Soil Investigation Report
US 50 Sewer Line Replacement Project
Grand Junction, Colorado

Prepared for:

City of Grand Junction
333 West Avenue, Building C
Grand Junction, Colorado 81501

Attention: Mr. Ken Haley, PE
Engineering Manager

March 14, 2022

Prepared by:

RockSol Consulting Group, Inc.
566 W Crete Circle, Unit 2
Grand Junction, Colorado 81505
(970)-822-4350

RockSol Project No. 599.46

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ATTACHMENTS

1.0 PROJECT PURPOSE AND DESCRIPTION

This report documents the soil investigation performed by RockSol Consulting Group, Inc. (RockSol) to assist with characterization of constructability/excavation of the US 50 Sewer Line Replacement Project in Grand Junction, Colorado. For this project, a 12-inch diameter sewer line is planned along US 50 starting approximately 150 feet west of Palmer Street and extending northwest to James Street, including approximately 400 feet within James Street. An additional 8-inch diameter sewer line is planned within Linden Avenue and will extend from B ½ Road north approximately 500 feet. The 12-inch and 8-inch sewer lines are proposed to be embedded to depths of 8 feet to 12 feet below existing grades. The soil investigation program was conducted to obtain information on the subsurface soil and bedrock condition and depth to groundwater, if encountered, for the proposed sewer line installation. Alignment of the sewer along US 50 is within CDOT right of way (ROW). Alignment of the sewer along James Street and Linden Avenue is within the City of Grand Junction (City) ROW.

The scope of work for this geotechnical investigation included:

- Preparing a drilling/sampling program to perform a subsurface investigation and implementing the program to collect soil samples for laboratory testing.
- Performing laboratory tests and analyzing the data.
- Preparing a soil investigation report presenting the field and laboratory data obtained, geological conditions, and constructability/excavation characterization for the proposed sewer line excavation and backfill.

2.0 PROJECT SITE CONDITIONS

The project site is located in a southern area of Grand Junction, Colorado, approximately 2,000 linear feet south of the Colorado River (see Image 1). The immediate surrounding areas include residential, commercial, and open space properties. Approximately 320 feet of the 500 foot 8-inch diameter sewer line will be located in front of Dos Rios Elementary School (see Appendix A).

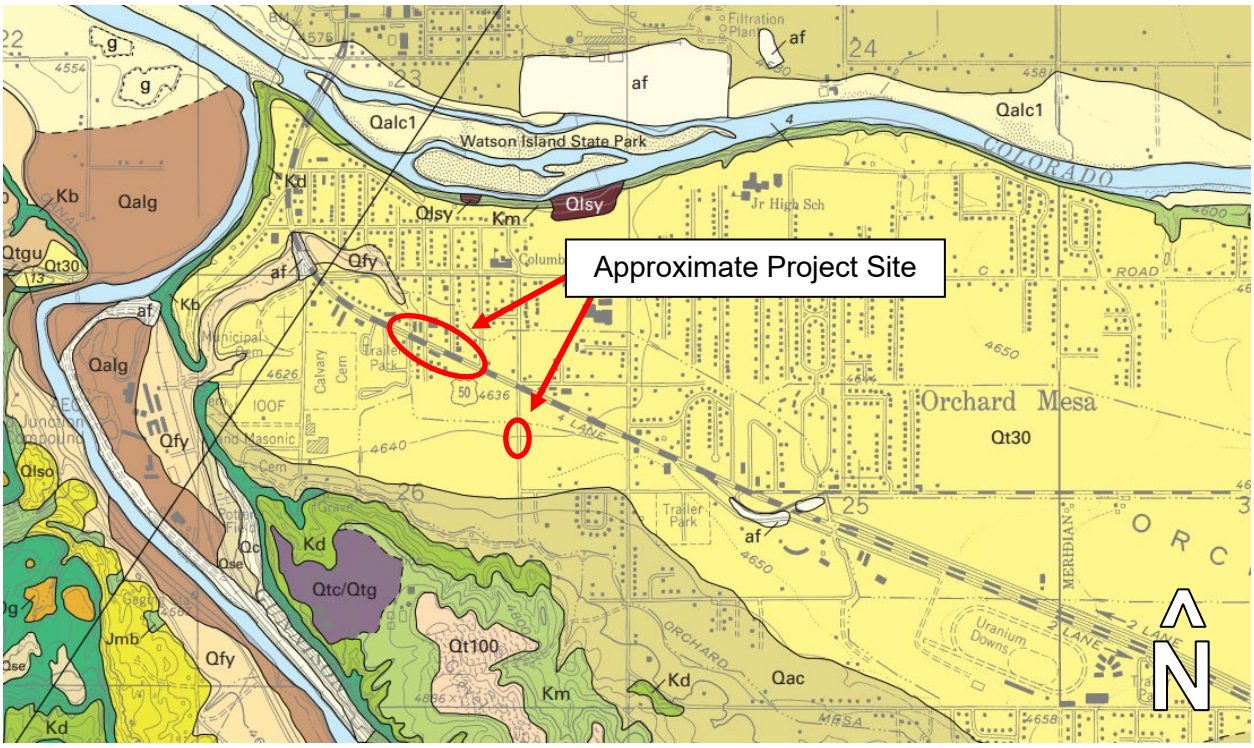
Image 1 –Site Vicinity Map

3.0 GEOLOGICAL SETTING

Geologic information about the project site and site vicinity is presented in the United States Geological Survey (USGS) *Geologic Map of the Grand Junction Quadrangle, Mesa County, Colorado* by Robert B. Scott, Paul E. Carrara, William C. Hood, and Kyle E. Murray, dated 2002 (See Image 2, Site Geology Map).

Based on the USGS map, terrace Alluvium 30 of the Colorado River (middle Pleistocene) (Qt30) is mapped at the project site and majority of the surrounding areas. Alluvium generally consists of silt, sand and gravels. A deposit of young fan-Alluvium and debris-flow deposits (Holocene) (Qfy) is mapped directly northwest of the western most end of the project site. Young fan-Alluvium and debris-flow deposits are typically described as non-cemented alluvial gravel with interbedded sand. The materials identified by the USGS mapping are consistent with native soils encountered during our geotechnical investigation.

Image 2 – Site Geology Map (USGS)



4.0 SUBSURFACE EXPLORATION

For this investigation, RockSol completed 4 boreholes identified as B-1 through B-4 for characterization of subsurface conditions, including groundwater depths, to assist with trench excavation considerations. See Image 3 and Appendix A for the borehole locations.

Image 3 – Borehole Location Map

Boreholes B-1 through B-4 extend to approximate depths ranging from 11 feet to 12 feet below existing grades. Borehole B-1 was drilled on James Street at the driveway of address 540 James Street. Borehole B-2 was drilled on the southbound US 50 shoulder approximately 660 feet east of James Street. Borehole B-3 was drilled on the southbound US 50 shoulder approximately 130 feet west of Aspen Street. Borehole B-4 was drilled in the northbound lane of Linden Avenue approximately 240 feet north of B ½ Road.

The boreholes were drilled on February 10, 2022. Boreholes were advanced with a Simco 2800 drill rig using 6-inch outside diameter solid stem. The boreholes were logged in the field by a representative of RockSol with the depth to groundwater, if encountered, noted at the time of drilling. The boreholes were backfilled at the completion of drilling.

Subsurface materials were sampled as bulk samples from auger cuttings. Penetration resistance values (blow counts) were not recorded at any borehole location for this project. Depths at which the samples were taken are shown on the Borehole Logs (See Appendix B).

5.0 SURFICIAL AND SUBSURFACE CHARACTERIZATION

5.1 Surficial Materials

Hot Mix Asphalt (HMA) pavement was encountered at the ground surface of each borehole location. Immediately under the HMA pavement was approximately 4 inches of class 6 Aggregate base course (ABC). A summary of the pavement thicknesses obtained is shown in Table 1.

Table 1 – Pavement Section

Borehole ID	Hot Mix Asphalt Approximate Thickness (inches)	Class 6 ABC Approximate Thickness (inches)	General Location
B-1	4	4	James Street (City ROW)
B-2	6	4	Southbound US 50 shoulder (CDOT ROW)
B-3	6	4	Southbound US 50 shoulder (CDOT ROW)
B-4	4	4	Northbound Linden Avenue (City ROW)

Note 1: ABC indicates Aggregate Base Coarse
Note 2: ROW indicates Right of Way

See Appendix B for copies of the borehole logs.

5.2 Subsurface Materials

B-1

Subsurface materials encountered consisted of a sandy gravel fill material overlying a native clayey sand, underlain by a silty with sand, gravel to the maximum depth explored of 12 feet below existing grades.

B-2

Subsurface materials encountered consisted of a sandy gravel fill material overlying a clayey with gravel sand fill material associated with adjacent gas and sewer line trench backfill. The trench backfill was underlain by a clayey with sand, gravel to the maximum depth explored of 11 feet below existing grades.

B-3

Subsurface materials encountered consisted of a sandy gravel fill material overlying a native clayey sand, underlain by 2 feet of a gravel, and further underlain by a clayey with sand gravel with 3” to 4” cobbles to the maximum depth explored of 12 feet below existing grades.

B-4

Subsurface materials encountered consisted of a sandy gravel fill material overlying a native clayey with gravel sand, underlain by 4 feet of sandy clay, and further underlain by a silty and sandy clay to the maximum depth explored of 12 feet below existing grades.

Borehole logs detailing the subsurface materials encountered are included in Appendix B.

5.3 Sedimentary Bedrock

Sedimentary bedrock was not encountered to the maximum depths of 11 to 12 feet below existing grades at any of the borehole locations.

5.4 Groundwater

Groundwater was not encountered during drilling/sampling activities at any borehole location to the maximum depths drilled at the time of drilling operations.

Groundwater elevations are subject to change depending on climatic conditions, Colorado River flow stages, local irrigation practices, changes in local topography, and changes in surface storm water management. Long-term monitoring of groundwater elevations is required to establish groundwater fluctuations.

6.0 LABORATORY TESTING SUMMARY

Soil samples retrieved from borehole locations were examined by the project geotechnical engineer in the RockSol laboratory. Selected samples were tested and classified according to the Unified Soil Classification System (USCS). The following laboratory tests were performed in accordance with the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), and current local practices:

- Percent Passing No. 200 Sieve (ASTM D-1140)
- Liquid and Plastic Limits (ASTM D-4318)
- Soil Classification (ASTM D-2487, ASTM D-2488, and AASHTO M145)
- Gradation (ASTM D6913)
- Moisture/Density Relationship (Proctor) (AASHTO T99 Method A)

Laboratory test results were used to characterize the engineering properties of the subsurface material. For soil classification, RockSol conducted sieve analyses and Atterberg Limits tests. All laboratory tests were performed by RockSol. Laboratory test results are presented in Appendix C. Please note that soil gradation curves are approximate and do not reflect all oversized material excavated and present in the site soil stratigraphy.

7.0 SUBSURFACE CHARACTERIZATION

Laboratory test results were used to characterize the engineering properties of the subsurface material encountered. For soil classification, RockSol conducted sieve analyses and Atterberg Limits tests. A summary of the test results is included in Appendix C.

7.1 Subsurface Soil Classification

Subsurface bulk samples were obtained at various depths from each borehole location and were tested for AASHTO and USCS soil classification. The subsurface soils tested varied between A-1-b and A-6 (3) AASHTO soil types. A summary of the subsurface soil classifications is presented in Table 2.

Table 2 – Subgrade Soil Classifications

Borehole Location	Depth (feet)	AASHTO Classification	USCS Classification
B-1	2-4	A-6 (3)	CL
B-1	4-12	A-1-b (0)	GM

B-2	3-5	A-6 (1)	SC
B-2	5-11	A-2-4 (0)	GC
B-3	2-5	A-2-6 (0)	SC
B-3	5-7	A-2-6 (0)	GP
B-3	7-12	A-2-6 (0)	GC
B-4	2-4	A-6 (2)	SC
B-4	4-8	A-4 (2)	CL
B-4	8-12	A-4 (0)	CL-ML

8.0 TRENCH EXCAVATION DISCUSSION

Based on information provided by the City of Grand Junction, RockSol understands excavations on the order of 8 feet to 12 feet will be required along the sewer pipe alignment.

Based on the materials encountered, RockSol anticipates the materials are excavatable with standard excavation equipment typically used for sewer line construction. Hard bedrock is not anticipated to the proposed depths. Trench boxes and/or sloped excavations are anticipated to allow for construction. Groundwater was not encountered; however, very moist soils may be encountered in the lower portions of the trench excavation.

Proper construction practices and adherence to project plans and specifications should be followed during site preparation, earthwork, excavations, and construction for the suitable long-term performance of the proposed improvements. Excavation support should be provided to maintain onsite safety and the stability of excavations and slopes. Excavations shall be constructed in accordance with local, state, and federal regulations including OSHA guidelines. The contractor must provide a competent person to determine compliance with OSHA excavation requirements. For preliminary planning, the fill material and native soils encountered in our boreholes may be considered as OSHA Type C soils.

9.0 TRENCH BACKFILL DISCUSSION

All embankment placement, subgrade preparation, and backfill placement shall be performed in accordance with City of Grand Junction's *Standard Contract Documents for Capital Improvements Construction,* Revised July 2010, or if more stringent, as specified by recommendations in this report.

9.1 Trench Foundation Preparation

Prior to pipeline construction, the excavation limits should be properly prepared by removal of all organic matter (topsoil), debris, loose material, and any deleterious material identified by the Project Engineer. The bottom of the trench should be prepared as a firm and uniform foundation.

9.2 Backfill Specifications

Backfill placement shall be performed in accordance with City of Grand Junction requirements. Sufficient bedding under the pipe and cover over the pipe should be used to prevent point-loading on the HDPE pipeline from the trench foundation and overlying backfill material, if excavated (native) material is allowed for backfill material after cover over the pipeline is established. To achieve proper compaction of the excavated material significant moisture conditioning is anticipated and oversized material (greater than 8-inch diameter) may need to be segregated and not allowed to be placed in the backfill zone directly above the pipe.

9.3 Compaction Specifications

The minimum compaction recommended by RockSol for this project are summarized in Tables 3 and 4 and are based on requirements outlined in CDOT Standard Specifications for Road and Bridge Construction (SSRBC), 2019, and Section 103.14 of City of Grand Junction's Standard Specifications for Construction of Underground Utilities. All sewer line alignment along US 50 will follow CDOT compaction requirements. The 400 linear feet of sewer line along James Street and 500 linear feet of sewer line along Linden Avenue will follow City requirements.

Table 3 – CDOT Compaction Specifications

Type of Material	Relative Compaction Percent of Maximum	Moisture Content Deviation from Optimum
Clay Soils A-4, A-5, A-6, and A-7	95% Min. AASHTO T-99 (Standard Proctor Method)	0% to +2% (>35% fines) -2% to +2% (≤35% fines) **Note 1**
Sands, Gravels and Silts A-1, A-2, and A-3	95% Min. AASHTO T-180 (Modified Proctor Method)	-2% to +2% As needed for compaction

Note 1: Soils with greater than 35 percent fines shall be compacted at a moisture content equal to or above OMC to achieve stability of the compacted lift. Stability is defined as the absence of rutting or pumping as observed and documented by the Contractor's Process Control Representative and as approved by the Engineer. If the soils cannot be compacted and prove to be unstable at a moisture content equal to or above OMC, then the required moisture content for compaction may be reduced below OMC if approved by the Engineer.

Table 4 – City of Grand Junction Compaction Specifications

Type of Material	Relative Compaction Percent of Maximum	Moisture Content Deviation from Optimum
All Backfill Material	95% Min. AASHTO T-99 (Standard Proctor Method)	-2% to +2%
All Backfill Material	90% Min. AASHTO T-180 (Modified Proctor Method)	-2% to +2%

Several moisture/density relationship curves (proctors) were performed on selected samples and are included in Appendix C. The proctor results indicate some variation in optimum moisture content and maximum dry density should be expected by the contractor during testing of compacted trench backfill soils.

A representative of the geotechnical engineer or the City should observe and test fill placement operations.

10.0 Roadway Pavement Restoration

Where existing roadway pavement is disturbed or removed to complete the sewer line installation, RockSol recommends the following during trench backfill operations:

- Existing HMA section must be matched but a minimum HMA thickness of 6 inches shall be placed in CDOT ROW and a minimum of 4 inches of HMA shall be placed in City ROW.
- Below all HMA a minimum of 4 inches of CDOT Class 6 ABC shall be placed and compacted.
- Place a minimum of 2 feet of Class 3 Aggregate Base Coarse (ABC) below the replaced pavement section. Where CDOT ROW is involved, the Class 3 ABC shall meet CDOT requirements. Where City ROW is involved, the Class 3 ABC shall meet City requirements.
- The disturbed or removed pavement section shall be replaced with a section that matches or exceeds the section that was in place prior to removal.
- The replaced pavement shall meet CDOT and City of Grand Junction requirements.

11.0 LIMITATIONS

This soil investigation was conducted in general accordance with the scope of work to provide geotechnical support for construction of the US 50 Sewer Replacement Project for the City of Grand Junction

Surface and groundwater hydrology, hydraulic engineering, and environmental studies including contaminant characterization were not included in RockSol's geotechnical scope of work.

The geotechnical practices are similar to that used in Colorado with similar soil conditions and our understanding of the proposed work. This report has been prepared by RockSol for the City of Grand Junction exclusively for the project described in this report. The report is based on our exploratory boreholes and does not take into account variations in the subsurface conditions that may exist between boreholes. Additional investigation is required to address such variation. If during construction activities, materials or water conditions appear to be different from those described herein, RockSol should be advised at once so that a re-evaluation of the recommendations presented in this report can be made. RockSol is not responsible for liability associated with interpretation of subsurface data by others