Huddleston-Berry
Engineering & Testing, LLC

GEOTECHNICAL INVESTIGATION
LOWER LITTLE SALT WASH TRAIL
FRUITA, COLORADO
PROJECT#00456-0006

RIVER CITY CONSULTANTS, INC.
744 HORIZON COURT, SUITE 110
GRAND JUNCTION, COLORADO 81506

JUNE 17, 2011

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Grand Junction, Colorado 81501

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A geologic hazards and geotechnical investigation was conducted for the proposed Lower Little Salt Wash Trail in Fruita, 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, pavement 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 nine borings, drilled on May 20th and May 23rd, 2011. The borings generally encountered native sand, clay, and silt soils above dense gravel soils. Groundwater was encountered in most of the borings at depths of between 6.5 and 14.8 feet below the existing ground surface. The native clay soils moderately plastic and are anticipated to range from tending to consolidate at their existing density to being slightly expansive after compaction and introduction to excess moisture. The native sand and silt soils are non-plastic to slightly plastic and are anticipated to compress under loading.

Geologic Hazards and Constraints (p. 4)

No geologic hazards were identified which would preclude construction. However, construction should consider the risks of movement associated with the moisture sensitive soils at the site. In addition, surface and groundwater may impact the construction depending upon the time of year that construction is completed.

Summary of Foundation Recommendations

Bridge/Culvert between City of Fruita Lagoons and James M. Robb state park

- *Foundation Type* – Shallow Foundations bearing on dense gravel soils. (p. 5)
- *Maximum Allowable Bearing Capacity* – 2,000 psf. (p. 6)

Retaining Walls

- *Subgrade Preparation* – 12-inches of scarified, recompacted native soils. Subgrade stabilization may be necessary. (p. 6)
- *Maximum Allowable Bearing Capacity* – 1,250 psf (p. 6)

Summary of Pavement Recommendations (p. 7)

It is recommended that the trail consist of 6-inches of concrete above 6-inches of base course.

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1.0 INTRODUCTION

As part of improvements to recreational infrastructure in Western Colorado, a new pedestrian trail is proposed between N. Coulson Street and Raptor Road along Little Salt Wash in Fruita. As part of the design development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by River City Consultants 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 the proposed Lower Little Salt Wash Trail in Fruita, 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 structure foundations 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 trail 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 River City Consultants, the City of Fruita, and Mesa County.

1.2 Site Location

The trail is proposed to run from N. Coulson Street, north of the Independence Village assisted living facility, to Raptor Road, east of the City of Fruita's sewage treatment lagoons. In addition, the trail is proposed to extend south to the James M. Robb state park. The project location is shown on Figure 1 – Site Location Map.

1.3 Proposed Construction

The proposed construction is anticipated to consist of a new pedestrian trail. As part of the construction a new culvert or bridge is likely between the City of Fruita lagoon property and the James M. Robb state park. In addition, to facilitate the trail construction, retaining walls may be necessary along portions of the alignment.

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 include Sagers silty clay loam, 0 to 2 percent slopes; Sagers silty clay loam, saline, 0 to 2 percent slopes; Glenton very fine sandy loam, 0 to 2 percent slopes; Fruitland sandy clay loam, 0 to 2 percent slopes; Bebeevar-Green River-Riverwash, 0 to 2 percent slopes; Ustifluvents, 0 to 2 percent slopes; and Turley clay loam, 0 to 2 percent slopes. Soil survey data, including descriptions of the soil units, is included in Appendix A.

Road and street construction (applicable to trail construction) in the Sagers soils is described as somewhat limited due to shrink-swell. Road and street construction in the Glenton, Bebeevar, Green River, and Ustifluvents soils is described as somewhat to very limited due to flooding. Road and street construction in the Fruitland and Turley soils is described as not limited.

Shallow excavation in the site soils is described as ranging from somewhat to very limited due to cutbank caving, depth to saturated zone, and/or flooding. The site soils have a low potential for frost action and moderate to high risk of corrosion of steel.

The Fruitland and Riverwash soils are described as having a low risk of corrosion of concrete. The remaining soil types are indicated to have a moderate to high 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 the Grand Valley and has a low to moderate potential for expansion.

2.3 Groundwater

Groundwater was encountered in all but two of the borings at depths of between 6.5 and 14.8 feet below the existing ground surface. In general, the groundwater levels were consistent with the water elevation in Little Salt Wash and/or the Colorado River.

3.0 SUBSURFACE INVESTIGATION

The subsurface investigation was conducted on May 20th and May 23rd, 2011, and consisted of nine borings drilled to depths of between 7.0 and 17.0 feet. 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 along the trail alignment were variable. Boring B-1, conducted in the northern portion of the trail near Gewont Lane, encountered 1.0 foot of clayey sand and gravel with organics and debris fill above tan to gray, dry to moist, loose to medium dense silty sand to a depth of 10.0 feet. The sand was underlain by reddish brown to gray, moist, stiff silty, sandy clay to the bottom of the boring. Groundwater was not encountered in B-1 at the time of the investigation.

Boring B-2, conducted on the north side of US Highway 6 & 50, encountered 7.5 feet of fill materials above brown to gray, moist, loose sandy silt to a depth of 11.0 feet. Below the silt, gray to white, moist to wet, medium dense to very loose silty sand extended to a depth of 16.0 feet. The sand was underlain by brown to red, moist, soft silty clay to the bottom of the boring. Groundwater was encountered in B-2 at a depth of 14.8 feet at the time of the investigation.

Boring B-3, conducted on the north side of US Highway 6 & 50 adjacent to Little Salt Wash, encountered 1.5 feet of silty sand with organics topsoil above brown to gray, moist to wet, loose to medium dense silty sand to a depth of 10.5 feet. The sand was underlain by gray, wet, medium dense to dense sandy gravel to the bottom of the boring. Groundwater was encountered in B-3 at a depth of 8.0 feet at the time of the investigation.

Boring B-4, conducted along Little Salt Wash between the railroad and I-70, encountered 9.25 feet of brown to red to gray, moist to wet, loose to medium dense silty sand above reddish brown to gray, moist to wet, stiff to very loose interbedded silty clay and sandy silt to a depth of 15.0 feet. The clay and silt was underlain by brown, wet, dense sandy gravel to the bottom of the boring. Groundwater was encountered in B-4 at a depth of 6.5 feet at the time of the investigation.

Boring B-5, conducted along Little Salt Wash on the north side of I-70, encountered brown to gray, moist to wet, very loose to medium dense silty sand from the ground surface to the bottom of the boring. Groundwater was encountered in B-5 at a depth of 8.0 feet at the time of the investigation.

Boring B-6, conducted along Little Salt Wash on the south side of I-70, encountered 1.0 foot of clayey sand with organics topsoil above brown, moist, loose silty sand to a depth of 5.0 feet. The sand was underlain by brown, moist to wet, medium dense to dense sandy gravel to the bottom of the boring. Groundwater was encountered in B-6 at a depth of 7.0 feet at the time of the investigation.

Boring B-7, conducted in the western portion of the City of Fruita lagoon property, encountered 1.0 foot of sandy gravel and cobbles fill above brown to gray, moist to wet, very loose sandy silt to a depth of 10.0 feet. The silt was underlain by gray, wet, loose silty sand to a depth of 12.0 feet. Below the sand, brown, wet, medium dense to dense sandy gravel extended to the bottom of the boring. Groundwater was encountered in B-7 at a depth of 9.0 feet at the time of the investigation.

Boring B-8, conducted at the location of the proposed bridge to the James M. Robb state park, encountered 4.0 feet of clayey sand and gravel fill above brown, moist, loose silty sand to a depth of 8.0 feet. The sand was underlain by brown, wet, dense sandy gravel to the bottom of the boring. Groundwater was not encountered in B-8 at the time of the investigation.

Boring B-9, conducted at the proposed trail connection to Raptor Road, encountered 0.5 feet of clay with sand and gravel fill above brown to gray, moist, soft to stiff lean clay with sand to a depth of 8.75 feet. The clay was underlain by brown, very moist, very loose silty sand to a depth of 9.5 feet. Below the sand, brown, wet, medium dense sandy gravel extended to the bottom of the boring. Groundwater was encountered in B-9 at a depth of 10.0 feet 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 and density determination, grain size analysis, Atterberg limits determination, maximum dry density and optimum moisture (Proctor) determination, swell/consolidation testing, California Bearing Ratio (CBR), and soluble sulfates content determination. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that the native sand soils are non-plastic. In addition, the sand soils were shown to tend to compress under loading. The native silt soils were shown to be slightly plastic. The native clay soils were indicated to be moderately plastic. In addition, the clay soils were shown to tend to consolidate under loading. However, the CBR results indicate that the native clay soils are slightly expansive when compacted and introduced to excess moisture. Water soluble sulfates were detected in the site soils in concentrations as high as 0.4%.

5.0 GEOLOGIC INTERPRETATION

5.1 Geologic Hazards

The most critical geologic hazard identified on the site is the risk of flooding of Little Salt Wash and the Colorado River. In addition, moisture sensitive soils are present at the site.

5.2 Geologic Constraints

The primary geologic constraint to construction is the presence of Little Salt Wash and the Colorado River. In addition, shallow groundwater associated with the watercourses will likely impact construction. The moisture sensitive soils may also impact the construction.

5.3 Water Resources

As discussed previously, Little Salt Wash and the Colorado River are the primary water features in the project area.

5.4 Mineral Resources

Potential mineral resources in western Colorado generally include gravel, uranium ore, and commercial rock products such as flagstone. As discussed previously, gravels were encountered during the subsurface investigation. In addition, the southern portion of the trail, crossing the City of Fruita sewage lagoon site, is mapped in the Mesa County GIS database as containing gravel resources. However, the trail will not occupy a significant area of land. As a result, the trail construction is not anticipated to impact the future extraction of any gravel resources in the project area.

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 of the trail. However, foundations, trail pavements, retaining walls, and earthwork will have to consider the impacts of the moisture sensitive soils and the potential for flooding of Little Salt Wash and/or the Colorado River.

7.0 RECOMMENDATIONS

7.1 Bridge/Culvert Foundations

As discussed previously, a new culvert or bridge is proposed to connect the trail from the City of Fruita sewage lagoons site to the James M. Robb state park. Boring B-9 conducted in this area encountered 9.5 feet of clay and sand soils above dense gravel soils. In general, due to the depth of the drainage channel proposed to be crossed by the culvert or bridge, it is recommended that a culvert or bridge at this location be founded on the native dense sandy gravel soils.

It is recommended that the bottoms of the foundation excavations be scarified to a depth of 6 to 8-inches, moisture conditioned, and proofrolled to the Engineer's satisfaction. Where soft or loose materials are encountered, they should be removed and replaced with structural fill.

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

For foundation subgrade prepared as recommended, a maximum allowable bearing capacity of 2,000 psf may be used.

7.2 Retaining Wall Foundations

Based upon information provided to HBET, retaining walls may be necessary to support the trail on the north side of the US Highway 6 & 50 culvert crossing and between US Highway 6 & 50 and the railroad tracks. Boring B-3, conducted on the north side of Highway 6 & 50 encountered native silty sand soils to a depth of 10.5 feet. Therefore, retaining walls will likely be constructed above the native sand soils. However, the actual depth of wall foundations will likely be dependent upon the results of scour analyses.

Prior to placement of wall foundation (concrete for rigid cantilever wall or concrete/base course for MSE wall), it is recommended that the bottoms of the foundation excavations be scarified to a depth of 12-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, the sand soils at the foundation elevation will likely be saturated and compaction of the subgrade may be difficult. Where instabilities in the subgrade are encountered, geotextile and/or geogrid reinforcement may be required. HBET should be contacted to provide specific recommendations for subgrade stabilization based upon the actual subgrade conditions encountered during construction.

For foundation subgrade prepared as recommended, a maximum allowable bearing capacity of 1,250 psf may be used.

7.3 Lateral Earth Pressures

Structures should be designed to resist lateral earth pressures. We recommend that the proposed retaining walls be designed using the following earth pressure coefficients:

Native Clay and Silt
- $K_a = 0.39$
- $K_p = 2.56$

Native Sand
- $K_a = 0.36$
- $K_p = 2.77$

Class 1 Structural Backfill
- $K_a = 0.33$
- $K_p = 3.00$

The earth pressure coefficients above assume horizontal backslope and should be increased where the backslope is not level. Computed lateral earth pressures on the walls should consider a surcharge loading of 100 psf for maintenance traffic on the trail.

Resistance to sliding at the base of foundations can be calculated based upon a coefficient of friction of 0.30 for the native silt/clay soils, a coefficient of 0.34 for the native sand soils, and a coefficient of 0.36 for Class I Structural Backfill. It is important to note that these coefficient of friction values are for ultimate soil strength. The structural engineer should apply an appropriate factor of safety to the above values.

7.4 Corrosion of Steel and Concrete

Based upon information provided in the USDA NRCS Web Soil Survey, the soils at the site generally have a moderate to high risk of corrosion of uncoated steel. The risk of corrosion may be increased where flooding or groundwater fluctuations result in periods of wetting and drying. Therefore, it is recommended that the structural engineer consider corrosion where steel utilities or steel retaining wall components are included in the design.

With regard to soil corrosivity to concrete, based upon the Soil Survey data and water soluble sulfate concentrations in the native soils, the risk of corrosion of concrete is high. In general, Type V cement is indicated by the International Building Code. However, Type V cement can be difficult to obtain in Western Colorado. Where Type V cement is unavailable, a minimum of Type I-II sulfate resistant cement is recommended

7.5 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. However, below and/or near the water table, the native soils are anticipated to tend to slough. As a result, shoring and or very shallow cut slopes may be required in some areas where the trail is immediately adjacent to Little Salt Wash or the Colorado River.

7.6 Trail Pavements

Based upon the results of the subsurface investigation and the anticipated earthwork, the trail subgrade may consist of materials ranging from granular fill to moderately plastic clay. In addition, HBET understands that maintenance traffic will likely use the trail. In general, it is recommended that the trail consist of 6-inches of concrete above 6-inches of base course.

Prior to trail construction, the prism should be stripped of all topsoil, uncontrolled fill, or other unsuitable materials. It is recommended that soils in the subgrade be scarified to a depth of 12 inches 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.

Aggregate base course should be placed in maximum 9-inch loose lifts, moisture conditioned, and compacted to a minimum of 95% of the maximum dry density, within ±2% 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 concrete pavement 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 trail 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. All pavements should conform to applicable local specifications.

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. 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 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

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

FIGURES

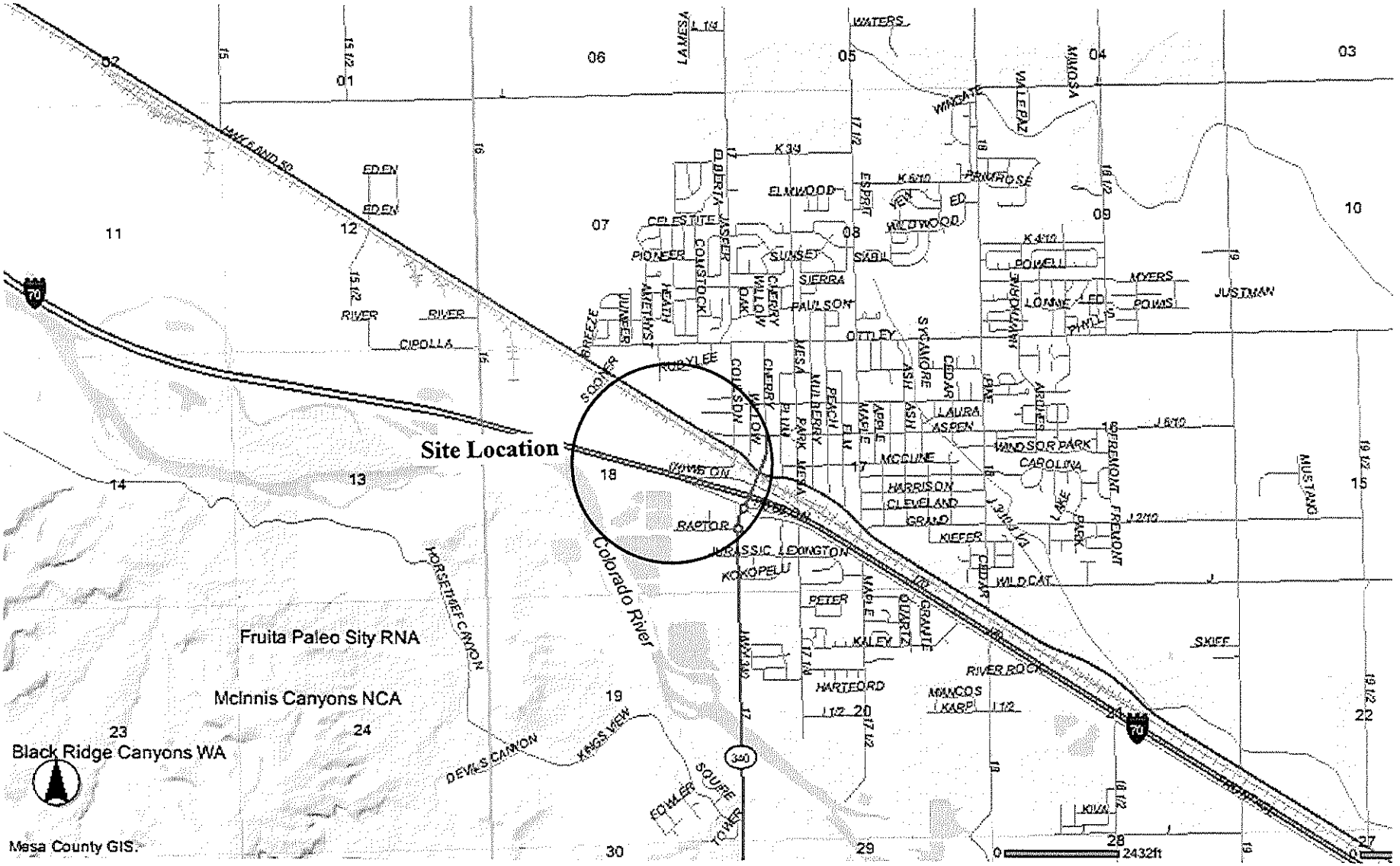


FIGURE 1
Site Location Map

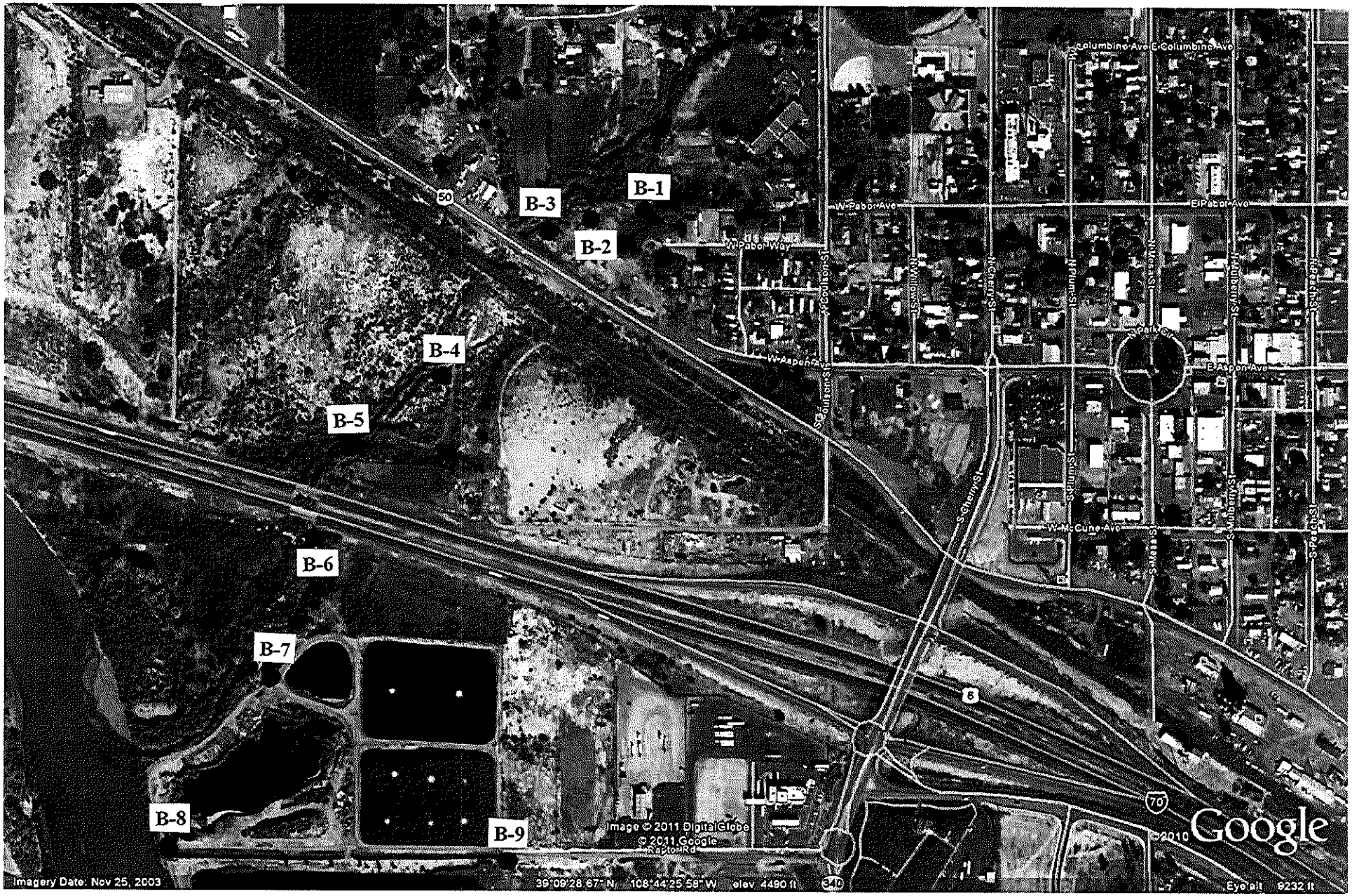
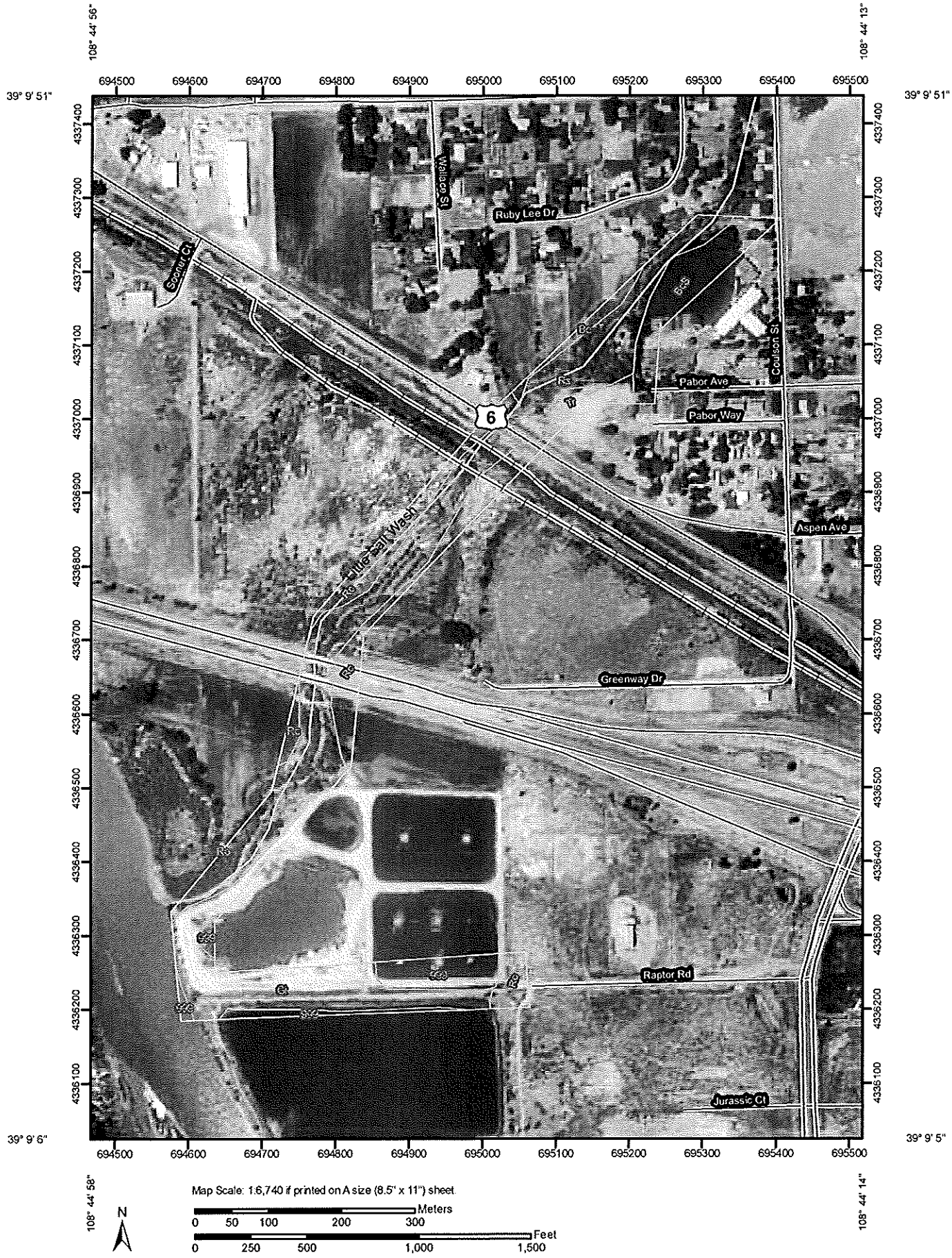


FIGURE 2
Site Plan

APPENDIX A
Soil Survey Data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108° 44' 13"
39° 9' 51"
39° 9' 6"
39° 9' 5"
108° 44' 58"
108° 44' 14"
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694700
694800
694900
695000
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4337100
4337000
4336900
4336800
4336700
4336600
4336500
4336400
4336300
4336200
4336100
Wallace St
Ruby Lee Dr
Gerald Ct
Pabor Ave
Pabor Way
Coulson St
6
Aspen Ave
Little Bell Wash
Greenway Dr
Raptor Rd
Jurassic Ct
Map Scale: 1:6,740 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1,000 1,500

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: 1:6,740 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: 8/1/1993; 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**
999	Water	2.7	8.1%
Bc	Sagers silty clay loam, 0 to 2 percent slopes	0.6	1.8%
BcS	Sagers silty clay loam, saline, 0 to 2 percent slopes	3.1	9.4%
Gt	Glenton very fine sandy loam, 0 to 2 percent slopes	6.6	19.7%
Rc	Fruitland sandy clay loam, 0 to 2 percent slopes	6.0	17.9%
Ro	Bebeevar-Green River-Riverwash, 0 to 2 percent slopes	0.0	0.0%
Rs	Ustifluvents, 0 to 2 percent slopes	13.4	40.2%
Tr	Turley clay loam, 0 to 2 percent slopes	0.9	2.8%
Totals for Area of Interest		**33.3**	**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

999—Water

Bc—Sagers silty clay loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 5,900 feet
Mean annual precipitation: 5 to 8 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition
Sagers and similar soils: 90 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

BcS—Sagers silty clay loam, saline, 0 to 2 percent slopes

Map Unit Setting
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 5 to 8 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition
Sagers, saline, and similar soils: 90 percent

Description of Sagers, Saline

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: Moderately saline to strongly saline (16.0 to 32.0 mmhos/cm)
Available water capacity: Very low (about 3.0 inches)

Interpretive groups
Land capability (nonirrigated): 8s

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

Gt—Glenton very fine sandy loam, 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
Glenton and similar soils: 90 percent

Description of Glenton

Setting
Landform: Alluvial fans, flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

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): High (2.00 to 6.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: Rare

Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Available water capacity: Moderate (about 8.1 inches)

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

Typical profile
0 to 14 inches: Very fine sandy loam
14 to 60 inches: Stratified sandy loam to very fine sandy loam

Rc—Fruitland sandy clay loam, 0 to 2 percent slopes

Map Unit Setting
Elevation: 4,600 to 4,800 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
Fruitland and similar soils: 90 percent

Description of Fruitland

Setting
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

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 to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 7.6 inches)

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

Typical profile
0 to 8 inches: Sandy clay loam
8 to 30 inches: Stratified sandy loam to gravelly fine sandy loam
30 to 60 inches: Stratified sandy loam to fine sandy loam

Ro—Bebeevar-Green River-Riverwash, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,430 to 4,820 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 190 days

Map Unit Composition

Bebeevar and similar soils: 45 percent
Green river and similar soils: 35 percent
Riverwash: 20 percent

Description of Bebeevar

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium over sandy and gravelly alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 7s

Typical profile

0 to 9 inches: Loam
9 to 14 inches: Loam
14 to 18 inches: Fine sandy loam
18 to 32 inches: Sand
32 to 59 inches: Very cobbly sand

Description of Green River

Setting

Landform: Flood plains, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Clayey alluvium over coarse-loamy alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately 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: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to moderately saline (2.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 7.7 inches)

Interpretive groups

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

Typical profile

0 to 10 inches: Clay loam
10 to 16 inches: Fine sandy loam
16 to 24 inches: Fine sandy loam
24 to 32 inches: Fine sandy loam
32 to 44 inches: Fine sandy loam
44 to 52 inches: Fine sandy loam
52 to 60 inches: Very cobbly sand

Description of Riverwash

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly alluvium

Properties and qualities

Slope: 0 to 2 percent
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent
Available water capacity: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability (nonirrigated): 7w

Typical profile

0 to 6 inches: Very gravelly sand
6 to 60 inches: Stratified extremely gravelly coarse sand to gravelly sand

Rs—Ustifluvents, 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

Ustifluvents and similar soils: 85 percent

Description of Ustifluvents

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Saltdesert Overflow (R034XY407CO)

Typical profile

0 to 2 inches: Sandy loam
2 to 8 inches: Very fine sandy loam
8 to 22 inches: Stratified loamy sand to sandy clay loam
22 to 60 inches: Very gravelly sandy loam

Tr—Turley clay loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 4,500 to 4,800 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
Turley and similar soils: 90 percent

Description of Turley

Setting
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

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: 10 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 10.6 inches)

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

Typical profile
0 to 10 inches: Clay loam
10 to 20 inches: Fine sandy loam
20 to 30 inches: Clay loam
30 to 60 inches: Stratified loam to silty clay loam

Data Source Information

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

Roads and Streets, Shallow Excavations, and Lawns and Landscaping

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. This table shows the degree and kind of soil limitations that affect local roads and streets, shallow excavations, and lawns and landscaping.

The ratings in the table are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Report—Roads and Streets, Shallow Excavations, and Lawns and Landscaping

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Roads and Streets, Shallow Excavations, and Lawns and Landscaping– Mesa County Area, Colorado							
Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
Bc—Sagers silty clay loam, 0 to 2 percent slopes							
Sagers	90	Somewhat limited		Somewhat limited		Not limited	
		Shrink-swell	0.50	Cutbanks cave	0.10		
BcS—Sagers silty clay loam, saline, 0 to 2 percent slopes							
Sagers, saline	90	Somewhat limited		Somewhat limited		Very limited	
		Shrink-swell	0.50	Cutbanks cave	0.10	Salinity	1.00
						Droughty	0.98

Roads and Streets, Shallow Excavations, and Lawns and Landscaping– Mesa County Area, Colorado							
Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
Gt—Glenton very fine sandy loam, 0 to 2 percent slopes							
Glenton	90	Somewhat limited		Somewhat limited		Not limited	
		Flooding	0.40	Depth to saturated zone	0.15		
				Cutbanks cave	0.10		
Rc—Fruitland sandy clay loam, 0 to 2 percent slopes							
Fruitland	90	Not limited		Somewhat limited		Not limited	
				Cutbanks cave	0.10		
Ro—Bebeevar-Green River-Riverwash, 0 to 2 percent slopes							
Bebeevar	45	Somewhat limited		Very limited		Somewhat limited	
		Flooding	0.40	Cutbanks cave	1.00	Droughty	0.01
				Depth to saturated zone	0.95		
Green river	35	Somewhat limited		Very limited		Not rated	
		Flooding	0.40	Cutbanks cave	1.00		
				Depth to saturated zone	0.95		
Riverwash	20	Not rated		Not rated		Not rated	
Rs—Ustifluvents, 0 to 2 percent slopes							
Ustifluvents	85	Very limited		Very limited		Somewhat limited	
		Flooding	1.00	Cutbanks cave	1.00	Flooding	0.60
				Depth to saturated zone	0.73	Droughty	0.10
				Flooding	0.60		
Tr—Turley clay loam, 0 to 2 percent slopes							
Turley	90	Not limited		Somewhat limited		Not limited	
				Cutbanks cave	0.10		

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*			
Bc—Sagers silty clay loam, 0 to 2 percent slopes									
Sagers		—	—		0	—	Low	High	Moderate
BcS—Sagers silty clay loam, saline, 0 to 2 percent slopes									
Sagers, saline		—	—		0	—	Low	High	High
Gt—Glenton very fine sandy loam, 0 to 2 percent slopes									
Glenton		—	—		0	—	Low	High	High
Rc—Fruitland sandy clay loam, 0 to 2 percent slopes									
Fruitland		—	—		0	—	Low	Moderate	Low
Ro—Bebeevar-Green River-Riverwash, 0 to 2 percent slopes									
Bebeevar		—	—		0	—	Low	High	High
Green river		—	—		0	—	Low	High	High
Riverwash		—	—		0	—	Low	High	Low

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*			
Rs—Ustifluvents, 0 to 2 percent slopes									
Ustifluvents		—	—		0	—	Low	High	High
Tr—Turley clay loam, 0 to 2 percent slopes									
Turley		—	—		0	—	Low	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 River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/20/11 COMPLETED 5/20/11
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 AS 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		Clayey SAND and GRAVEL with Organics and Debirs (FILL), brown, moist, medium dense										
		Silty SAND (SM) tan to gray, dry to moist, loose to medium dense										
2.5		GB1: Lab Classified	GB 1					5	NP	NP	NP	32
5.0			MC 1	83	5-8-9 (17)		98	20				
7.5												
10.0		Silty Sandy CLAY (cl), reddish brown to gray, moist, stiff, abundant sulfates										
12.5												
			SS 1	100	4-4-4-4 (8)							
15.0		Bottom of hole at 15.0 feet.										

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

BORING NUMBER B-2

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/20/11 COMPLETED 5/20/11
GROUND ELEVATION ___ HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
AT TIME OF DRILLING 14.8 ft
LOGGED BY AS CHECKED BY MAB
AT END OF DRILLING 14.8 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	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Silty SAND with Gravel and Organics (FILL), red, dry to moist, loose										
		Sandy CLAY with Gravel (FILL), brown to dark gray, moist, stiff										
5			SS 1	17	2-3-4-5 (7)							
		Sandy SILT (ml), brown to gray, moist, loose, organics present										
10			SS 2	100	2-4-4-7 (8)							
		Silty SAND (sm), gray to white, moist to wet, medium dense to very loose										
15			SS 3	100	3-1-1-2 (2)							
		Silty Clay (cl), brown to light red, moist, soft, abundant sulfates										
		Bottom of hole at 17.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
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Grand Junction, CO 81501
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970-255-6818

BORING NUMBER B-3

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/20/11 COMPLETED 5/20/11
GROUND ELEVATION ____ HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
▽ AT TIME OF DRILLING 8.0 ft
LOGGED BY AS CHECKED BY MAB
▼ AT END OF DRILLING 8.0 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		Silty SAND with Organics (TOPSOIL), brown, moist										
		Silty SAND (sm), with thin clayey sand lenses and gravel lenses, brown to gray, moist to wet, loose to medium dense										
2.5			MC 1	75	3-6-8-9 (14)							
5.0												
7.5												
10.0			SS 1	92	3-14-14-15 (28)							
		Sandy GRAVEL (gw), gray, wet, medium dense to dense										
12.5												
		Bottom of hole at 14.5 feet.										

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

BORING NUMBER B-4

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/23/11 COMPLETED 5/23/11
GROUND ELEVATION ___ HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
AT TIME OF DRILLING 6.5 ft
LOGGED BY AS CHECKED BY MAB
AT END OF DRILLING 6.5 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		Silty SAND (sm), with silty clay lenses, brown, reddish brown and dark gray, moist to wet, loose to medium dense	GB 1									
			SS 1	67	4-5-6-6 (11)							
5												
10		Interbedded layers of Silty CLAY (cl) and Sandy SILT (ml), reddish brown to gray, moist to wet, stiff and very loose	SS 2	100	1-2-4-6 (6)							
15		Sandy GRAVEL (gw), brown, wet, dense	SS 3	83	17-17-20 (37)							
		Bottom of hole at 16.3 feet.										

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

BORING NUMBER B-5

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/23/11 COMPLETED 5/23/11
GROUND ELEVATION ____ HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
AT TIME OF DRILLING 8.0 ft
LOGGED BY AS CHECKED BY MAB
AT END OF DRILLING 8.0 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		Silty SAND (sm) with clayey sand lenses, brown to gray, moist to wet, very loose to medium dense, abundant sulfates										
2.5			MC 1	89	3-4-7 (11)							
			GB 1									
5.0												
7.5			SS 1	46	1-0-0-1 (0)							
10.0												
12.5												
15.0			SS 2	100	3-2-6-6 (8)							
		Bottom of hole at 15.0 feet.										

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BORING NUMBER B-6

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/20/11 COMPLETED 5/20/11
GROUND ELEVATION ____ HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
AT TIME OF DRILLING 7.0 ft
LOGGED BY AS CHECKED BY MAB
AT END OF DRILLING 7.0 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		Clayey SAND with Organics (TOPSOIL), brown, moist										
2.5		Silty SAND (sm), with gravel lenses, brown, moist, loose										
5.0		Sandy GRAVEL (gw), brown, moist to wet, medium dense to dense	SS 1	78	5-16-20-26/0"							
		Bottom of hole at 7.0 feet.										

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BORING NUMBER B-7

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/20/11 COMPLETED 5/20/11
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 (%)
0.0		Sandy GRAVEL and COBBLES (FILL), brown, moist, dense										
		Sandy SILT (ML), with silty sand lenses, brown to gray, moist to wet, very loose										
2.5		SS1: Lab Classified	SS 1	88	2-2-2-2 (4)			26	22	21	1	55
5.0												
7.5												
10.0		Silty SAND (sm), gray, wet, loose	SS 2	100	2-1-2-3 (3)							
12.5		Sandy GRAVEL (gw), brown, wet, medium dense to dense										
		Bottom of hole at 14.0 feet.										

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BORING NUMBER B-8

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/20/11 COMPLETED 5/20/11
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 AS 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		Clayey SAND and GRAVEL (FILL), brown, moist, dense										
2.5		Silty SAND (sm), brown, moist, loose										
5.0			SS 1	17	3-3-3-2 (6)							
7.5		Sandy GRAVEL (gw), brown, wet, dense										
		Bottom of hole at 9.0 feet.										

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BORING NUMBER B-9

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO
DATE STARTED 5/20/11 COMPLETED 5/20/11
GROUND ELEVATION ____ HOLE SIZE 4"
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 2000 Truck Rig
AT TIME OF DRILLING 10.0 ft
LOGGED BY AS CHECKED BY MAB
AT END OF DRILLING 10.0 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 and Gravel (FILL), brown, moist										
		Lean CLAY with Sand (CL), sandy silt lenses, trace gravel, brown to gray, moist, soft to stiff, abundant sulfates GB1: Lab Classified	GB 1					2	39	15	24	80
2.5			MC 1	89	5-5-6 (11)		94	27				
5.0												
7.5			SS 1	83	1-2-1-2 (3)							
		Silty SAND (sm), brown, very moist, very loose										
10.0		Sandy GRAVEL (gw), brown, wet, medium dense to dense										
12.5			SS 2	0	9-9-14 (23)							
		Bottom of hole at 14.5 feet.										

APPENDIX C
Laboratory Testing Results

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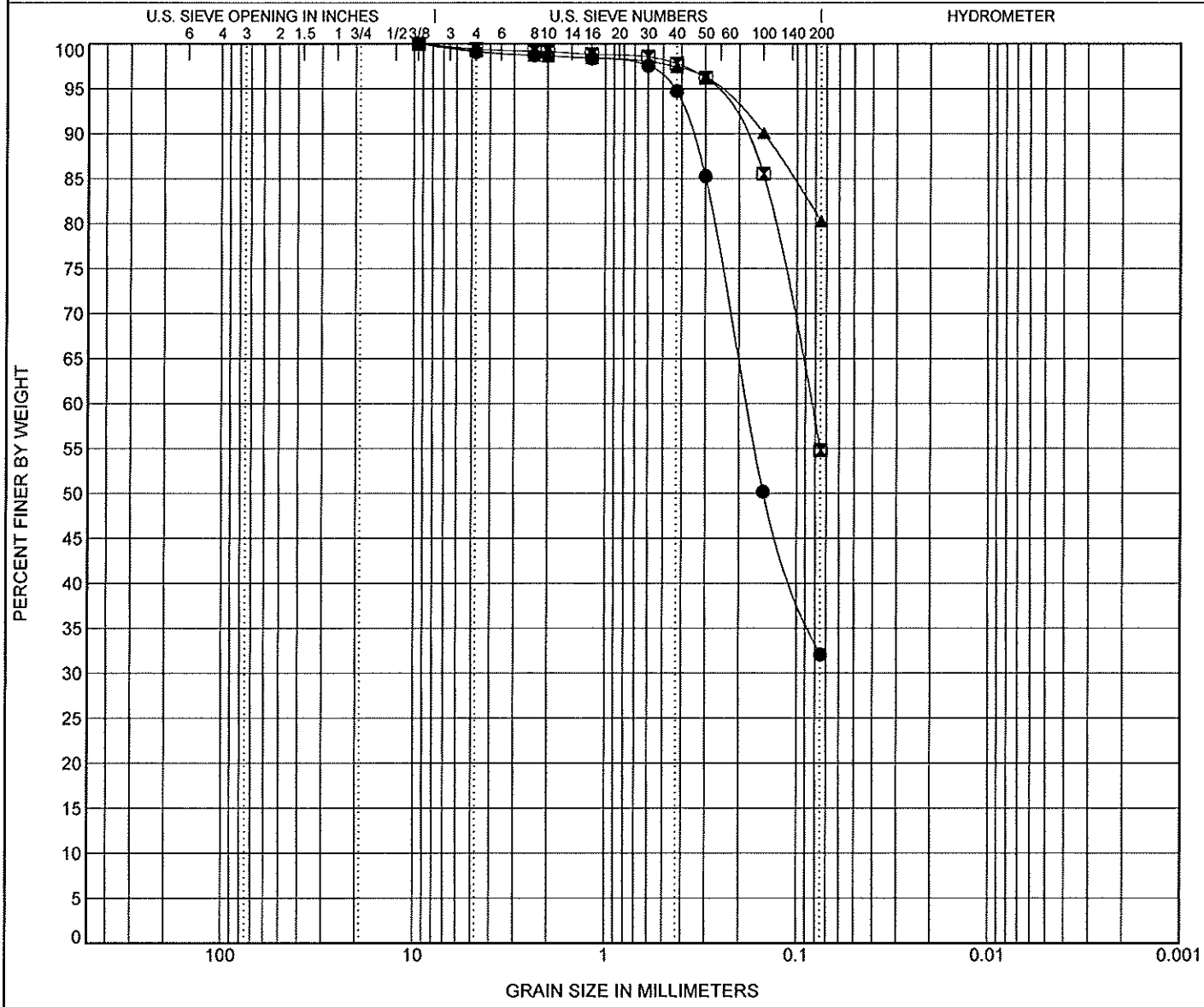
GRAIN SIZE DISTRIBUTION

CLIENT River City Consultants **PROJECT NAME** Lower Little Salt Wash

PROJECT NUMBER 00456-0006 **PROJECT LOCATION** Fruita, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-1 GB-1 5/2011	SILTY SAND(SM)	NP	NP	NP		
⊠ B-7 SS-1 5/2011	SANDY SILT(ML)	22	21	1		
▲ B-9 GB-1 5/2011	LEAN CLAY with SAND(CL)	39	15	24		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1 GB-1 5/2011	9.5	0.182			0.9	67.0	32.1	
⊠ B-7 SS-1 5/2011	9.5	0.084			0.6	44.6	54.8	
▲ B-9 GB-1 5/2011	9.5				0.8	18.9	80.3	

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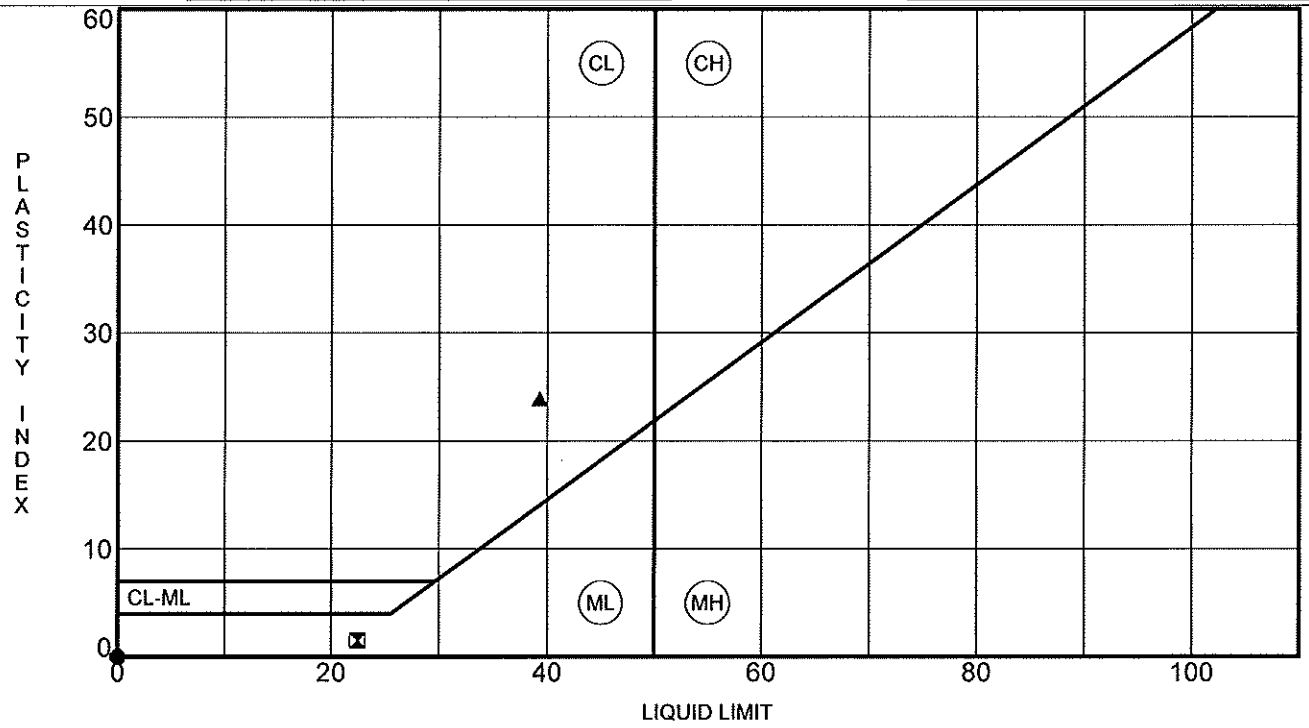
ATTERBERG LIMITS' RESULTS

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	B-1 GB-1	5/20/2011	NP	NP	NP	32	SILTY SAND(SM)
⊠	B-7 SS-1	5/20/2011	22	21	1	55	SANDY SILT(ML)
▲	B-9 GB-1	5/20/2011	39	15	24	80	LEAN CLAY with SAND(CL)

ATTERBERG LIMITS 00456-0006 LOWER LITTLE SALT WASH.GPJ GINT US LAB.GDT 6/17/11

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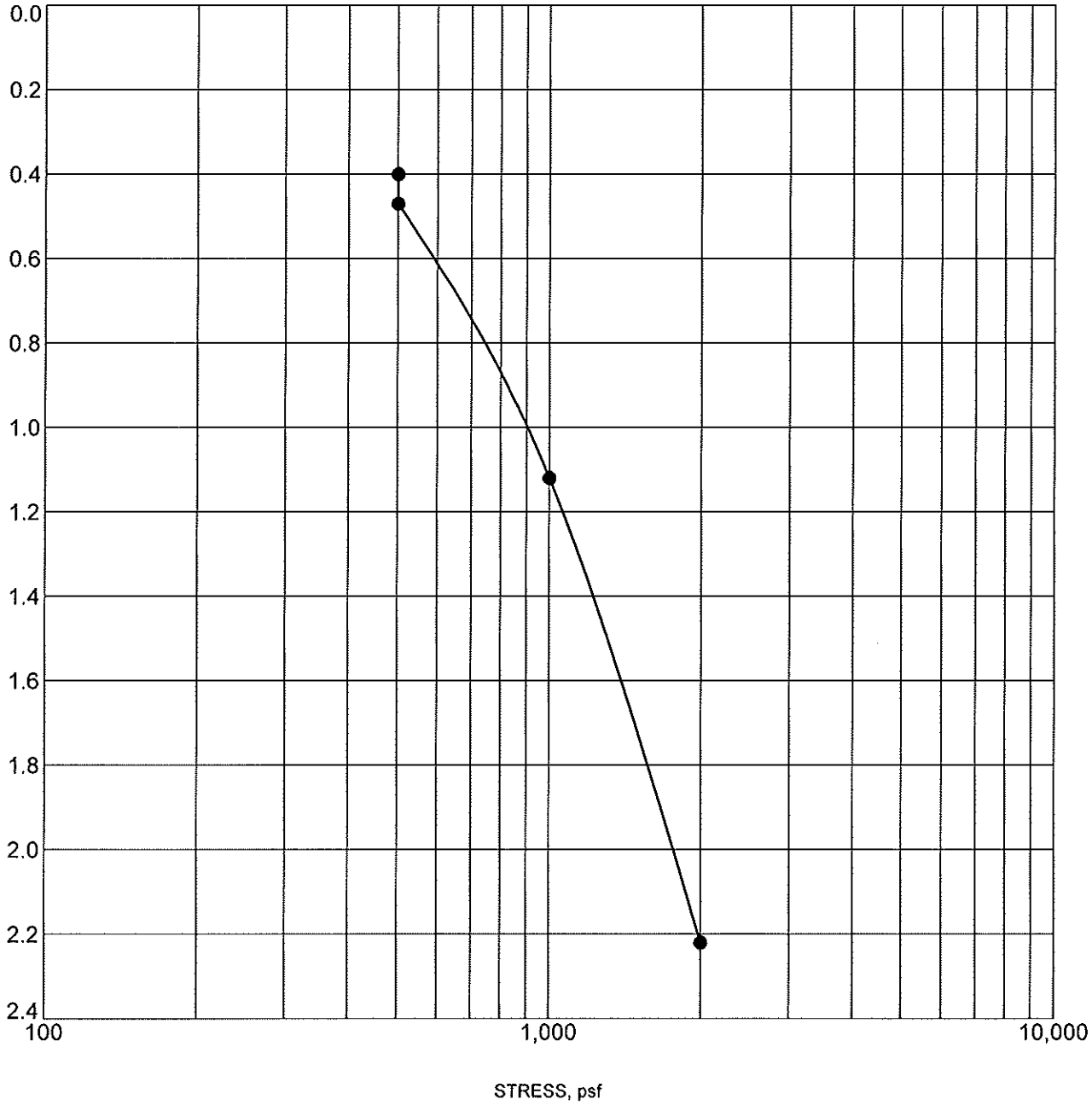
CONSOLIDATION TEST

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO



Specimen Identification		Classification	γ_d	MC%
● B-1	5.0		98	20

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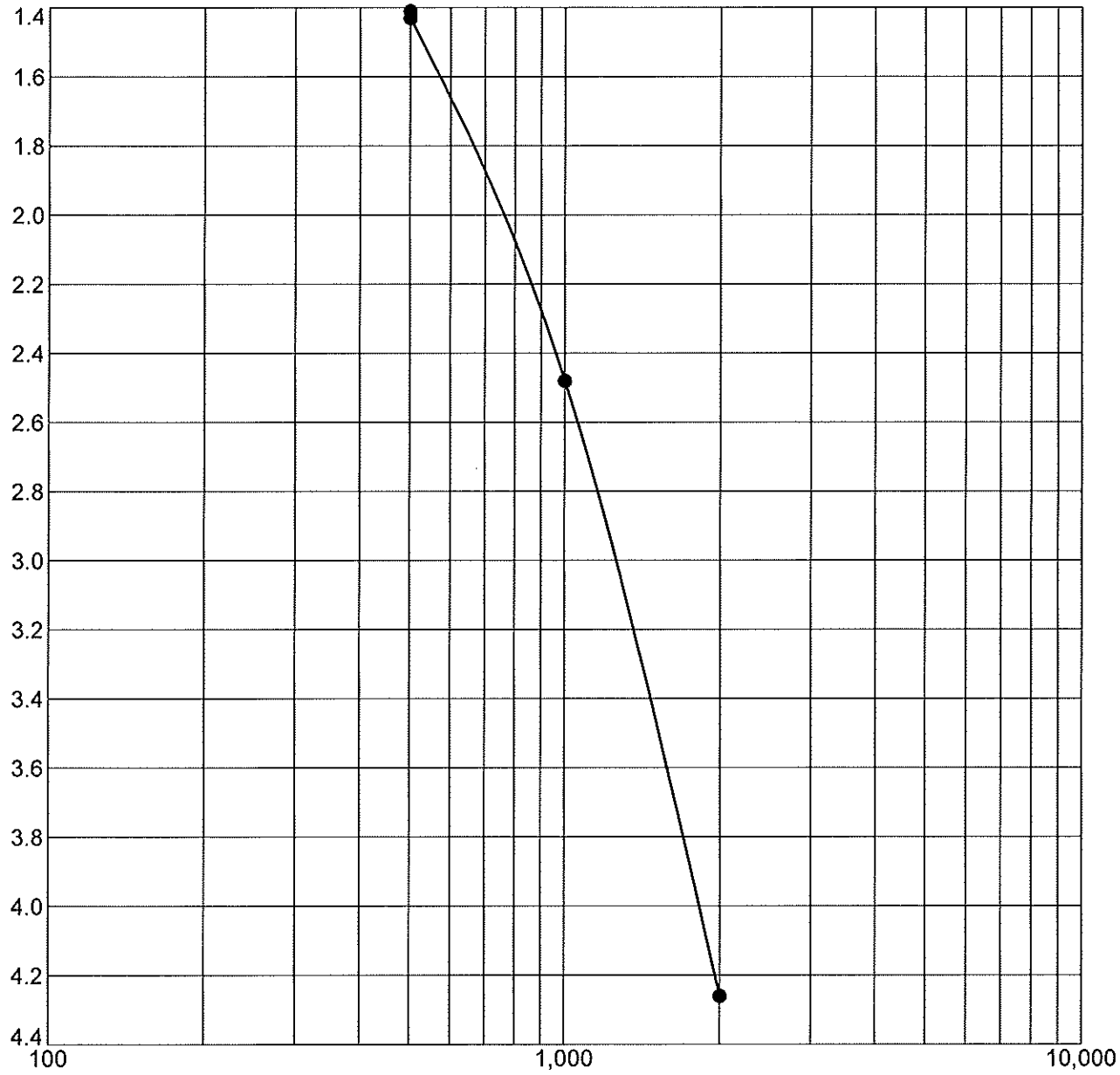
CONSOLIDATION TEST

CLIENT River City Consultants **PROJECT NAME** Lower Little Salt Wash

PROJECT NUMBER 00456-0006 **PROJECT LOCATION** Fruita, CO



Specimen Identification		Classification	γ_d	MC%
● B-9	2.0		94	27

CONSOL STRAIN 00456-0006 LOWER LITTLE SALT WASH.GPJ GINT US LAB.GDT 6/17/11

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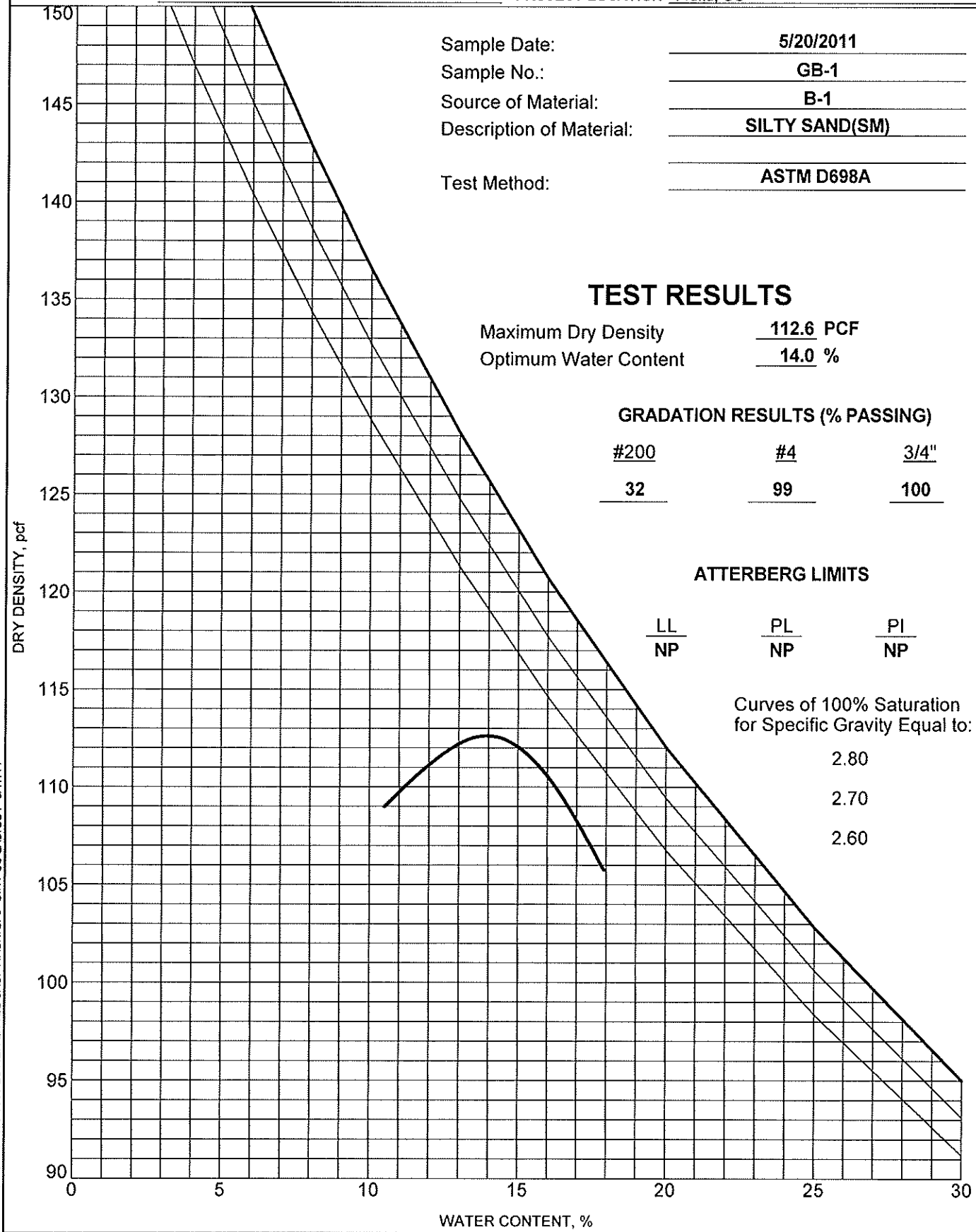
MOISTURE-DENSITY RELATIONSHIP

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO



Sample Date: 5/20/2011
Sample No.: GB-1
Source of Material: B-1
Description of Material: SILTY SAND(SM)

Test Method: ASTM D698A

TEST RESULTS

Maximum Dry Density 112.6 PCF
Optimum Water Content 14.0 %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
32	99	100

ATTERBERG LIMITS

LL	PL	PI
NP	NP	NP

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

COMPACTION 00456-0006 LOWER LITTLE SALT WASH.GPJ GINT US LAB.GDT 6/17/11

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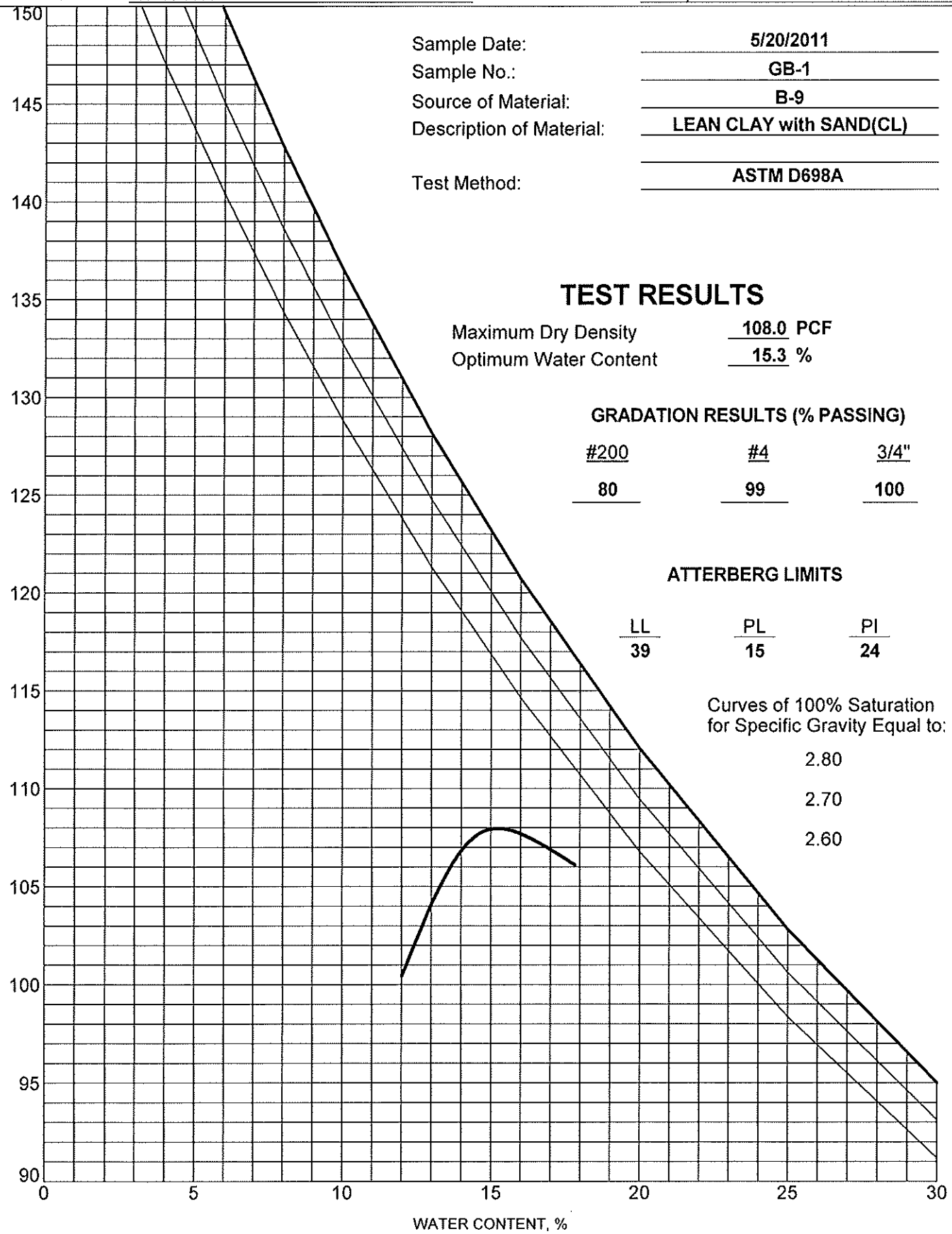
MOISTURE-DENSITY RELATIONSHIP

CLIENT River City Consultants
PROJECT NAME Lower Little Salt Wash
PROJECT NUMBER 00456-0006
PROJECT LOCATION Fruita, CO



Sample Date: 5/20/2011
Sample No.: GB-1
Source of Material: B-9
Description of Material: LEAN CLAY with SAND(CL)
Test Method: ASTM D698A

TEST RESULTS

Maximum Dry Density 108.0 PCF
Optimum Water Content 15.3 %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
80	99	100

ATTERBERG LIMITS

LL	PL	PI
39	15	24

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.:	00456-0006		**Authorized By:**	Client	**Date:** 05/20/11
Project Name:	Lower Little Salt Wash Trail		**Sampled By:**	AS	**Date:** 05/20/11
Client Name:	River City Consultants		**Submitted By:**	AS	**Date:** 05/20/11
Sample Number:	11-0291	**Location:** B-9 GB1	**Reviewed By:**	MAB	**Date:** 06/16/11

Compaction Method ASTM D698, Method A

Maximum Dry Density (pcf): 112.6

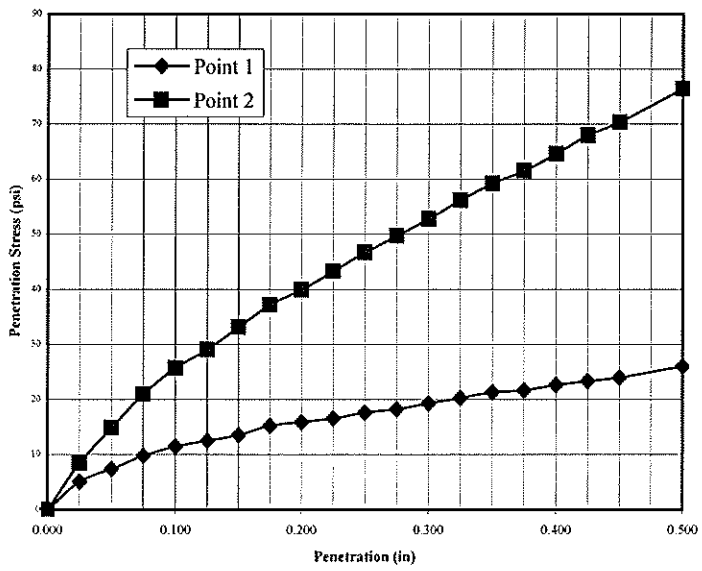
Opt. Moisture Content (%): 14.0

Sample Condition: Soaked

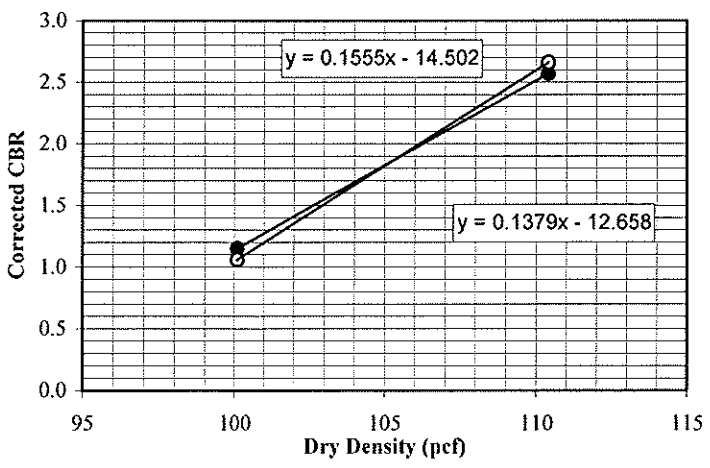
Remarks:

		Sample Data		
		Point 1	Point 2	
Blows per Compacted Lift:		15	56	
Surcharge Weight (lbs):		10.0	10.0	
Dry Density Before Soak (pcf):		100.1	110.4	
Dry Density After Soak (pcf):		97.3	107.7	
Moisture Content (%)	Bottom Pre-Test	15.2	13.7	
	Top Pre-Test	14.7	13.6	
	Top 1" After Test	30.7	23.4	
	Average After Soak:	22.1	18.0	
Percent Swell After Soak:		2.9	2.5	

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		
0.025	15	5	0.025	25	8	0.025		
0.050	22	7	0.050	44	15	0.050		
0.075	29	10	0.075	62	21	0.075		
0.100	34	12	0.100	76	26	0.100		
0.125	37	13	0.125	86	29	0.125		
0.150	40	14	0.150	98	33	0.150		
0.175	45	15	0.175	110	37	0.175		
0.200	47	16	0.200	118	40	0.200		
0.225	49	17	0.225	128	43	0.225		
0.250	52	18	0.250	138	47	0.250		
0.275	54	18	0.275	147	50	0.275		
0.300	57	19	0.300	156	53	0.300		
0.325	60	20	0.325	166	56	0.325		
0.350	63	21	0.350	175	59	0.350		
0.375	64	22	0.375	182	62	0.375		
0.400	67	23	0.400	191	65	0.400		
0.425	69	23	0.425	201	68	0.425		
0.450	71	24	0.450	208	70	0.450		
0.500	77	26	0.500	226	76	0.500		

Corrected CBR @ 0.1"		
1.2	2.6	
Corrected CBR @ 0.2"		
1.1	2.7	

Penetration Distance Correction (in)		
0.000	0.000	0.000

Figure: ____