Groundwater was not encountered in B-6 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 and density, grain size analysis, Atterberg limits, maximum dry density and optimum moisture (Proctor), swell/consolidation, and water 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. In addition, the native clay soils were indicated to tend to consolidate at their existing density. However, the CBR results indicate that the native clay soils may expand as much as 1% when compacted and introduced to excess moisture. The native sand soils were shown to be slightly plastic. The native sand soils are anticipated to be slightly collapsible.

5.0 GEOLOGIC INTERPRETATION

5.1 Geologic Hazards

The most critical geologic hazard identified on the site is the presence of moisture sensitive soils. However, due to the proximity of the site to the Colorado River, flooding could impact the site.

5.2 Geologic Constraints

In general, the primary geologic constraint to construction at the site is the presence of moisture sensitive soils.

5.3 Water Resources

No water supply wells were observed on the property. As discussed previously, the site lies adjacent to the Colorado River. In general, with proper design and construction, the development of the property is not anticipated to adversely impact surface water or groundwater.

5.4 Mineral Resources

Potential mineral resources in western Colorado generally include gravel, uranium ore, and commercial rock products such as flagstone. The site is mapped in the Mesa County GIS database as containing potential gravel resources. As indicate in the boring logs, gravels were encountered during the subsurface investigation. However, due to the size and location of the property, the existing gravel resources likely do not reflect an economically recoverable resource.

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, pavements, and earthwork may have to consider the impacts of moisture sensitive soils.

7.0 RECOMMENDATIONS

7.1 Foundations

As discussed previously, moisture sensitive soils were encountered at the site. However, based upon the nature of the proposed construction, shallow foundations are recommended. Spread footings and isolated pads and monolithic (turndown edge) structural slabs are the recommended foundation alternatives. However, to provide a uniform subgrade, it is recommended that the foundations be constructed above structural fill. Where the dense gravel soils are shallow, it is recommended that the foundations be constructed above a minimum of 12-inches of structural fill resting on the dense gravel soils. Where the dense gravel soils are deeper, a minimum of 24-inches of structural fill is recommended.

As discussed previously, the native clay soils were shown to be slightly expansive when compacted and introduced to excess moisture. However, the magnitude of expansion measured in the laboratory was small. Therefore, with careful moisture control and proper compaction, the native clay soils, exclusive of topsoil, may be reused as structural fill. The native sand and gravel soils, exclusive of topsoil, are also suitable for reuse 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 or the native gravels are used as structural fill, a minimum of 6-inches of base course, crusher fines, or other suitable fill material should be placed above the pit-run/gravels to prevent large point stresses on the bottoms of the foundations due to large particles in the pit-run/gravels.

Prior to placement of structural fill, it is recommended that the bottoms of the foundation excavations in gravel and cobble soils be proofrolled to the Engineer's satisfaction. It is recommended that the bottoms of the foundation excavations in the native sand or clay soils be scarified to a depth of 9 to 12-inches, moisture conditioned, and 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.

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 soils and 90% of the modified Proctor maximum dry density for coarse grained soils, within ± 2% of the optimum moisture content as determined in accordance with ASTM D698 and D1557C, respectively. Pit-run or native gravels used as structural fill should be proofrolled to the Engineer's satisfaction.

For the foundation building pad prepared as recommended with structural fill consisting of the native soils or imported granular materials, a maximum allowable bearing capacity of 1,500 psf may be used. In addition, a modulus of subgrade reaction of 150 pci may be used for structural fill consisting of the native sand and/or clay soils and a modulus of 250 pci may be used for structural fill consisting of the native gravel soils, crusher fines, pit-run, or base course. The bottoms of exterior foundations should extend a minimum of 24-inches below grade for frost protection.

7.2 Seismic Design Criteria

In general based upon the results of the subsurface investigation, the site classifies as Site Class D for a stiff soil profile.

7.3 Corrosion of Concrete

Water soluble sulfates are common to the soils in Western Colorado. Therefore, at a minimum, Type I-II sulfate resistant cement is recommended for construction at this site.

7.4 Non-Structural Floor Slabs and Exterior Flatwork

As mentioned above, expansive materials are present in the subsurface at the site. In general, slabs-on-grade cannot develop sufficient bearing pressures to resist swelling pressures. Therefore, some movement of slabs-on-grade should be expected. The only way to eliminate the potential for excessive differential movements would be to utilize a structural floor supported by the foundations. However, where a structurally supported floor is not used, while the risk of movement cannot be eliminated, the risk can be reduced by constructing a floating floor slab on a minimum of 18-inches of structural fill. Exterior flatwork should be constructed on a minimum of 12-inches of structural fill.

Huddleston-Berry Engineering & Testing LLC

Floating slabs-on-grade should not be tied in or connected to the foundations in any manner. If a non-structurally supported floor slab is used, interior non-bearing partitions should include a slip-joint or framing void which permits a minimum of 2-inches of vertical movement.

7.5 Lateral Earth Pressures

Stemwalls and/or any retaining walls 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 55 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.

7.6 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*. For Type C soils, the maximum allowable slope in temporary cuts is 1.5H:1V. However, the soil classifications above are based solely upon the geotechnical boring data. HBET should be contacted to further evaluate site soils with regard to OSHA soil classification at the time of construction.

7.7 Pavements

The proposed construction is anticipated to include new site roadways, parking lots, etc. As discussed previously, the pavement subgrade materials at the site range from clay to gravel. However, the clay will be critical for the pavement design. The design California Bearing Ratio (CBR) of the native clay soils was determined in the laboratory to be approximately 2.0. This corresponds to a Resilient Modulus of 3,000 psi.

Based upon the subgrade conditions and anticipated traffic loading, pavement section alternatives were developed in accordance with the *Guideline for the Design and Use of Asphalt Pavements for Colorado Roadways* by the Colorado Asphalt Pavement Association and CDOT *Pavement Design Manual*. The following pavement section alternatives are recommended:

Automobile Parking Areas (Limited Truck Traffic)
ESAL's = 100,000, Structural Number = 3.10

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
Full Depth HMA	7.0				7.0
A	3.0	13.0			16.0
B	4.0	10.0			14.0
C	3.0	6.0	10.0		19.0
Rigid Pavement		6.0		6.0	12.0

Mixed Use Areas (Higher Truck Traffic)
ESAL's = 350,000; Structural Number = 3.50

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Rigid Pavement	TOTAL
Full Depth HMA	9.0				9.0
A	4.0	14.0			18.0
B	5.0	11.0			16.0
C	4.0	6.0	11.0		21.0
Rigid Pavement		6.0		8.0	14.0

Prior to new pavement placement, areas to be paved should be stripped of all topsoil, fill, or other unsuitable materials. It is recommended that the subgrade soils be scarified to a depth of 12-inches; moisture conditioned, and recompacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of optimum moisture content as determined by AASHTO T-99.

Aggregate base course and subbase course should be placed in maximum 9-inch loose lifts, moisture conditioned, and compacted to a minimum of 95% and 93% of the maximum dry density, respectively, at -2% to +3% of optimum moisture content as determined by AASHTO T-180. In addition to density testing, base course should be proofrolled to verify subgrade stability.

It is recommended that Hot-Mix Asphaltic (HMA) pavement conform to CDOT grading SX or S specifications and consist of an approved 75 gyration Superpave method mix design. HMA pavement should be compacted to between 92% and 96% of the maximum theoretical density. An end point stress of 50 psi should be used. It is recommended that rigid pavements consist of CDOT Class P concrete or alternative approved by the Engineer. In addition, pavements should conform to local specifications.

The long-term performance of the pavements is dependent on positive drainage away from the pavements. Ditches, culverts, and inlet structures in the vicinity of paved areas must be maintained to prevent ponding of water on the pavement

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 variable. However, the precise nature and extent of any subsurface variability may not become evident until construction. Therefore, it is recommended that a representative of HBET observe the foundation excavations prior to structural fill placement to verify that the subsurface conditions are consistent with those described herein. In addition, it is recommended that a representative of HBET test compaction of structural fill materials.

As discussed previously, moisture sensitive soils were encountered at the site. The recommendations contained herein are designed to reduce the potential for excessive differential movements; however, HBET cannot predict long-term changes in subsurface moisture conditions and/or the precise magnitude or extent of volume change. Where significant increases in subsurface moisture occur due to poor grading, improper stormwater management, utility line failure, excess irrigation, etc. either during construction or the result of actions of the Owner, significant movements are possible.

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
MICHAEL ALLAN BERRY
39010
10/17/14
PROFESSIONAL ENGINEER

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

FIGURES

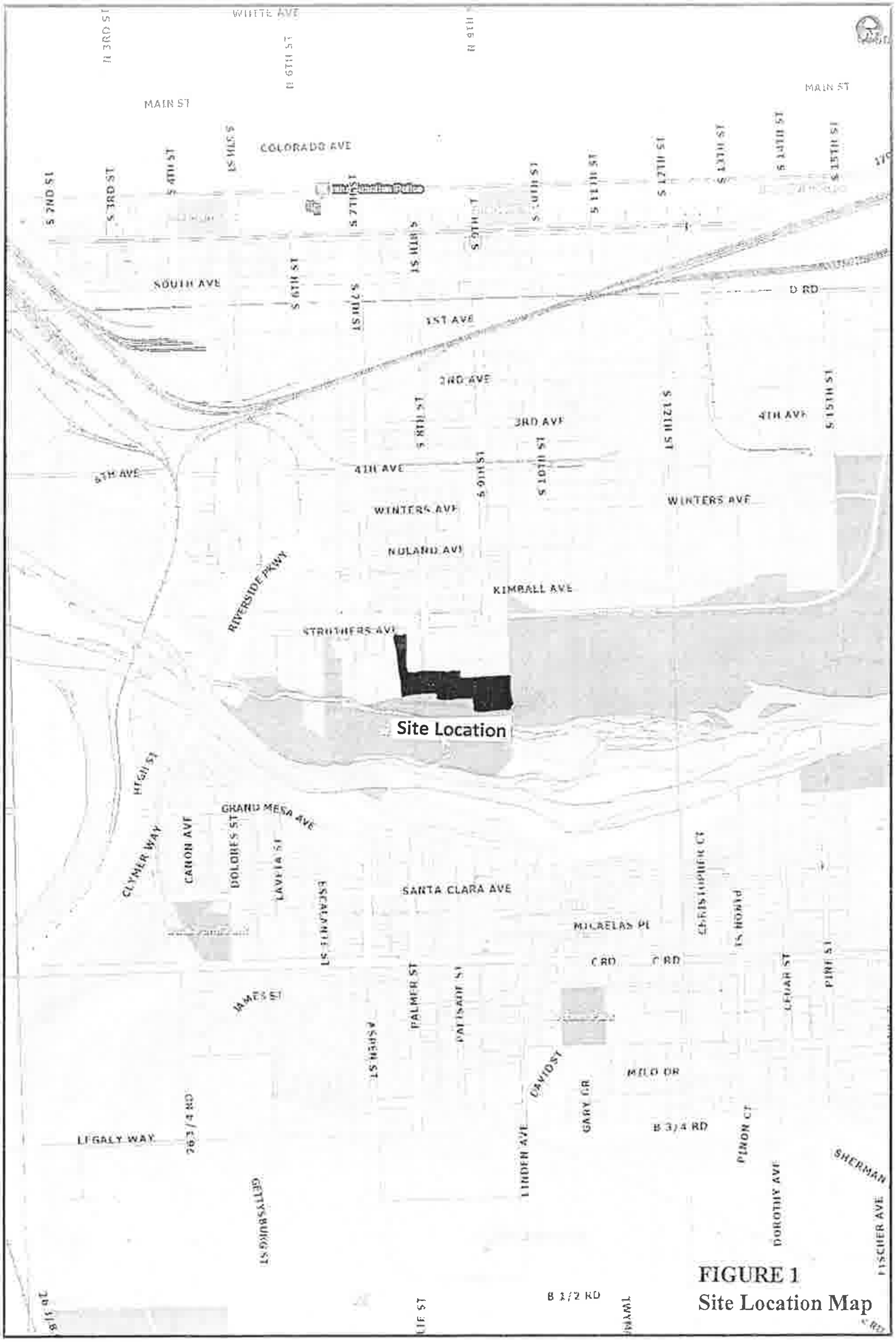


FIGURE 1
Site Location Map

Mesa County Map

Print Date: October 16, 2014

0 0.05 0.1 0.2 mi

0 0.075 0.15 0.3 km

Mesa County, Colorado
GIS/IT Department

City of Grand Junction

N

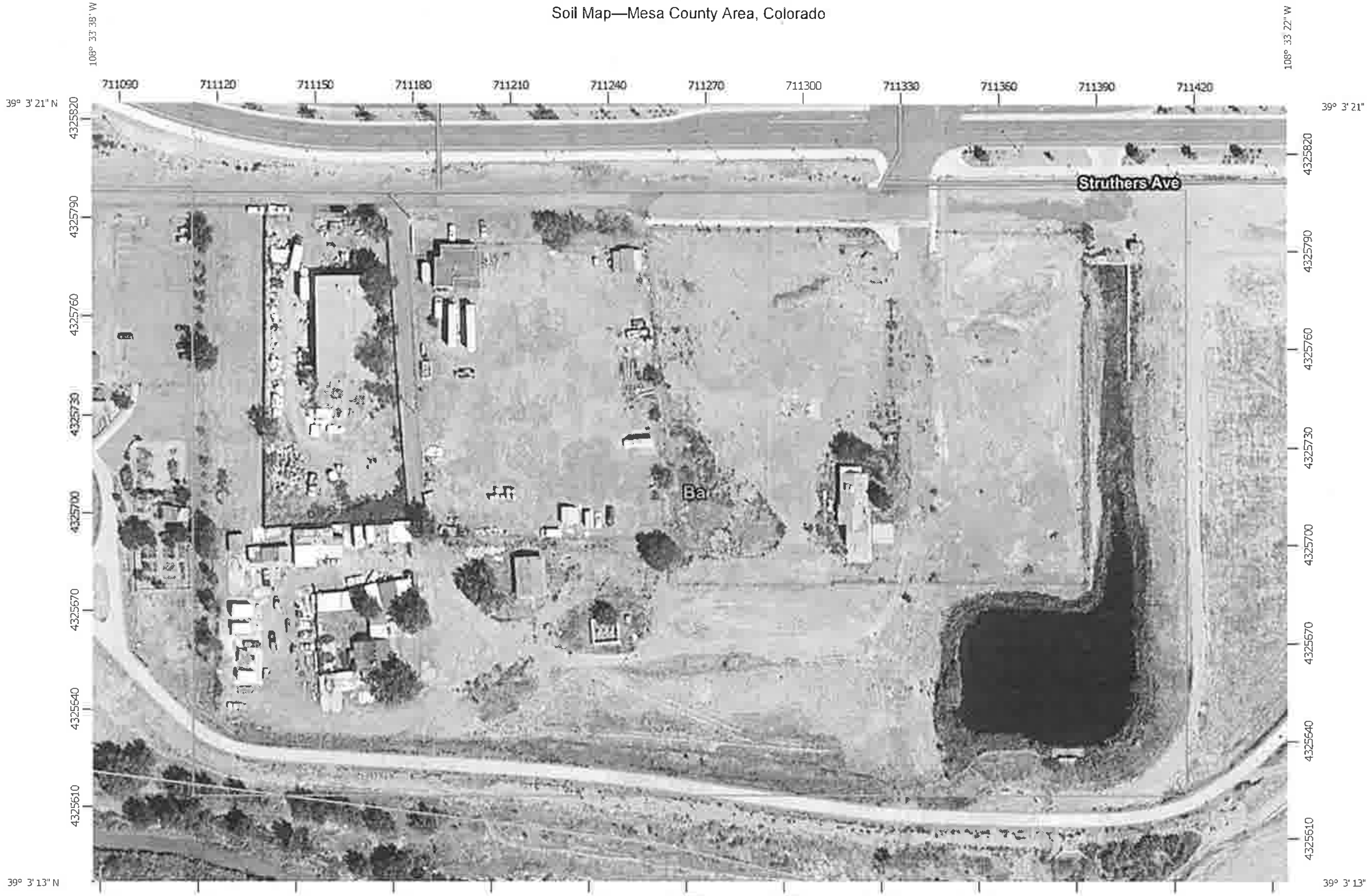
0 0.035 0.07 Miles

Printed: 10/16/2014

1 inch = 126 feet

Grand Junction COLORADO

APPENDIX A
Soil Survey Data



Map Scale: 1:1,680 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 20, 40, 80, 120

N

Feet: 0, 50, 100, 200, 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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 5, Sep 22, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 22, 2010—Sep 2, 2010

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**
Ba	Massadona silty clay loam, 0 to 2 percent slopes	14.1	100.0%
Totals for Area of Interest		**14.1**	**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

Ba—Massadona silty clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k06n
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
Farmland classification: Not prime farmland

Map Unit Composition

Massadona and similar soils: 70 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Massadona

Setting

Landform: Fan remnants
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium derived from clayey shale

Typical profile

A - 0 to 2 inches: silty clay loam
Bw - 2 to 12 inches: silty clay
Bky - 12 to 24 inches: silty clay
BCky1 - 24 to 48 inches: stratified silty clay loam to fine sandy loam
BCky2 - 48 to 60 inches: stratified silty clay loam to fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Moderately saline to strongly saline (10.0 to 32.0 mmhos/cm)
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 5, Sep 22, 2014

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	City of Grand Junction	PROJECT NAME	Las Colonias Park
PROJECT NUMBER	00208-0044	PROJECT LOCATION	Grand Junction, CO
DATE STARTED	9/12/14 COMPLETED 9/12/14	GROUND ELEVATION	HOLE SIZE 4"
DRILLING CONTRACTOR	S. McKracken	GROUND WATER LEVELS:	
DRILLING METHOD	Simco 2000 Truck Rig	AT TIME OF DRILLING	5.0 ft
LOGGED BY	NWB CHECKED BY MAB	AT END OF DRILLING	5.0 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 (%)
0.0		Lean CLAY with Sand (cl), brown, moist to wet, soft	GB 1									
2.5			SS 1	83	1-2-1 (3)							
5.0												
7.5		Sandy GRAVEL (gw), brown, wet, dense	SS 2	100	18-37							
		Bottom of hole at 9.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
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970-255-8005
970-255-6818

BORING NUMBER B-2

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Park
PROJECT NUMBER 00208-0044
PROJECT LOCATION Grand Junction, CO
DATE STARTED 9/12/14 **COMPLETED** 9/12/14
GROUND ELEVATION **HOLE SIZE** 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
▽ **AT TIME OF DRILLING** 5.0 ft
LOGGED BY NWB **CHECKED BY** MAB
▼ **AT END OF DRILLING** 5.0 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 (%)
0.0		Lean CLAY with Sand (cl), brown, moist, stiff										
2.5			SS 1	50	1-1-8 (9)							
		Sandy GRAVEL (gw), brown, moist to wet, dense										
5.0	▼		SS 2	75	21-24							
		Bottom of hole at 7.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
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970-255-8005
970-255-6818

BORING NUMBER B-3

CLIENT City of Grand Junction

PROJECT NAME Las Colonias Park

PROJECT NUMBER 00208-0044

PROJECT LOCATION Grand Junction, CO

DATE STARTED 9/12/14 COMPLETED 9/12/14

GROUND ELEVATION HOLE SIZE 4"

DRILLING CONTRACTOR S. McKracken

GROUND WATER LEVELS:

DRILLING METHOD Simco 2000 Truck Rig

AT TIME OF DRILLING dry

LOGGED BY NWB CHECKED BY MAB

AT END OF DRILLING dry

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		Sandy GRAVEL (gw), brown, moist, dense										
1												
2			SS 1	50	22-28							
3		*** Auger Refusal at 4 ft ***										
4		Bottom of hole at 4.0 feet.										

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BORING NUMBER B-4

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Park
PROJECT NUMBER 00208-0044
PROJECT LOCATION Grand Junction, CO
DATE STARTED 9/12/14 COMPLETED 9/12/14
GROUND ELEVATION ______ HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
AT TIME OF DRILLING 5.5 ft
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING 5.5 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 (%)
0.0		Lean CLAY with Sand (cl), brown, moist to wet, medium stiff to soft										
2.5			SS 1	61	4-3-4 (7)							
5.0												
7.5		Sandy GRAVEL (gw), brown, wet, dense	SS 2	50	7-15-18 (33)							
		*** Auger Refusal at 9 ft ***										
		Bottom of hole at 9.0 feet.										

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BORING NUMBER B-5

CLIENT City of Grand Junction | PROJECT NAME Las Colonias Park

PROJECT NUMBER 00208-0044 | PROJECT LOCATION Grand Junction, CO

DATE STARTED 9/12/14 COMPLETED 9/12/14 | GROUND ELEVATION HOLE SIZE 4"

DRILLING CONTRACTOR S. McKracken | GROUND WATER LEVELS:

DRILLING METHOD Simco 2000 Truck Rig | AT TIME OF DRILLING dry

LOGGED BY NWB CHECKED BY MAB | AT END OF DRILLING dry

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		CONCRETE										
1.5		Lean CLAY with Sand (cl), brown, moist, stiff										
2.5		Sandy GRAVEL (gw), brown, moist, dense	MC 1	33	15-27		103	15				
		*** Auger Refusal at 4 ft ***										
4		Bottom of hole at 4.0 feet.										

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BORING NUMBER B-6

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Park
PROJECT NUMBER 00208-0044
PROJECT LOCATION Grand Junction, CO
DATE STARTED 9/12/14 COMPLETED 9/12/14
GROUND ELEVATION
HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
AT TIME OF DRILLING dry
LOGGED BY NWB CHECKED BY MAB
AT END OF DRILLING dry
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 (%)
0.0		Silty, Clayey SAND (SC-SM), brown, moist, very loose										
2.5			SS 1	67	2-2-1 (3)			15	24	19	5	34
		Sandy GRAVEL (gw), brown, moist, dense										
5.0												
		*** Auger Refusal at 6.5 ft ***										
		Bottom of hole at 6.5 feet.										

APPENDIX C
Laboratory Testing Results

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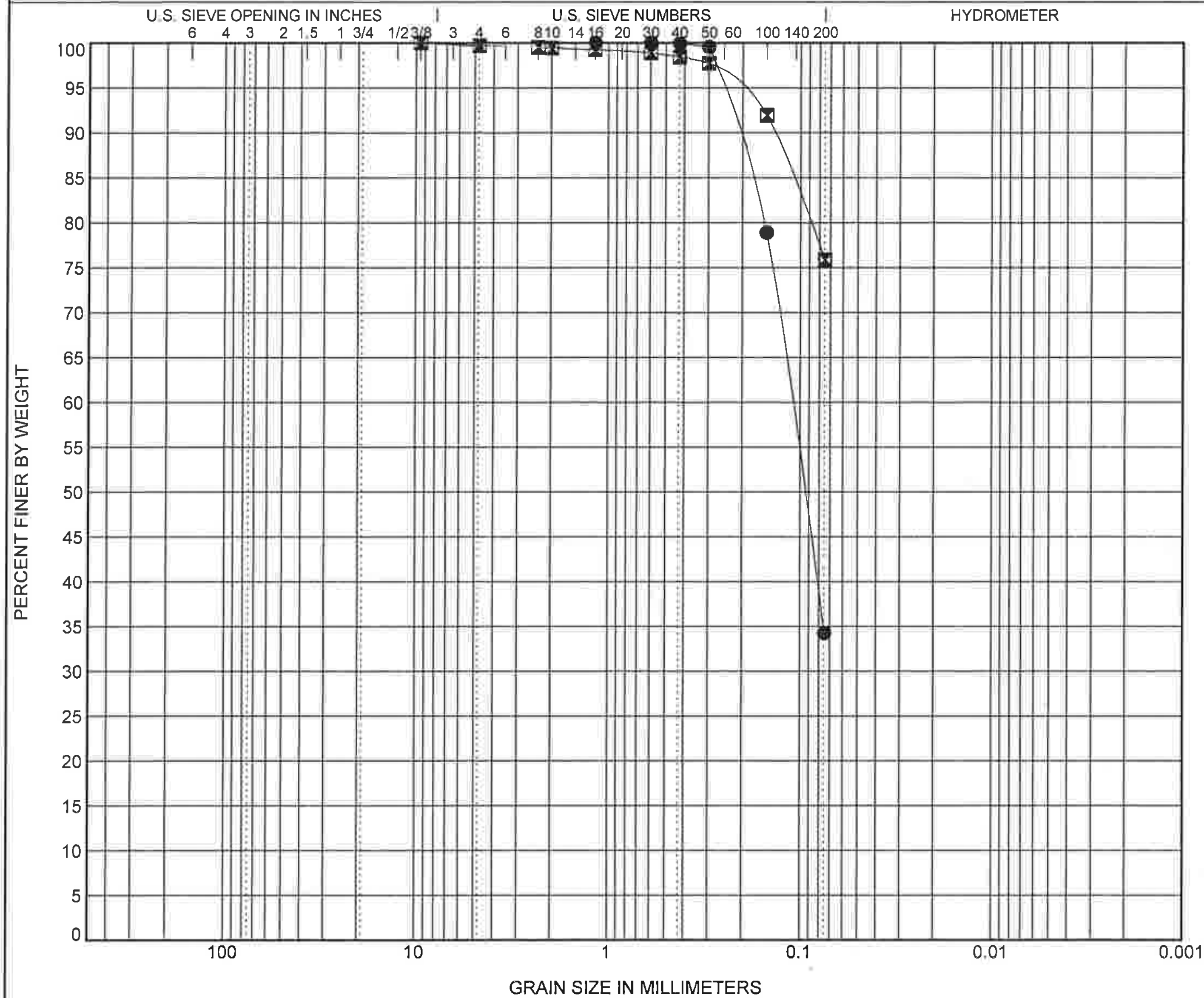
GRAIN SIZE DISTRIBUTION

CLIENT City of Grand Junction

PROJECT NAME Las Colonias Park

PROJECT NUMBER 00208-0044

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-6, SS1**	**9/2014**	**SILTY, CLAYEY SAND(SC-SM)**	**24**	**19**	**5**		
⊠	**Composite**	**9/2014**	**LEAN CLAY with SAND(CL)**	**26**	**18**	**8**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-6, SS1**	**9/2014**	**1.18**	**0.112**			**0.0**	**65.7**	**34.3**	
⊠	**Composite**	**9/2014**	**9.5**				**0.3**	**23.8**	**75.9**	

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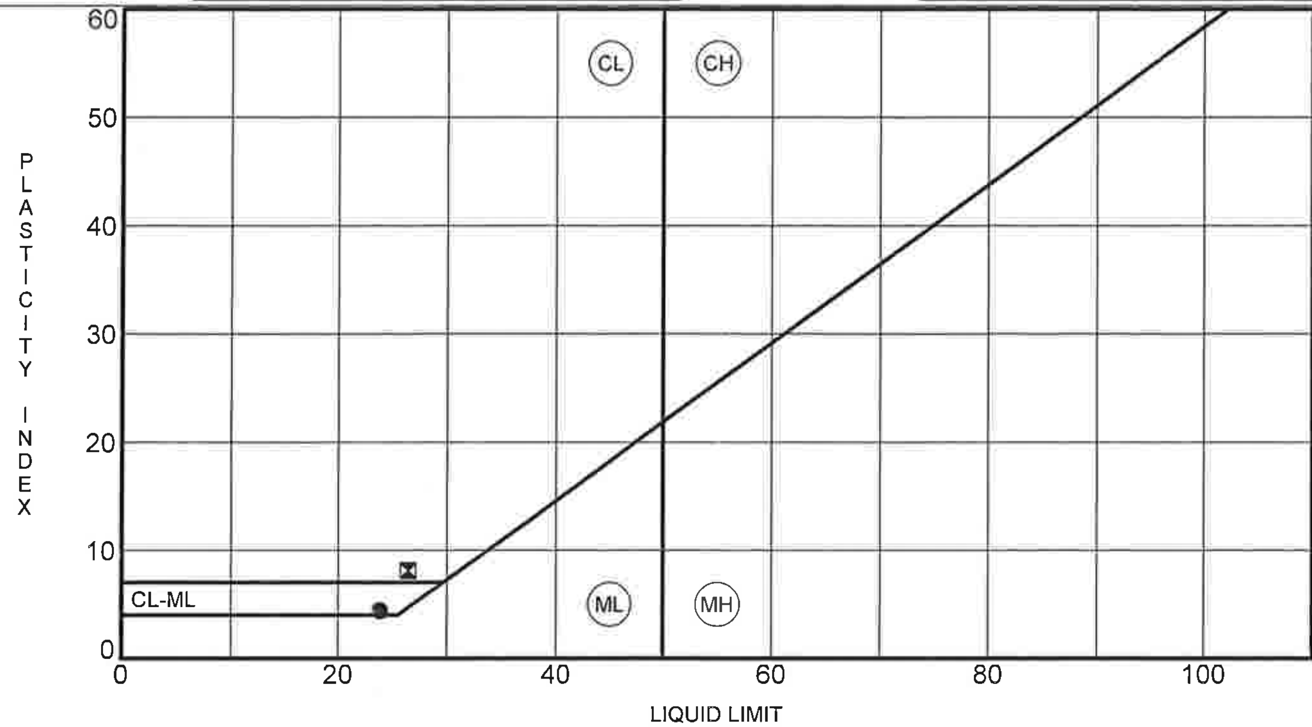
ATTERBERG LIMITS' RESULTS

CLIENT City of Grand Junction

PROJECT NAME Las Colonias Park

PROJECT NUMBER 00208-0044

PROJECT LOCATION Grand Junction, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	B-6, SS1	9/12/2014	24	19	5	34	SILTY, CLAYEY SAND(SC-SM)
⊠	Composite	9/12/2014	26	18	8	76	LEAN CLAY with SAND(CL)

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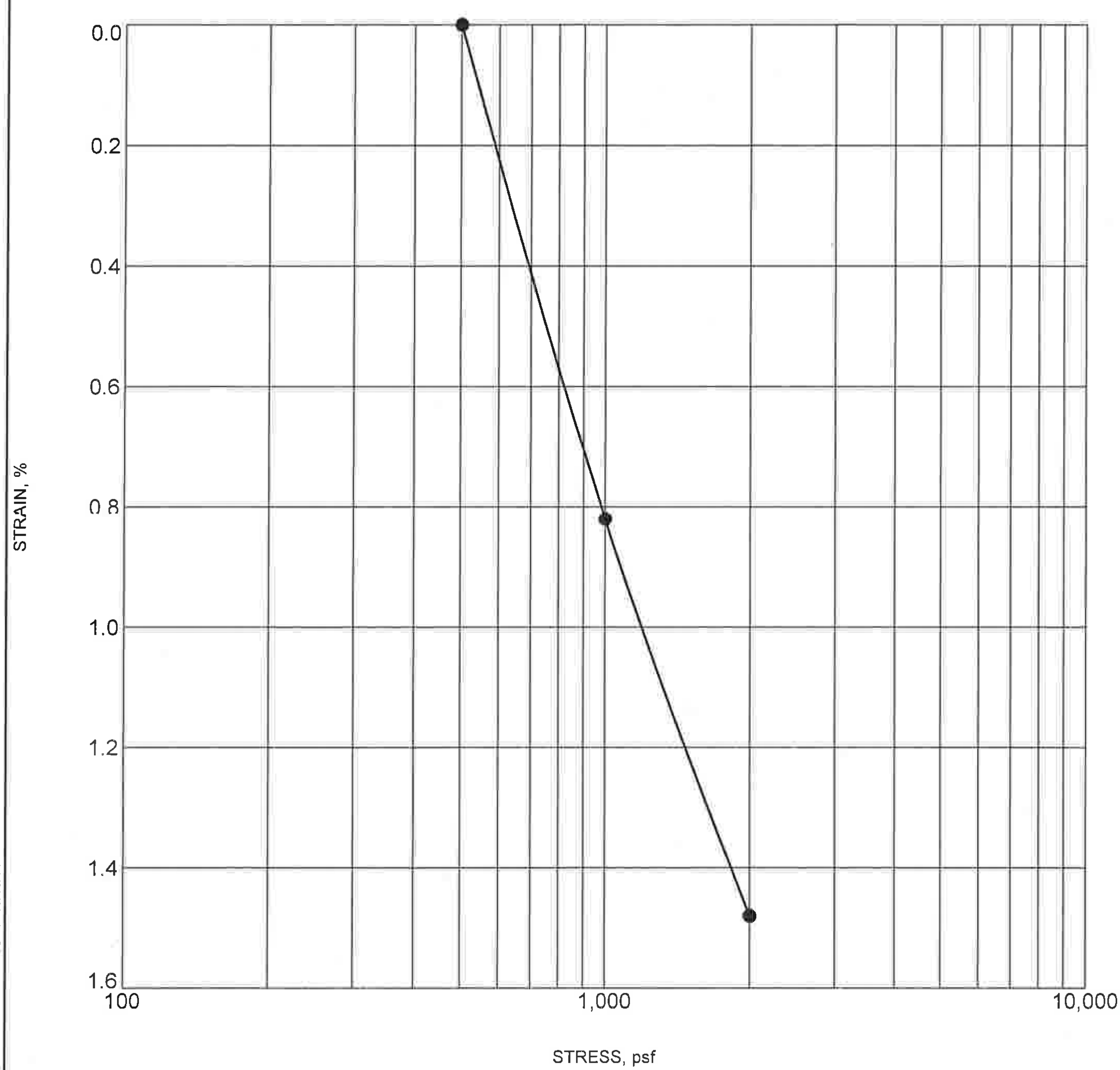
CONSOLIDATION TEST

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Park
PROJECT NUMBER 00208-0044
PROJECT LOCATION Grand Junction, CO



	Specimen Identification		Classification	γ_d	MC%
●	B-5	2.0		103	15

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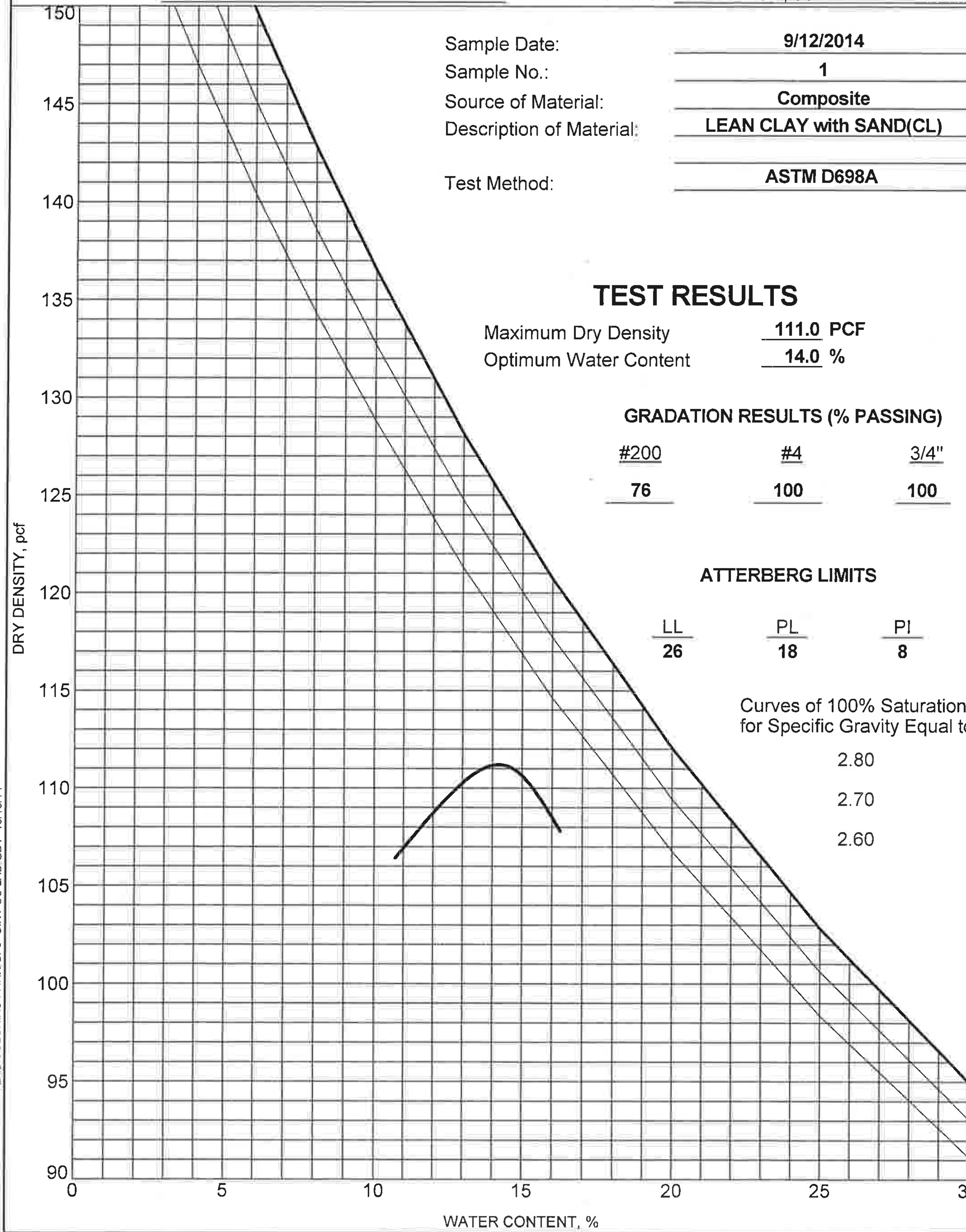
MOISTURE-DENSITY RELATIONSHIP

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Park
PROJECT NUMBER 00208-0044
PROJECT LOCATION Grand Junction, CO



Sample Date:	9/12/2014
Sample No.:	1
Source of Material:	Composite
Description of Material:	LEAN CLAY with SAND(CL)
Test Method:	ASTM D698A

TEST RESULTS

Maximum Dry Density **111.0** PCF
Optimum Water Content **14.0** %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
76	100	100

ATTERBERG LIMITS

LL	PL	PI
26	18	8

Curves of 100% Saturation for Specific Gravity Equal to:
2.80
2.70
2.60

Huddleston-Berry
Engineering & Testing, LLC

CALIFORNIA BEARING RATIO
ASTM D1883

Project No.:	00208-0044	**Authorized By:**	Client	**Date:**	09/12/14
Project Name:	Las Colonias Park	**Sampled By:**	NB	**Date:**	09/12/14
Client Name:	City of Grand Junction	**Submitted By:**	NB	**Date:**	10/16/14
Sample Number:	14-0612 **Location:** Composite	**Reviewed By:**	MAB	**Date:**	10/17/14

Compaction Methoc ASTM D698, Method A

Maximum Dry Density (pcf): 111.0

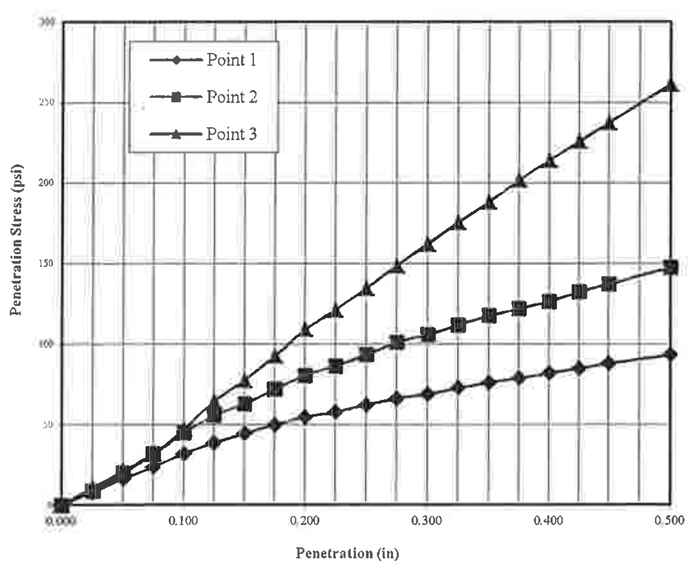
Opt. Moisture Content (%): 14.0

Sample Condition: Soaked

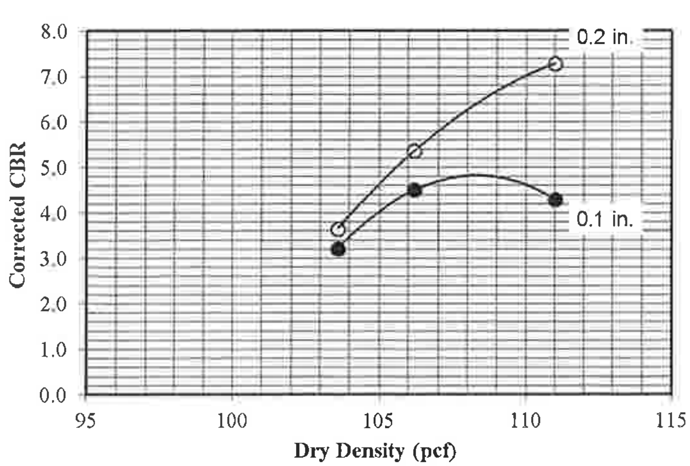
Remarks:

Sample Data		Point 1	Point 2	Point 3
Blows per Compacted Lift:		15	25	56
Surcharge Weight (lbs):		10.0	10.0	10.0
Dry Density Before Soak (pcf):		103.6	106.2	111.0
Dry Density After Soak (pcf):		102.6	105.4	109.9
Moisture Content (%)	Bottom Pre-Test	12.7	13.0	12.1
	Top Pre-Test	12.2	12.6	12.3
	Top 1" After Test	19.6	18.6	17.5
	Average After Soak:	19.4	17.8	15.8
Percent Swell After Soak:		1.0	0.8	1.0

Load Pentration Curve(s)



Dry Density vs CBR



Penetration Data								
Point 1			Point 2			Point 3		
Dist. (in)	Load (lbs)	Stress (psi)	Dist. (in)	Load (lbs)	Stress (psi)	Dist. (in)	Load (lbs)	Stress (psi)
0.000	0	0	0.000	0	0	0.000	0	0
0.025	24	8	0.025	25	8	0.025	32	11
0.050	49	17	0.050	59	20	0.050	64	22
0.075	71	24	0.075	95	32	0.075	95	32
0.100	95	32	0.100	133	45	0.100	140	47
0.125	115	39	0.125	165	56	0.125	191	65
0.150	132	45	0.150	186	63	0.150	230	78
0.175	147	50	0.175	213	72	0.175	274	93
0.200	162	55	0.200	238	81	0.200	323	109
0.225	171	58	0.225	256	87	0.225	359	121
0.250	184	62	0.250	276	93	0.250	399	135
0.275	196	66	0.275	299	101	0.275	440	149
0.300	204	69	0.300	313	106	0.300	480	162
0.325	215	73	0.325	331	112	0.325	520	176
0.350	225	76	0.350	348	118	0.350	557	188
0.375	233	79	0.375	361	122	0.375	597	202
0.400	242	82	0.400	374	127	0.400	633	214
0.425	251	85	0.425	391	132	0.425	668	226
0.450	260	88	0.450	406	137	0.450	703	238
0.500	276	93	0.500	436	148	0.500	773	262

Corrected CBR @ 0.1"		
3.2	4.5	4.3
Corrected CBR @ 0.2"		
3.7	5.4	7.3

Penetration Distance Correction (in)		
0.000	0.000	0.000

Figure: ____

Form L20a CBR Report