Stormwater Management Plan

For Construction Activities At:
Lake Pump Station No .2 and Transmission Pipeline
1596 Lake Woodmoor Dr
Monument, CO 80132

Contractor:
Stanek Constructors, Inc
651 Corporate Circle Ste 108
Golden, CO 80401
419-566-4130
sleonard@stanekconstuctors.com

SWMP Prepared By:
Stanek Constructors, Inc
Joe Giron
651 Corporate Circle Ste 108
Golden, CO 80401
303-746-3710
jgiron@stanekconstuctors.com

SWMP Preparation Date:
05/28/2021

Estimated Project Dates:
Project Start Date: 06/15/2021
Project Completion Date: 05/13/2022

Qualified Stormwater Manager:
Chris Miller
Stanek Constructors, Inc
651 Corporate Circle Ste 108
Golden, CO 80401

PCD Filing No.:

PPR-21-019

Contents

SECTION 1: CONTACT INFORMATION/RESPONSIBLE PARTIES

1.1 Owner(s) / Operator(s) / Subcontractor(s)

Owner(s):

Woodmoor Water and Sanitation District No. 1
Jessie Shaffer
1845 Woodmoor Drive
PO Box 1407
Monument, CO 80132
719-488-2525
jessies@woodmoorwater.com
Owner

Operator(s):

Stanek Constructors, Inc.
Chris Miller
651 Corporate Circle, Ste 108
Golden, CO 80401
Chris 218-866-0371
General Contractor

Subcontractor(s):

Colorado Civil Construction, Inc.
PO Box 207
Peyton, CO 80831
303-817-0130
Mike Peterson

CDI Environmental Contractors
5585 West Airport Rd.
Sedalia, CO 80135
303-241-1853
Jamie Salisbury

Emergency 24-Hour Contact:

Stanek Constructors, Inc.
Chris Miller
218-866-0371

1.2 Stormwater Team

Stormwater Team		
Name and/or position, and contact	Responsibilities	I Have Read the CGP and Understand the Applicable Requirements
Chris Miller Superintendent 218-866-0371 cmiller@stanekconstructors.com	Qualified Stormwater Manager	☒ Yes Date: 4/20/2021

SECTION 2: SITE EVALUATION, ASSESSMENT, AND PLANNING

2.1 Project/Site Information

Project Name and Address

Project/Site Name: Lake Pump Station No. 2 and Transmission Pipeline
Project Street/Location: 1596 Lake Woodmoor Dr.
City: Monument
State: CO
ZIP Code: 80132
Business days and hours for the project: 7-5 M-F

Project Latitude/Longitude

Latitude: 39.097964° N (decimal degrees)

Longitude: -104.856599 ° W (decimal degrees)

Latitude/longitude data source:

☒ Map ☐ GPS ☐ Other (please specify): _____

CDPS Stormwater Permit
The CDPS stormwater general permit is attached to this SWMP.

Site Information
Via a visual observation, the existing project site ground surface & vegetation surrounding the proposed Lake Pump Station is a sandy beach area that slopes to the north east into Lake Woodmoor. To the south is grass and topsoil with a dirt access road into the work area.

In addition to this dedicated pump station, a transmission line is included in the project. From visual site inspection and validated via aerial information, this area and existing vegetation is described as follows:

- The Pipeline beginning at the pump station moves to the south west and turns west onto Lake Woodmoor Dr. for approximately 240'.
- The pipe then turns west and moves around Lake Woodmoor for approximately 520'. This area is grass and topsoil.

- The pipeline then turns north for approximately 1252'. This area is grass and topsoil.
- The pipeline then turns south west and runs into Willow Park Way for approximately 160'. This area moves through a dirt path and then ties into an existing water transmission line located in Willow Park way.
- The new pipeline will then connect to the existing pipeline at the intersection of Woodmoor Dr. and Willow Park Way at the NW corner of the paved intersection.
- The pipeline then heads north east on the shoulder Woodmoor Dr. for approximately 1738' to Deer Creek Rd. The pipeline runs through a grass and topsoil shoulder and crosses 3 asphalt parking lot entrances.
- The pipeline then turns west onto Deer Creek Rd. and runs along the grass and topsoil shoulder for approximately 377' where the pipeline connects to the existing RW supply to the Central Water Treatment Plant.
- There are no stream crossings.

During construction the plan will be followed to mitigate soil erosion. The Engineer of Record has reviewed and planned the site to limit impacts.

2.2 Discharge Information

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)? ☐ Yes ☒ No

Are there any waters of the U.S. within 50 feet of your project's earth disturbances? ☒ Yes ☐ No

2.3 Nature of the Construction Activities

General Description of Project

The project consists of the construction of a new pump station on the south east side of Lake Woodmoor, that requires earth disturbance for a new pump station wet well structure, lake intake pipes, and approximately 5263' of a new 12" transmission pipeline to the Central Water Treatment Plant.

Portions of the 7.82-acre site will be graded and shaped along with revised gravel driveway and revised drainage sloping. The main disturbance will be excavation and backfill while installing the new pump station with an underground intake structure and the installation of a new raw water pipeline to the existing Central Water Treatment Plant. While all work will be contained by sediment control logs on the downslope side of the work areas, excavations should be stabilized and monitored to prevent soil erosion during a moisture event. Once final grade is achieved, seeding and restoral as detailed in the attached Seeding Specification should take place. See Drawings C1.0 and C1.1 for the Site Layout Plan showing areas of gravel pavement, final grading, and riprap installation. See also Drawings C2.0 through C2.5 for pipeline installation and restoration of work areas.

Construction traffic on areas that will receive final stabilization through vegetative cover will be minimized to reduce soil compaction. The existing topsoil will be stockpiled onsite for reuse. Temporary stabilization will be implemented when any earth disturbing activity ceases for

more than 14 calendar days. Project site disturbances will be minimized, especially on steep slopes.

It is anticipated that contaminated soils will not be encountered at the project site.

Current and final drainage or sloping of the site to the west and south of the project site direct flows towards Lake Woodmoor, which is believed to be part of the Dirty Woman watershed that also contributes to the Arkansas River watershed.

In the unlikely event of encountering groundwater during excavation, it will be pumped, diverted, and contained in the new drainage area onsite allowing for sediment control and onsite infiltration.

Size of Construction Site

Size of Property	7.82 Acres
Total Area Expected to be Disturbed by Construction Activities	7.82 Acres
Maximum Area Expected to be Disturbed at Any One Time	7.82 Acres

Type of Construction Site *(check all that apply):*

☐ Single-Family Residential ☐ Multi-Family Residential ☒ Commercial ☐ Industrial
☐ Institutional ☐ Highway or Road ☒ Utility ☒ Other Municipal Pump Station and Pipeline

Pollutant-Generating Activities

Pollutant-Generating Activity (e.g., paving operations; concrete, paint, and stucco washout and waste disposal; solid waste storage and disposal; and dewatering operations)	**Pollutants or Pollutant Constituents** (e.g., sediment, fertilizers, pesticides, paints, caulks, sealants, fluorescent light ballasts, contaminated substrates, solvents, fuels)
Concrete & Masonry	Wash out, Form Oils, Cure Chemical, Sealers
Asphalt paving	Oils
Heavy Equipment	Fuel, Oil, Grease
Coating	Paint/Caulk
Excavation	Soil/Sediment run off
Ground water	Create Soil/Sediment run off
Saw Cutting	Dust

Construction Support Activities

Onsite lay down area, Field Office, Dumpster/Trash removal

Contact information for construction support activity:

Chris Miller
218-866-0371
cmiller@stanekconstructors.com

2.4 Sequence and Estimated Dates of Construction Activities

Phase I

Construct Pipeline, Pump Station, and associated sitework	
Estimated Start Date of Construction Activities for this Phase	5/17/2021
Estimated End Date of Construction Activities for this Phase	5/13/2022
Estimated Date(s) of Application of Stabilization Measures for Areas of the Site Required to be Stabilized	4/29/2022 *[Add additional dates as necessary]*
Estimated Date(s) when Stormwater Controls will be Removed	5/13/2022 *[Add additional dates as necessary]*

General Construction Sequence

1. Place BMP's, initial

2. Install transmission pipeline, interim →
   Seeding/Restoral, final
   Final seeding and restoration will follow as the transmission work progresses, unrelated to the remaining construction as outlined in #3-10 below

3. Excavation for pump station wet well and intake pipes, interim
4. Construct pump station wet well, interim
5. Install lake intake pipelines, interim
6. Backfill pump station wet well, interim
7. Construction pump station building, interim
8. Install site piping and electrical lines, interim
9. General Site Grading/berm/roadway, interim
10. Seeding/Restoral, final

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2.5 Authorized Non-Stormwater Discharges

List of Authorized Non-Stormwater Discharges Present at the Site

Type of Authorized Non-Stormwater Discharge	Likely to be Present at Your Site?
Discharges from emergency fire-fighting activities	☐ Yes ☒ No
Fire hydrant flushing	☐ Yes ☒ No
Landscape irrigation	☐ Yes ☒ No
Waters used to wash vehicles and equipment	☒ Yes ☐ No
Water used to control dust	☒ Yes ☐ No
Potable water including uncontaminated water line flushing	☒ Yes ☐ No
External building washdown (soaps/solvents are not used and external surfaces do not contain hazardous substances)	☒ Yes ☐ No
Pavement wash waters	☐ Yes ☒ No
Uncontaminated air conditioning or compressor condensate	☐ Yes ☒ No
Uncontaminated, non-turbid discharges of ground water or spring water	☐ Yes ☒ No
Foundation or footing drains	☐ Yes ☒ No
Construction dewatering water	☒ Yes ☐ No

2.6 Site Maps

See Project Plans and Specs

SECTION 3: DOCUMENTATION OF COMPLIANCE WITH OTHER FEDERAL REQUIREMENTS

3.1 Endangered Species Protection

None Identified in Plans or Specifications

3.2 Historic Preservation

Per plan and specification – Existing Site nothing is expected but if encountered stop work and alert owner and engineer.

SECTION 4: EROSION AND SEDIMENT CONTROLS

Silt fencing and sediment control shall be installed before construction activities, maintained throughout the duration and final vegetation achieve (see part 7) before removal. The engineer has detailed the measures with respect to the specific site conditions and drainage patterns.

4.1 Natural Buffers or Equivalent Sediment Controls

Buffer Compliance Alternatives

Are there any waters of the U.S. within 50 feet of your project's earth disturbances? ☒ YES ☐ NO

(Note: If no, no further documentation is required for Part 4.1 in the SWMP Template. Continue on to Part 4.2.)

Check the compliance alternative that you have chosen:

☐ (i) I will provide and maintain a 50-foot undisturbed natural buffer.

☐ (ii) I will provide and maintain an undisturbed natural buffer that is less than 50 feet and is supplemented by additional erosion and sediment controls, which in combination achieves the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.

☐ (iii) It is infeasible to provide and maintain an undisturbed natural buffer of any size, therefore I will implement erosion and sediment controls that achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.

☒ I qualify for one of the exceptions in Part 2.2.1.b. (If you have checked this box, provide information on the applicable buffer exception that applies, below.

Buffer Exceptions

Which of the following exceptions to the buffer requirements applies to your site?

☐ There is no discharge of stormwater to the water of the U.S. that is located 50 feet from my construction disturbances.

(Note: If this exception applies, no further documentation is required for Section 4.1 of the

☐ No natural buffer exists due to preexisting development disturbances that occurred prior to the initiation of planning for this project.

☐ For a "linear construction sites" (defined in Appendix A), site constraints (e.g., limited right-of-way) make it infeasible to meet any of the CGP Part 2.2.1.a compliance alternatives.

☐ The project qualifies as "small residential lot" construction (defined in Appendix A) (see Appendix G, Part G.3.2).

☐ For Alternative 1:

▪

☐ For Alternative 2:

☐ Buffer disturbances are authorized under a CWA Section 404 permit.

☒ Buffer disturbances will occur for the construction of a water-dependent structure or water access area (e.g., pier, boat ramp, and trail).

4.2 Perimeter Controls

General

- BMP's Silt Fence and Logs – See plan Sheets CE1.0 to CE1.2

Specific Perimeter Controls

INSERT NAME OF PERIMETER CONTROL TO BE INSTALLED	
Description: Silt Fence and Logs	
Installation	TBD
Maintenance Requirements	Inspection and Correct deficiencies
Design Specifications	See Project Plans and Specs

4.3 Sediment Track-Out

General

- Vehicle Track out Control – See plan Sheet C1.0 and CE1.4 Detail SM-4

Specific Track-Out Controls

INSERT NAME OF TRACK-OUT CONTROL TO BE INSTALLED	
Description: Vehicle Track out Mat	
Installation	TBD
Maintenance Requirements	Inspect, clean or replace as needed
Design Specifications	See plans and Specs

In the event track-out is evident outside site, the roads will be scraped (for mud) and swept (for dust) as inspected by the Stormwater Manager during daily inspections.

4.4 Stockpiled Sediment or Soil

General

- Located inside perimeter controls and used timeline to be limited

Specific Stockpile Controls

Description: Silt Fence or Temp Stabilization if needed	
Installation	TBD
Maintenance Requirements	Inspections
Design Specifications	See plans & Specs

4.5 Minimize Dust

General

- Water as required

Specific Dust Controls

Description: Wet/water as required	
Installation	TBD
Maintenance Requirements	Visual inspection
Design Specifications	See plans and Specs

PLEASE NOTE, THERE WILL NO CONCRETE ONSITE BATCH PLANT. OUR CONCRETE IS BATCHED AT A DEDICATED PLANT AND TRUCKED TO SITE FOR EACH POUR. WASHOUT AND TRACKOUT APPLIES TO DELIVERY TRUCKS, INCLUDING CONCRETE TRUCKS.

In addition, the project does not rely on control measures owned or operated by other entities.

SECTION 5: POLLUTION PREVENTION STANDARDS

5.1 Potential Sources of Pollution

In accordance with the Stanek site specific safety plan, our emergency spill response and environmental protection sections are attached as reference with this submission.

Construction Site Pollutants

Potential sources of pollution:

1. Soil runoff from excavations during rain or snow event.
2. Vehicle track out
3. Fuel, oil or grease from construction equipment.
4. Materials and chemicals used during construction.
5. Dust
6. Concrete washouts
7. Dumpsters/Porta toilets
8. Masonry mixing stations
9. Loading and unloading operations

Practices used:

1. The use of BMP's as detail on plan sheet plan Sheet CE1.0 to CE1.2.
2. Proper storage and containment of fuel, oil and grease, Use of proper containers
3. Proper storage and containment of chemical and construction materials per SDS data
4. Inspect and Maintain of BMP's and Storage/containment (See Dot Form)
5. Dust Control by watering
6. Concrete trucks, including the concrete truck chute, will be washed out into a dedicated concrete washout. See Detail MM-1 / CE1.3.
7. Portable toilet service from professional provider
8. Garbage service picked up regularly avoiding overflow
9. On Site universal Spill Kit with basic absorbing socks/pads etc.
10. The portable toilets will be anchored in place with concrete stakes.

11. For the masonry mixing stations, a dirt berm will be built around the masonry mixing station to contain any potential spills.
12. For loading and unloading operations, dust control by watering and keeping spill control supplies and cleanup materials onsite near the loading and unloading area

5.2 Spill Prevention and Response

Chemicals will be stored in watertight containers or in a weather tight job storage container, with appropriate secondary containment. Spill Kits will be kept onsite and be readily available. Spills will be reported to the proper authority.

Secondary containment of sanitation facilities will be accomplished by surrounding the facilities with wood framing and attaching poly to the framing to line the entire area under the facilities. They will also be cleaned and inspected regularly for leaks and spills.

Concrete washout areas will be lined and bermed so there is no leakage or overflow into the underlying soil and onto the surrounding areas. Washout areas will be positioned away from drain inlets and/or waterways, including the sloping to the lake and be clearly labeled and in-place in advance and for the duration of concrete activities.

Good housekeeping practices will be used for vehicle storage and maintenance, including not allowing fuel, oil, or grease to leak into the soil, placing all equipment or vehicles that are to be fueled, maintained, or stored in a designated area fitted with appropriate BMPs, and cleaning leaks immediately and disposing of leaked materials properly.

5.2.1 Fueling and Maintenance of Equipment or Vehicles

General

- Portable Fuels tanks and Cans, stored properly, spill kits

Specific Pollution Prevention Practices

Description: Containment	
Installation	TBD
Maintenance Requirements	Clean, Inspect Replace if needed
Design Specifications	D.O.T.

5.2.2 Construction and Domestic Waste

General

- Dumpster Service for construction Waste

Specific Pollution Prevention Practices

Description: Professional disposal	
Installation	TBD

Maintenance Requirements	**Regular Pickup** **Request a pull when receptacle is no more than ¾" full to ensure pick up and disposal before overflow**
Design Specifications	n/a

5.2.3 Sanitary Waste

General

- Professional services

Specific Pollution Prevention Practices

Description: Portable toilets	
Installation	TBD
Maintenance Requirements	Regular service and pumping
Design Specifications	N/a

All areas will be checked for leaks and overflows as part of daily site observation. Portable toliets will be located a minimum of 10 feet from stormwater inlets and 50 feet from state waters. 4 corners will be secured and on level ground to prevent overturning and spillage. In accordance with OSHA, cleaning and service is, at a minimum, once a week.

SECTION 6: INSPECTION, MAINTENANCE, AND CORRECTIVE ACTION

6.1 Inspection Personnel and Procedures

Personnel Responsible for Inspections, *QSM*

Stanek Superintendent – Chris Miller
The QSM will be sufficiently qualified for the required duties per the ECM Appendix I.5.2.A

Inspection Schedule

Select the inspection frequency(ies) that applies, based on CGP Parts 4.2, 4.3, or 4.4
(Note: you may be subject to different inspection frequencies in different areas of the site. Check all that apply)

Standard Frequency:
☐ Every 7 days ☒ Every 14 days and after any precipitation or snowmelt event that cause surface erosion
Increased Frequency (if applicable):
For areas of sites discharging to sediment or nutrient-impaired waters or to waters designated as Tier 2, Tier 2.5, or Tier 3 ☐ Every 7 days and within 24 hours of a 0.25" rain
Reduced Frequency (if applicable)

For stabilized areas

☐ Twice during first month, no more than 14 calendar days apart; then once per month after first month;

(Note: It is likely that you will not be able to include this in your initial SWMP. If you qualify for this reduction (see CGP Part 4.4.1), you will need to modify your SWMP to include this information.)

For stabilized areas on "linear construction sites"

☐ Twice during first month, no more than 14 calendar days apart; then once more within 24 hours of a 0.25" rain

(Note: It is likely that you will not be able to include this in your initial SWMP. If you qualify for this reduction (see CGP Part 4.4.1), you will need to modify your SWMP to include this information.)

For arid, semi-arid, or drought-stricken areas during seasonally dry periods or during drought

☐ Once per month and within 24 hours of a 0.25" rain

Insert beginning and ending dates of the seasonally-defined dry period for your area or the valid period of drought:

- Beginning date of seasonally dry period:
- Ending date of seasonally dry period:

For frozen conditions where earth-disturbing activities are being conducted

☐ Once per month

Insert beginning and ending dates of frozen conditions on your site:

- Beginning date of frozen conditions:
- Ending date of frozen conditions:

Rain Gauge Location (if applicable)

Inspection Report Forms

See form. Inspections shall include a signature on each entry.

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6.2 Corrective Action

The plan remains a living document that is customized to site conditions and updated as work progresses, and measures are continuously reviewed as part of the overall process of evaluating and managing stormwater quality issues at the site.

SWMP changes addressing BMP installation and/or implementation are often required to be made in response to changing conditions, or when current BMPs are determined ineffective. The majority of these SWMP revisions can be made immediately with in-the-field revisions to the SWMP. In the less common situation where more complex development of materials to modify the SWMP is necessary, the revisions shall be made in accordance with the following requirements: The Qualified Stormwater Manager shall amend the SWMP when there is a change in design, construction, operation or maintenance of the site which would require the implementation of new or revised BMPs or if the SWMP proves to be ineffective in achieving the general objectives of controlling pollutants in stormwater discharges associated with construction activity or when BMPs are no longer necessary and are removed.

Any BMP deficiencies. Replacement or additional BMPs that may be required shall be documented on the Stormwater Management Plans and in the appropriate logs. Copies of the Corrective Action Log and SWMP Amendment Log have been included for reference and use.

Personnel Responsible for Corrective Actions
Stanek Superintendent

Corrective Action Forms
See Form

Unresolved comment from Review 1:

Item 25. Add a note stating that the inspection log must include a signature. And discuss location of SWMP records onsite.

Review 2 comment: state where SWMP records can be found on-site.

6.3 *Delegation of Authority*

Duly Authorized Representative(s) or Position(s):
Stanek Constructors
Chris Miller - Superintendent

SECTION 7: PROJECT CLOSEOUT

The majority of the disturbed areas will be restored closely to the pre-construction grade and vegetation cover. New grading will occur at the site of the proposed lake pump station, adjacent to Woodmoor Lake with riprap and other permanent slope measures will be implement in accordance with the contract documents. Native perennial seeding will be established in non-irrigated areas. Final stabilization will be reached when all soil disturbing

activities at the site have been completed and uniform vegetative cover has been established with a density of at least 70% or pre-disturbance levels.

SECTION 8: CERTIFICATION AND NOTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Sherri Leonard Title: Project Manager

Signature:  Date: 5/28/2021

VI. EMERGENCY SPILL RESONSE

A. This plan addresses emergency procedures for responding to the release of spill of hazardous substances. All personnel shall be instructed at the time of site-specific orientation concerning these safety procedures.

B. These procedures shall include employee training, alarm systems, escape routes and procedures, critical operation or equipment, rescue and medical duty assignments, designation of responsible parties, emergency reporting procedures and methods to account for personnel after evacuation.

C. In the event of an accidental spill or release of hazardous materials, on-site personnel shall contain the material to the greatest extent possible. These personnel shall be equipped with the appropriate levels of protective clothing as designated by the Safety Department.

D. Containment shall include the use of sorbent pads and/or booms, diking with soil, covering, and/or diverting spills from sewers, drains, surface water bodies, etc. For spills that cannot be contained by on-site personnel the Site Supervisor shall secure the area and notify local emergency services, the Owner's Representative, the company Safety Director and the Project Manager immediately.

E. Depending on the size and magnitude of the spill or release, notifications to the State Duty Officer and clean up teams will be coordinated through the Safety Director or Project Manager. Reportable spills should be directed to the State Duty Officer.

VII. ENVIRONMENTAL PROTECTION

A. Pollution of natural resources of air, land and water by operations shall be prevented controlled and abated in accordance with the established and applicable rules, regulations, and standards.

B. Erosion Control - Controls shall be implemented to minimize erosion of soils and to prevent sediments from entering the storm water system or washing into other low ares. Such controls include dewatering, temporary culverts, silt fences or straw bales. SWPP shall be put in place where required and maintained as statue dictates.

C. Dust Control – Airborne concentrations of dust shall be kept at a minimum during construction operations in accordance with applicable regulations. Dust suppression using water and/or calcium chloride shall be applied at such times, locations, and amounts as directed by the engineer.

D. Detection of unsuitable materials or hazardous materials –
   1. Immediately notify the Owners project representative prior to proceeding with the removal of any unsuitable material.
   2. Excavate unsuitable soil material as directed by Engineer.
   3. If other potentially hazardous waste is encountered, Stop. Contact owner representative for hazardous waste identification, removal, and disposal.

E. All fuel containers shall be stored in a containment that protects it from spilling or leaking into the ground.

Appendix 3
Emergency Action List
Post with Hospital & Clinic Route Maps

Site Specific INFO	Location
Job-Site Address	
Hospital/ER	
Occupational Clinic	
Muster Point	
Severe Weather Shelter	
First Aid & Eye Wash	
Fire Extinguisher/s	
Spill Kit Location	

Hazardous Material List with Storage Location	
1.	7.
2.	8.
3.	9.
4.	10.
5.	11.
6.	12.

Resource	Name - E-mail	Phone #
Superintendent		
Project Manager		
VP Operations		
Safety Director	wayne_devoe@ricelake.org	218-866-0981
Customer's Contact Person		
Fire-Rescue Department	911	Admin:
Police	911	Admin:
WORKPARTNERS	Direct Access to Doctor	800-359-5020
Poison Control	Poison emergency or question:	1-800-222-1222
Safety Hotline - SDS Access		888-847-2922

SWMP Amendment Log

No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

SECTION 02370

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This work consists of temporary measures needed to control erosion and water pollution. These temporary measures will include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the project and during site restoration, and as directed by ENGINEER, and as shown on the drawings.

B. The Erosion Control Plan presented in the drawings serves as a minimum for the requirements of erosion control during construction. Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. Therefore, if the provided plan is not working sufficiently to protect the project areas, then Contractor shall provide additional measures as required to obtain the required protection.

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02220 – Demolition

C. Section 02300 – Earthwork

D. Section 02750 – Rigid Paving

E. Section 02950 – Seeding

1.3 REFERENCES AND STANDARDS

A. CDOT – Colorado Department of Transportation

B. UDFCD – Urban Drainage and Flood Control District

C. CDPHE – Colorado Department of Public Health and Environment

1.4 SUBMITTALS

A. Submit under provisions of Division One specifications.

B. Submit the following information:
   1. Erosion Control Plan,
   2. Construction schedule for Erosion Control per Article Scheduling,
   3. Sequencing Plan per Article Scheduling,
   4. All applicable permits for Erosion Control.

C. Product data: Submit on all products or materials supplied herein.

1.5 REGULATORY REQUIREMENTS

A. Obtain and comply with all requirements of El Paso County, Woodmoor Water & Sanitation District, and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.

B. 401 Construction Dewatering Industrial Wastewater Permit (Construction Dewatering Permit 401):
   1. Contractor shall apply for and obtain a Construction Dewatering Permit 401 from the Colorado Department of Public Health and Environment.
   2. All costs for this permit shall be the responsibility of Contractor.
   3. This permit requires that specific actions be performed at designated times.
   4. Contractor is legally obligated to comply with all terms and conditions of the permit including testing for effluent limitations.
   5. Contractor shall allow the Colorado Department of Public Health and Environment or other representatives to enter the site to test for compliance with the permit.
   6. Non-compliance with the permit can result in stoppage of all work.

C. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.

1.6 SCHEDULING

A. Sequencing Plan:
   1. Contractor shall submit a sequencing plan for approval for erosion control in conformance with Contractor's overall Construction Plan for approval by El Paso County, Owner.
   2. Changes to the Erosion Control Sequencing Plan may be considered by El Paso County, Owner only if presented in writing by the Contractor.

B. Temporary Erosion Control:
   1. When so indicated in the Contract Documents, or when directed by El Paso County, Owner. Contractor shall prepare construction schedules for accomplishing temporary erosion control work including all maintenance procedures.
   2. These schedules shall be applicable to clearing and grubbing, grading, structural work, construction, etc.

C. Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits and a plan for disposal of waste material.

D. Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that develop during construction.

E. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

PART 2 PRODUCTS

2.1 MATERIALS

A. Comply with all applicable municipal or local Municipal Separate Storm Sewer System (MS4) requirements.

B. All materials shall be submitted for approval prior to installation.

C. Natural or biodegradable materials shall be reasonably clean, free of deleterious materials, and certified weed free. Materials may include, but are not limited to, hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel.

D. Grass Seed:
   1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, in accordance with local criteria and permit requirements, which will provide temporary cover, and not compete with the grasses sown for permanent cover.
   2. All grass seed shall be approved by El Paso County, Owner and in accordance with local regulations prior to installation.

E. Fertilizer and soil conditioners shall be approved by El Paso County, Owner and in accordance with local regulations prior to installation.

PART 3 EXECUTION

3.1 GENERAL

A. All temporary and permanent erosion and sediment control practices will be maintained and repaired as needed to ensure continued performance of their intended function.

B. El Paso County, Owner will monitor Contractor's erosion control methods. If the overall function and intent of erosion control is not being met, El Paso County, Owner will require Contractor to provide additional measures as required to obtain the desired results.

C. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the project is accepted.

3.2 PROTECTION OF ADJACENT PROPERITES

A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition.

B. In addition to the erosion control measures required on the drawings, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:
   1. Vegetated buffer strip around the lower perimeter of the land disturbance.
      a. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least twenty (20) feet in width.
   2. Sediment barriers such as straw bales, erosion logs, and silt fences.
   3. Sediment basins and porous landscape detention ponds.
   4. Combination of above measures.

3.3 CONSTRUCTION

A. Stabilization of Disturbed Areas:
   1. Temporary sediment control measures shall be established within five (5) days from time of exposure or disturbance.
   2. Permanent erosion protection measures shall be stablished within five (5) days after final grading of areas.

B. Stabilization of Sediment and Erosion Control Measures:
   1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.
   2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.
   3. Stormwater outlets shall also be stabilized prior to any upstream land disturbing activities.

C. Stabilization of Waterways and Outlets:
   1. All onsite stormwater conveyance channels used by Contractor for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events.
   2. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.

D. Storm Sewer Inlet Protection: All storm sewer inlets which are made operable during construction or which drain stormwater runoff from a construction site shall be protected from sediment deposition by the use of filters.

E. Construction Access Routes:

1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.
2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.
3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area.
4. Street washing shall be allowed only after sediment is removed in the manner described above.

3.4 DISPOSITION OF TEMPORARY MEASURES

A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by El Paso County, Owner.

B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.

C. Substantial Completion of Erosion Control Measures:
   1. At the time specified in the Contract Documents, and subject to compliance with specified materials and installation requirements, Contractor shall receive a Substantial Completion Certificate for temporary erosion control measures.
   2. Maintenance of Erosion Control Measures after Substantial Completion: Contractor shall be responsible for maintaining temporary erosion control measures as specified in the drawings and Contract Documents until such time as work has been accepted by El Paso County, Owner and as specified in Division 1 for Closeout Procedures.

END OF SECTION

SECTION 02920

SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soil preparation

B. Fertilization

C. Seeding methods

D. Areas to be reseeded

E. Seed Mix

F. Maintenance

G. Seed protection and slope stabilization

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02300 – Earthwork

C. Section 02370 – Erosion and Sedimentation Control

1.3 REFERENCES

A. Federal Specification (FS) O-F-241 - Fertilizers, Mixed, Commercial

B. American Association of Nurserymen - Standardized Plant Names

C. Association of Official Seed Analysts (AOSA)

D. Colorado Department of Agriculture (CDA) Seed Act

E. Colorado Department of Transportation (CDOT) Construction Specifications

1.4 SUBMITTALS

A. Submit under Division One Specifications for products related to seeding work including but not limited to seed mixes, mulches, composts, tackifiers, fertilizers and herbicides.

B. Product Data:

1. Certified Live Seed analyses not more than 6 months old by a recognized laboratory of seed testing for grass mixtures including percent of live seed (PLS), germination, all crop seeds in excess of 1 percent, inerts and weeds
2. Manufactures guaranteed chemical analysis, name, trade name, trademark and conformance to state and local laws of all fertilizers and herbicides

1.5 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging

B. Provide a certificate of the PLS test of the grass seed intended for the project, certifying that the seed furnished is from a lot that has been tested by a recognized laboratory within the last 6 months

C. All brands furnished shall be free from such noxious seeds as Russian or Canadian Thistle, Coarse Fescue, European Birdweed, Johnson Grass, Leafy Spurge, field bindweed, kochia, or any state-listed or [CDOT-listed] noxious weed species

D. Any materials that have become wet, moldy or otherwise damaged in transit or in storage will not be used

1.6 QUALIFICATIONS

A. Applicator: Company specializing in performing work of this section with landscaping license from State of Colorado
   1. Experienced with type, elevation, topography and scale of work specified
   2. Adequate equipment and personnel to perform work

1.7 REGULATORY REQUIREMENTS

A. Comply with codes and ordinances of local regulatory agencies for fertilizer and herbicide composition and regulations of State of Colorado and El Paso County.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One specifications

B. All materials and products will remain in original manufacturers shipping bags or containers until they are used. All material or products will be stored in a manner to prevent them from coming into contact with water or other contaminating substance and in a manner that product effectiveness will not be impaired

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable

D. Commercial fertilizer or commercial herbicide: mixed in original bags or containers of the manufacturer, showing weight, chemical analysis and manufacturer name. Store in such a manner such that product effectiveness will not be impaired

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not prepare or seed frozen soils

B. Perform seeding and planting only after preceding work establishing final ground surface is completed

C. Conduct minimum of two (2) soil tests to confirm fertilizer type and application rates

1.10 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition

1.11 WARRANTY

A. All plant material and work accomplished under this section shall be guaranteed to provide a uniform stand of grass acceptable to the Owner at the end of a one (1) year time period from the completion of the Seeding and Erosion Control work

PART 2 PRODUCTS

2.1 SEED

A. In conformance with State and Federal regulations and subject to the testing provisions of the Associate of Official Seed Analysts (AOSA)

B. Seed Suppliers: Licensed Seed Dealer with Colorado Department of Agriculture

C. Provide the latest crop available in accordance with Colorado Department of Agriculture Seed Laws, Chapter 35, Article 27

D. Compensate for percentage of purity and germination by furnishing sufficient additional seed to equal the specified pure live seed product. The formula for determining the quantity of pure live seed (PLS) is as follows:

Pounds of Seed (Bulk) x Purity x Germination = Pounds of Pure Live Seed (PLS)

2.2 SEED MIX

A. Permanent seed mixes per tables below:

1. Permanent Upland Area Seed Mix (UDFCD Table A-2, recommended for sandy soil)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Grasses					
Switchgrass	*Panicum virgatum*	Warm	Sod/Bunch	15	2.3
Prairie sandreed	*Calamovilfa longifolia*	Warm	Sod	10	2.2
Sideoats grama	*Bouteloua curtipendula*	Warm	Sod	10	3.1
Blue grama	*Bouteloua gracilis*	Warm	Sod	10	0.7
Indian ricegrass	*Oryzopsis hymenoides*	Cool	Bunch	10	4.3
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	5.5
Little bluestem	*Schizachyrium scoparium*	Warm	Bunch	10	2.3
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	10	0.1
Green needlegrass	*Stipa viridula*	Cool	Bunch	10	3.3
Herbaceous/Wildflowers					
Pasture sage	*Artemisia frigida*			1	0.1
Blanket flower	*Gaillardia aristata*			2	0.9
Tansy aster	*Maceranthera tanacetifolia*			2	0.2
TOTAL PLS POUNDS/ACRE				**100**	**25**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

B. Temporary native seed mixes per tables below:

1. Upland Area Temporary Seed Mix (UDFCD Table A-11, recommended for sandy soil)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Sand lovegrass	*Eragrostis trichodes*	Warm	Bunch	20	0.5
Sand bluestem	*Andropogon hallii*	Warm	Sod	20	7.1
Prairie sandreed	*Calamovilfa longifolia*	Warm	Sod	15	2.2
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	15	0.1
Needle and Thread	*Hesperostipa comata spp. comata*	Cool	Bunch	15	5.2
Red three-awn	*Aristida purpurea var. longiseta*	Warm	Bunch	15	2
TOTAL PLS POUNDS/ACRE				**100**	**17.1**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

2.3 SOIL MATERIALS

A. Select onsite topsoil: Earth material of loose friable clay loam reasonably free of admixtures of subsoil, refuse stumps, roots, rocks, brush, weeds or other material which can be detrimental to the proper development of site revegetation

2.4 ACCESSORIES

A. Soil Additives (Fertilizer)
   1. Dry fertilizers: Primary element composition by weight of 6-10-5
      a. Nitrogen (N) six (6%) percent of which fifty (50%) per-cent inorganic, phosphoric acid (P_2O_5) ten (10%) percent, and potash (K_2O) five (5%) percent
   2. Commercial fertilizer: Primary element composition by weight of 18-46-0
      a. Nitrogen, eighteen (18%) percent, of which fifty (50%) percent is organic, and phosphoric acid (P_20_5), forty-six (46%) percent
      b. These elements may be organic, inorganic, or a combination and shall be available according to the methods adopted by the Association of Official Chemists
   3. Dry, pelletized or granular, uniform in composition and a free flowing product. Do not use material which has caked, segregated, exceeded the expiration date of application, or be otherwise damaged
   4. Thoroughly mixed by the manufacturer. Clearly identify the contents of each container. Do not use materials and containers previously opened, exceeding the expiration date for application or otherwise damaged

B. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass

C. Mulching Material: Straw or onsite grasses from grubbing operation, dry, free from foreign matter detrimental to plant life

PART 3 EXECUTION

3.1 GENERAL

A. Seed all areas disturbed by construction, including all areas along the roadside ditches

B. Pattern for seeding and fertilization as required by field conditions. In no case shall revegetation occur within 30 days of the application of any chemical weed control substance

C. Engineer to review grading prior to seeding

3.2 SOIL PREPARATION

A. Uniformly place and spread topsoil removed during grubbing and stored on site. Provide minimum thickness of 4 inches to meet finished grade. Key topsoil to the underlying and surrounding material by the use of harrows, rollers or other equipment suitable for the purpose

B. Apply water to the topsoil for compaction purposes in a fine spray by nozzles in such a manner that it will not wash or erode the newly placed soil

C. Exercise care during soil preparation on all embankments so as not to disturb established ground cover. Areas disturbed during the soil preparation will be fertilized and seeded at the discretion of the Engineer in accordance with these documents

3.3 FERTILIZATION

A. Do not proceed with fertilization in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen and untillable ground or conditions detrimental to the effectiveness of the application

B. Apply fertilizer in a manner to assure uniform distribution, light watering is acceptable for dispersion

C. In cases where work progress is stopped due to the above conditions, fertilization will begin again, when appropriate conditions exist. The application will begin again with a reasonable overlapping of the previously applied area

3.4 SEEDING METHODS

A. All seeding shall be installed either by hydroseeding or drilling method. Small areas of restoration may be broadcast seeded if directed by Engineer. *NTU: Confirm whether hydroseeding will be acceptable to client/owner.*

B. Do not proceed with seeding in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen or untillable ground or conditions detrimental to the effectiveness of the application. All seeding shall be performed between either March 1st to May 30th of the calendar year of construction unless indicated otherwise by Engineer

C. Hydroseeding:
   1. Apply seeded slurry with hydraulic seed at a rate of //160 lbs// live seed per 1,000 square feet, evenly in two intersecting directions
   2. Do not hydroseed areas in excess of that which can be mulched on same day
   3. Immediately following seeding apply mulch to a thickness of 1/8 inch
   4. Apply water with a fine sprat immediately after each area has been mulched. Saturate to four (4) inches of soil

D. Drilling:
   1. Accomplish seeding by means of an approved power drawn drill, followed by drag chains. The grass drill should be equipped with a satisfactory feeding mechanism, agitation, and double disk furrow openers. Equip drills with depth bands set to maintain a planting depth of approximately 3 to 2 inch and shall be set to space rows not more than 7 inches apart
   2. If inspections indicate that strips wider than the specified space between the rows planted have been left or other areas skipped, the Engineer will require immediate resowing of seed in such areas at the Contractor's expense. The seeding mixture shown in the Materials Section applies at a pure live seed rate per acre
   3. Immediately following seeding apply straw mulch at a rate of one (1) ton per acre

4. Apply water with a fine spray immediately after each area has been mulched. Saturate to four (4) inches of soil depth
5. Provide additional watering weekly until revegitation seed has germinated

3.5 AREAS TO BE RESEEDED

A. Seed all disturbed areas that are damaged or disturbed by the Contractor's activities during the entire project scope

B. Additional areas as requested by the Owner and approved by the Engineer

3.6 MAINTENANCE

A. Fertilize the seeded areas once a uniform stand of grass has been established

B. Maintain seeded areas until there is an acceptable uniform plant growth. Reseed areas that are not producing a uniform plant growth within five (5) weeks following seeding. Acceptable uniform plant growth shall be defined as that time when the scattered bare spots, not greater than 1 square foot in area, do not exceed three percent (3%) of the seeded area

C. Maintenance period - 1 year

D. Areas that are seeded late in the fall planting season which are not producing acceptable uniform plant growth, as described above, shall be reseeded during the following spring planting season. If such a condition exists, and the Contractor has diligently, in the opinion of the Engineer, pursued the performance of his work, the Owner at his option, may extend the contract completion date and reduce contract retainage. Retainage may be reduced to less than five percent (5%) of the total contract amount, but shall be at least two (2) times the estimated cost of obtaining the required growth in the indicated areas, plus areas which are susceptible to damage by winter kill, washout or other causes

E. Contractor shall control perennial weeds, thistle, spotted and napweed, spurge and other weeds during the maintenance period

3.7 SEED PROTECTION AND SLOPE STABILIZATION

A. Cover seeded slopes with erosion control fabric where grade is 4 to 1 or greater and where indicated on the Drawings and/or Section 02300. Cover seed with mulch in all other areas

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric until seed germination. If seed is washed out before germination, fertilize, reseed and restore affected areas

END OF SECTION

CONSTRUCTION STORMWATER SITE INSPECTION REPORT

Facility Name		Permittee	
Date of Inspection		Weather Conditions	
Permit Certification #		Disturbed Acreage	
Phase of Construction		Inspector Title	
Inspector Name			

	YES	NO
Is the above inspector a qualified stormwater manager? (permittee is responsible for ensuring that the inspector is a qualified stormwater manager)	☐	☐

INSPECTION FREQUENCY	
Check the box that describes the minimum inspection frequency utilized when conducting each inspection	
At least one inspection every 7 calendar days	☐
At least one inspection every 14 calendar days, with post-storm event inspections conducted within 24 hours after the end of any precipitation or snowmelt event that causes surface erosions	☐
• This is this a post-storm event inspection. Event Date: _____	☐
Reduced inspection frequency - Include site conditions that warrant reduced inspection frequency	☐
• Post-storm inspections at temporarily idle sites	☐
• Inspections at completed sites/area	☐
• Winter conditions exclusion	☐

	YES	NO
Have there been any deviations from the minimum inspection schedule? If yes, describe below.	☐	☐

INSPECTION REQUIREMENTS*
i. Visually verify all implemented control measures are in effective operational condition and are working as designed in the specifications
ii. Determine if there are new potential sources of pollutants
iii. Assess the adequacy of control measures at the site to identify areas requiring new or modified control measures to minimize pollutant discharges
iv. Identify all areas of non-compliance with the permit requirements, and if necessary, implement corrective action
*Use the attached **Control Measures Requiring Routine Maintenance** and **Inadequate Control Measures Requiring Corrective Action** forms to document results of this assessment that trigger either maintenance or corrective actions

AREAS TO BE INSPECTED

Is there evidence of, or the potential for, pollutants leaving the construction site boundaries, entering the stormwater drainage system or discharging to state waters at the following locations?

	NO	YES	If "YES" describe discharge or potential for discharge below. Document related maintenance, inadequate control measures and corrective actions **Inadequate Control Measures Requiring Corrective Action** form
Construction site perimeter	☐	☐	
All disturbed areas	☐	☐	
Designated haul routes	☐	☐	
Material and waste storage areas exposed to precipitation	☐	☐	
Locations where stormwater has the potential to discharge offsite	☐	☐	
Locations where vehicles exit the site	☐	☐	
Other: _____	☐	☐	

CONTROL MEASURES REQUIRING ROUTINE MAINTENANCE

Definition: Any control measure that is still operating in accordance with its design and the requirements of the permit, but requires maintenance to prevent a breach of the control measure. These items are not subject to the corrective action requirements as specified in Part I.B.1.c of the permit.

Are there control measures requiring maintenance?	NO	YES	
	☐	☐	If "YES" document below

Date Observed	Location	Control Measure	Maintenance Required	Date Completed

INADEQUATE CONTROL MEASURES REQUIRING CORRECTIVE ACTION

Definition: Any control measure that is not designed or implemented in accordance with the requirements of the permit and/or any control measure that is not implemented to operate in accordance with its design. This includes control measures that have not been implemented for pollutant sources. If it is infeasible to install or repair the control measure immediately after discovering the deficiency the reason must be documented and a schedule included to return the control measure to effective operating condition as possible.

	NO	YES	
Are there inadequate control measures requiring corrective action?	☐	☐	If "YES" document below

	NO	YES	
Are there additional control measures needed that were not in place at the time of inspection?	☐	☐	If "YES" document below

Date Discovered	Location	Description of Inadequate Control Measure	Description of Corrective Action	Was deficiency corrected when discovered? YES/NO if "NO" provide reason and schedule to correct	Date Corrected

REPORTING REQUIREMENTS

The permittee shall report the following circumstances orally within twenty-four (24) hours from the time the permittee becomes aware of the circumstances, and shall mail to the division a written report containing the information requested within five (5) working days after becoming aware of the following circumstances. The division may waive the written report required if the oral report has been received within 24 hours.

All Noncompliance Requiring 24-Hour Notification per Part II.L.6 of the Permit

a. Endangerment to Health or the Environment

Circumstances leading to any noncompliance which may endanger health or the environment regardless of the cause of the incident (See Part II.L.6.a of the Permit)

This category would primarily result from the discharge of pollutants in violation of the permit

b. Numeric Effluent Limit Violations

- o Circumstances leading to any unanticipated bypass which exceeds any effluent limitations (See Part II.L.6.b of the Permit)
- o Circumstances leading to any upset which causes an exceedance of any effluent limitation (See Part II.L.6.c of the Permit)
- o Daily maximum violations (See Part II.L.6.d of the Permit)

Numeric effluent limits are very uncommon in certifications under the COR400000 general permit. This category of noncompliance only applies if numeric effluent limits are included in a permit certification.

Has there been an incident of noncompliance requiring 24-hour notification?	NO	YES	
	☐	☐	If "YES" document below

Date and Time of Incident	Location	Description of Noncompliance	Description of Corrective Action	Date and Time of 24 Hour Oral Notification	Date of 5 Day Written Notification *

*Attach copy of 5 day written notification to report. Indicate if written notification was waived, including the name of the division personnel who granted waiver.

After adequate corrective action(s) and maintenance have been taken, or where a report does not identify any incidents requiring corrective action or maintenance, the individual(s) designated as the Qualified Stormwater Manager, shall sign and certify the below statement:

"I verify that, to the best of my knowledge and belief, all corrective action and maintenance items identified during the inspection are complete, and the site is currently in compliance with the permit."

Name of Qualified Stormwater Manager	Title of Qualified Stormwater Manager
Signature of Qualified Stormwater Manager	Date

Notes/Comments

***Sample* Grading and Stabilization Activities Log**

Date Grading Activity Initiated	**Description of Grading Activity**	**Description of Stabilization Measure and Location**	**Date Grading Activity Ceased** (Indicate Temporary or Permanent)	**Date When Stabilization Measures Initiated**

Geotechnical Engineering Report

Woodmoor Lake Pump Station and Water Line
Monument, Colorado
December 17, 2020
Terracon Project No. 23205117

Prepared for:
JVA, Inc.
Boulder, Colorado

Prepared by:
Terracon Consultants, Inc.
Colorado Springs, Colorado

December 17, 2020

JVA, Inc.
1319 Spruce Street
Boulder, Colorado 80302

Attn: Mr. Adam J. Teunissen P.E – Project Manager
P: (303) 565-4936
E: ateunissen@jvajva.com

Re: Geotechnical Engineering Report
Woodmoor Lake Pump Station and Water Line
Woodmoor Drive and Lake Woodmoor Drive
Monument, Colorado
Terracon Project No. 23205117

Dear Mr. Teunissen:

We have completed Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P23205117 dated October 12, 2020, and email supplemental scope of service for slope stability on December 7, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and slabs, for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

For: Nathan D. Hukkanen, E.I.
Staff Engineer

Robert M. Hernandez, P.E.
Geotechnical Services Manager

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	The proposed project will consist of the design and construction of a new pump station (Lake Pump Station) and pipeline. The pump station is planned to consist of an approximately 50-foot deep by 12-foot by 12-foot rectangular wet well and an approximately 20-foot by 25-foot Process Valve/Instrumentation Building. A raw water transmission pipeline will also be constructed as part of the project. Conventional cut-and-cover techniques have been assumed for the pipeline installation. Reportedly the underground pipeline will be constructed within 6 to 8 feet of existing grades.
Geotechnical Characterization	Fill sand soils encountered in three test borings to depths of about 3.5 to 6 feet Native sand soils to depths of about 3.5 to 8.5 feet, and the full depth of exploration in Borings SB-3 (a depth of about 10 feet). Weathered and unweathered sandstone bedrock to the full depths of exploration beneath native sand soils, depths of approximately 10 to 65 feet.
Earthwork	The on-site fill and native sand soils are considered acceptable for re-use as structural fill. The on-site sand soils may also be re-used as general fill outside of structural areas. On-site sandstone bedrock may be reused as either structural and/or general fill after processing to a soil like consistency meeting the recommended gradation presented herein for imported soils. Although not encountered in our boring, claystone bedrock is known to be encountered in the area. If encountered during construction, claystone bedrock may be reused in non-structural areas as general fill after processing to a soil like consistency with a maximum particle size of 3 inches.
Deep Foundations	Deep foundations are recommended for support of the planned buildings for this project.
Shallow Foundations	Shallow foundations are not recommended at this time due to the potential for excessive differential movement and the potential differing bearing conditions based on the planned earthwork at this site.
Pavements	None reported
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Woodmoor Lake Pump Station and Water Line
Woodmoor Drive and Lake Woodmoor Drive
Monument, Colorado

Terracon Project No. 23205117
December 17, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed project to be located near the intersection of Woodmoor Drive and Lake Woodmoor Drive in Monument, Colorado. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Global slope stability
- Floor slab design and construction
- Seismic site classification per IBC
- Lateral earth pressures
- Water line construction

The geotechnical engineering Scope of Services for this project included the advancement of six test borings to depths of about 9½ to 65 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil and bedrock samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located near the intersection of Woodmoor Drive and Deer Creek Road in Monument, Colorado. See **Site Location**

Item	Description
Existing Improvements	The subject water line alignment passes through areas previously developed with school buildings, asphalt concrete paved roadways, and single-family, residential homes. Overall the project alignment is bordered to the north by Deer Creek Road, to the west by Interstate 25, to the south by Lake Woodmoor Drive, and to the east by Lower Lake Road.
Current Ground Cover	Earthen, lightly- moderately vegetated, paved.

We also collected photographs at the time of our field exploration program. Representative photos are provided in our **Photography Log**.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	■ Emails between Terracon and JVA from October 7 to present day. ■ Woodmoor Lake Pump Station Request for Proposal for Geotechnical Services, received electronically on October 7, 2020. ■ LPS and Pipeline 30% Review Set, dated October 2020.
Project Description	The proposed project will consist of the design and construction of a new pump station (Lake Pump Station) and pipeline. The pump station is planned to consist of an approximately 50-foot deep by 12-foot by 12-foot rectangular wet well and an approximately 20-foot by 25-foot Process Valve/Instrumentation Building. A raw water transmission pipeline will also be constructed as part of the project. Conventional cut-and-cover techniques have been assumed for the pipeline installation. Reportedly the underground pipeline will be constructed within 6 to 8 feet of existing grades.
Maximum Loading	Columns – 50 to 100 kips (assumed) Walls – 4.5 k/ft at Process Valve/Instrumentation Building (reported) Floor slab – 150 to 250 psf (assumed)
Foundations	Based on the reported amount of excavation and fill planned at the site, it is our understanding that the proposed buildings will be supported on a deep, drilled pier foundation system.
Grading/Excavation	New fill placement up to 20 feet, with total fill placement up to 48 feet after pump station construction. Excavation depth of approximately 48 feet for Pump Station and 4 feet for Process Valve/Instrumentation Building.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at the exploration points are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at the boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Fill**	Generally consisting of sand with various amounts of clay and silt; fine to coarse grained; tan, brownish gray, gray, brown, and dark brown; very loose to medium dense.
2	**Sand**	With various amounts of clay and silt; fine to coarse grained; tan, light brown, brown, dark brown, reddish brown, light gray, and dark gray; loose to dense.
3	**Weathered Sandstone Bedrock**	With silt; fine to coarse grained; light brown; firm to medium hard.
4	**Sandstone Bedrock**	With various amounts of silt and clay; fine to coarse grained; tan, light brown, light grayish brown, and light gray; medium hard to very hard.

As noted in the **General Comments**, the characterization is based upon widely spaced borings at the site, and variations are likely. Stratification boundaries on the boring logs represent the approximate location of changes in soil and material types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and sampling for the presence and level of groundwater and about 48 hours after drilling. The water levels encountered in the boreholes can be found on the boring logs in the **Exploration Results** and are summarized in the table on the following page:

Boring Number	Approximate Depth to Bottom of Boring (feet) [1]	Approximate Depth to Groundwater While Drilling (feet) [1]	Approximate Depth to Groundwater Approximately 48 Hours After Drilling (feet) [1]
SB-1	65	27	12.5
SB-2	10	Not Observed	Not Observed
SB-3	10	8	4
SB-4	9.5	Not Observed	Not Observed
SB-5	10	Not Observed	Not Observed
SB-6	10	Not Observed	Not Observed

1. Below ground surface

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Zones of perched and/or trapped groundwater may also occur at times in the subsurface soils overlying bedrock, on top of the bedrock surface or within permeable fractures in the bedrock materials. The location and amount of perched water is dependent upon several factors, including hydrologic conditions, type of site development, irrigation demands on or adjacent to the site, seasonal fluctuations, and weather conditions.

Laboratory Testing

Selected laboratory test results are presented in the paragraph below. The results of laboratory testing completed for this project can be found in the **Exploration Results** section of this report.

Sand soils tested exhibit low consolidation when subjected to incremental loads up to 500 pounds per square foot (psf) at in-situ water contents. When exposed to increases in moisture content at an applied load of 500 psf, sand soils tested exhibit non- to low expansive potential followed by low to moderate consolidation at increased loadings up to 4,000 psf.

GEOTECHNICAL OVERVIEW

Based on the results of our field investigation, laboratory testing program and geotechnical analyses, development of the site is considered feasible from a geotechnical viewpoint provided that the conclusions and considerations provided herein are incorporated into the design and construction of the project.

The proposed pump station building and wet well structure can be supported on deep drilled pier foundations with floor slabs-on-grade. Additional foundation and floor slab information pertaining to the structures can be found in the **Deep Foundations**, and **Floor Slabs** sections of this report. The **General Comments** section provides an understanding of the report limitations.

We have identified the following geotechnical conditions that could impact design and construction of the proposed project.

Excavations

Excavations into the on-site soils can likely be accomplished with conventional earthwork equipment. Excavations into the weathered and hard to very hard bedrock may require heavy duty earthwork equipment or other specialized techniques. A local contractor experienced with bedrock excavations in the area should be consulted regarding pricing and schedule.

Loose Soils

Test boring data indicate that loose soils are present along the proposed water line alignment and near surface at the location of the pump station. Loose soils could be encountered in excavations and these conditions will likely require some corrective work. Corrective work could involve removal and re-compaction or replacement, the use of geotextiles, or deepening excavations to suitable bearing materials. Terracon should be contacted to observe excavations to evaluate conditions and to provide guidance concerning corrective work (if needed).

Groundwater

Groundwater was encountered as shallow as 4 to 12 feet in Borings SB-3 and SB-1, respectively. Groundwater should be expected during construction. At a minimum, temporary dewatering measures will be required to properly construct portions of the proposed pump station and water line. Although water was not observed within the other borings performed along the water line, it has been our experience that zones of perched and/or trapped groundwater may also occur at times in the subsurface soils overlying bedrock, on top of the bedrock surface or within permeable fractures in the bedrock materials. The location and amount of perched water is dependent upon several factors, including hydrologic conditions, type of site development, irrigation demands on or adjacent to the site, seasonal fluctuations, and weather conditions. We recommend the contractor be aware of the possibility of localized groundwater collection that may need to be dewatered during construction. We also recommend a sump and pump be incorporated into the final construction documents to remove water that may become trapped within tank excavations after project completion.

Buoyancy Forces

Based on our experience in the area and the subsurface conditions encountered in the exploratory boring, we recommend the underground wet well be designed to resist uplift forces from buoyancy.

Shoring

Excavations on the order of 45 to 50 feet are anticipated to install the proposed wet well for the pump station building. Shoring may be required to reach the planned excavation depths. The depth of excavation and subsurface soils and bedrock will influence the type of shoring system that may be used. A qualified shoring contractor should be contacted to design and install the shoring system.

The lateral earth pressure parameters provided in this report may be used for temporary shoring design; however, the use of these parameters is at the discretion of the designer. It has been our experience that shoring designers have proprietary or various earth pressure diagrams to base the shoring design. It is up to the shoring designer to interpret the provided parameters as necessary for their design, as well as recommend supplemental exploration or parameters they feel are appropriate to complete their design.

Deep Backfill Zones/Settlement

Excavations for the wet well will result in backfills on the order of 48 feet in thickness based on the provided 30 percent plans. Backfill between 1 to 41 feet will also be required during installation of three, approximate 16-inch diameter intake pipes. The magnitude of settlement of the deep backfill zones associated with these fills will be directly related to the type of fill material used, the degree of compaction, and the thickness of the fill zone. If the on-site sand soils, properly processed sandstone bedrock, and/or imported soils meeting the recommendations of this report are used as the backfill material, the settlement of fill zones about 50 feet or less in thickness are estimated to be about 6 to 12 inches. This assumes that the degree of compaction for fill zones is maintained in accordance with this report.

It is our understanding that the proposed pump station building will be constructed on drilled pier foundations bottomed into the onsite sandstone bedrock. The proposed pump station slab and associated utilities are anticipated to be constructed on top and within the reported backfill. Due to the granular nature of the on-site soils it is anticipated that a majority of the settlement will occur during fill placement and within three weeks after fill placement is complete. We recommend settlement monitoring pins be installed in fills that are greater than about 15 feet thick immediately after completion of fill placement.

The settlement monitoring pins should be monitored for a period of at least three weeks prior to construction of slabs, utilities, ancillary structures and flatwork. Utilities should be designed with

restrained joints and designed to accommodate potential differential movement as an added design precaution to reduce the potential for underground utility leaks. If the planned intake pipes will be constructed at the time of fill placement, we recommend these pipes be designed for additional settlement of the backfill soils to reduce the potential for pipe breaks and leaks.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations and floor slabs.

Site Preparation

Pipe bedding and trench backfill within open cut excavations to construct the proposed water line should conform to the applicable local municipality guidelines.

Prior to placing fill, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed building, wet well, and water line areas. Stripped materials consisting of vegetation, unsuitable fills, and organic materials should be wasted from the site or used to revegetate landscaped areas after completion of grading operations. All exposed surfaces to receive fill should be free of mounds and depressions that could prevent uniform compaction.

Although evidence of underground facilities such as grease pits and septic tanks were not observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned of these materials and loose soils prior to backfill placement and/or construction.

Foundation and floor slab subgrades should be proof-rolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proof-rolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proof-roll should be delineated and subsequently addressed by the Geotechnical Engineer. The bottom of foundation and floor slab excavations should also be probed with a metal T-probe to aid in locating loose, soft, or otherwise undesirable areas. Unacceptable areas delineated by the proof-roll or probing should be removed or mitigated in place prior to placing fill or foundation and slab concrete. Such areas should either be removed or modified by stabilizing with geotextile. Material that is determined to be excessively wet or dry should be removed, or moisture conditioned and re-compacted.

Fill Slopes

Reconstructed fill slopes will be performed as part of pump station construction. Based on the provided site topography and grading plan, reconstructed slopes with gradients between 10:1 to 2.5:1 (horizontal:vertical) are planned during construction. Where fill is placed on existing or temporary slopes steeper than 5H:1V, benches should be cut into the existing slopes prior to fill placement. The benches should have a minimum vertical face height of 1 foot and a maximum vertical face height of 3 feet and should be cut wide enough to accommodate compaction equipment. This benching will help provide a positive bond between the fill/ natural soils and bedrock and reduce the possibility of failure along the fill/natural soil and bedrock interface. We also recommend similar construction methods be implemented within other cut/fill transitions areas at the site.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below or within 10 feet of structures. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Locations for Placement
On-site sand soils	SW-SM	The on-site sand soils are considered acceptable for re-use as structural fill after water conditioning and recompaction. The on-site sand soils may also be re-used as general fill outside of structural areas.
On-site sandstone bedrock	N/A	On-site sandstone bedrock may be reused as either structural and/or general fill after processing to a soil like consistency meeting the gradation presented herein for imported soils with a maximum particle size of 3 inches.
On-site claystone bedrock	N/A	Although not encountered in our borings, claystone bedrock is known to be encountered in the area. If encountered during construction, claystone bedrock is not considered suitable for reuse as structural fill but may be reused in non-structural areas as general fill after processing to a soil like consistency with a maximum particle size of 3 inches.
Imported soils	Varies	Imported soils meeting the gradation outlined herein can be considered suitable for use as structural and/or general fill.

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Imported soils for use as structural and/or general fill should conform to the following:

Gradation	Percent finer by weight (ASTM C136)
3”	100
No. 4 Sieve	50-100
No. 200 Sieve	20 (max)

Soil Properties	Value
Liquid Limit	NP
Plastic Index	NP

Fill Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill
Maximum lift thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack, plate compactor) is used
Minimum compaction requirements [1, 2, 3]	95% of the materials maximum dry density for fill less than 6 feet in thickness below final grades. 98% of the materials maximum dry density for fill 6 feet in thickness or greater below final grades.
Water content range [2, 4]	Within three percent of optimum water content (granular soils)

1. We recommend that engineered fill be tested for water content and compaction during placement. Should the results of the in-place density tests indicate the specified water or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified water and compaction requirements are achieved.
2. Maximum dry density and optimum water content as determined by the Modified Proctor test (D1557).
3. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D4253 and D4254).
4. Moisture contents should be maintained low enough to allow for satisfactory compaction to be achieved without the compacted fill material becoming unstable under the weight of construction equipment or during proof-rolling. Indications of unstable soil can include pumping or rutting.

Shrinkage and Bulking Factors

For balancing grading plans, estimated shrink or swell of soils when used as compacted fill following recommendations in this report are as follows:

Material	Estimated Shrink (-) / Swell (+) Based on ASTM D698
On-Site Sands	-10% to -15%

Grading and Drainage

All grades must provide effective drainage away from the structure during and after construction and should be maintained throughout the life of the structure. Water retained next to the structure can result in soil and bedrock movements greater than those discussed in this report. Greater movements can result in unacceptable differential slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the structure perimeter.

Exposed ground should be sloped and maintained at a minimum 5% away from the structure for at least 10 feet beyond the structure perimeter. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After construction and landscaping (if incorporated) have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment within the overburden sand soils. Deeper excavations that encounter bedrock may become more difficult and necessitate the use of specialized equipment and/or techniques. A local excavation contractor should be consulted about pricing within bedrock excavations.

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of foundations and floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to foundation and floor slab construction.

Depending on seasonal groundwater fluctuations, groundwater may be encountered during construction and if encountered will likely cause difficulties. Dewatering of excavations and utility trenches may be required during construction. Groundwater seeping into excavations at this site could most likely be controlled by the use of well points or shallow trenches leading to a sump pit where the water could be removed by pumping; however, the requirements for properly dewatering excavations are beyond the scope of services provided for this project.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. The bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

DEEP FOUNDATIONS

Drilled Shaft Design Parameters

Deep drilled shaft foundations are recommended for support of proposed buildings at this site. For this project, we recommend the following:

Description	Value
Minimum shaft length [1]	20 feet and a minimum embedment of 5 feet into bearing stratum, or one shaft diameter, whichever is greater
Minimum shaft diameter [1]	16 inches
Minimum spacing between shafts	3 shaft diameters
Minimum bedrock embedment [1]	5 feet
Pier concrete slump (cased piers)	7 to 9 inches
Approximate total movement [2]	Less than 1-inch

1. Drilled shafts should be embedded into competent bedrock materials. Actual structural loads may dictate larger shaft diameters and/or shaft lengths/embedment deeper than the recommended minimums contained herein.
2. The foundation movement will depend upon the variations within the subsurface soil and bedrock profile, the structural loading conditions, the quality of the earthwork operations, and maintaining uniform soil and bedrock water content throughout the life of the structure. The estimated movements are based on maintaining uniform soil and bedrock water content during the life of the structure. Additional foundation movements could occur if water from any source infiltrates the foundation soils and bedrock; therefore, proper drainage and irrigation practices should be incorporated into the design and operation of the facility. Failure to maintain soil and bedrock water content and positive drainage will nullify the movement estimates provided above.

Design parameters are provided below in the **Drilled Shaft Design Summary** table for the design of deep foundations. The values presented for allowable side friction and end bearing include a factor of safety. We recommend neglecting skin friction for the upper 36 inches of foundations because of the potential for disturbance.

Drilled Shaft Design Summary [1]			
Stratigraphy [2]		**Allowable Skin Friction (psf)** [3]	**Allowable End Bearing Pressure (psf)** [4]
GeoModel No.	**Material**		
N/A	Compacted Sand Structural Fill	100	End Bearing within Sand Soils Not Recommended
2	Native Sand	100	End Bearing within Sand Soils Not Recommended

Drilled Shaft Design Summary [1]			
Stratigraphy [2]		Allowable Skin Friction (psf) [3]	Allowable End Bearing Pressure (psf) [4]
GeoModel No.	Material		
4	Sandstone Bedrock	800	20,000

1. Design capacities are dependent upon the method of installation, and quality control parameters. Skin friction values should not be used within the subsurface profile if slurry or other "wet" shaft techniques are used for installation.
2. See **Subsurface Profile** in **Geotechnical Characterization** for more details on stratigraphy.
3. Applicable for compressive loading only. Reduce to 2/3 of values shown for uplift loading. Effective weight of shafts can be added to uplift load capacity.
4. Shafts should extend at least 5 feet into the bearing stratum for end bearing to be considered.

The structural engineer should determine the reinforcement necessary for foundations. Tensile reinforcement should extend to the bottom of shafts subjected to uplift loading. Buoyant unit weights of the soil and concrete should be used in the calculations below groundwater elevation. Due to seasonal fluctuations in the groundwater elevation, we anticipate the groundwater level could vary about 5 feet above observed levels at the time of our field exploration.

Shafts should be considered to work in group action if the horizontal spacing is less than three pier diameters. A minimum practical horizontal clear spacing between shafts of at least three diameters should be maintained, and adjacent shafts should bottom at the same elevation. The capacity of individual shafts must be reduced when considering the effects of group action. Capacity reduction is a function of spacing and the number of foundations within a group. The following table presents capacity reductions for closely spaced shafts.

Description	Value [1]		
Shaft spacing (center to center)	>3 diameters	>2 to 3 diameters	2 diameters
Capacity reduction	None	30 percent	50 percent

1. End bearing values do not need to be reduced for closely spaced shafts if the bottoms of foundations bear at the same elevation. Spacing closer than 2 diameters is not recommended.

Drilled Shaft Lateral Loading

The following table lists input values for use in LPILE analyses. The provided lateral parameter design values do not include a factor-of-safety, which should be applied. We recommend neglecting lateral resistance for the upper 36 inches of foundations because of the potential for disturbance.

Stratigraphy [1]		L-Pile Soil Model	ϕ [2]	γ (pcf) [2]	ε_{50} [2]	K (pci) [2]	
GeoModel No.						Static	Cyclic
N/A	Compacted Sand Structural Fill	Sand	32°	120 [3]	Allow L-Pile to choose these parameters based on the undrained shear strength or friction angle provided in this table.		
2	Native Sand	Sand	32°	115 [3]			
4	Sandstone Bedrock	Sand	36°	125			

1. See **Subsurface Profile** in **Geotechnical Characterization** for more details on Stratigraphy.
2. Definition of Terms:

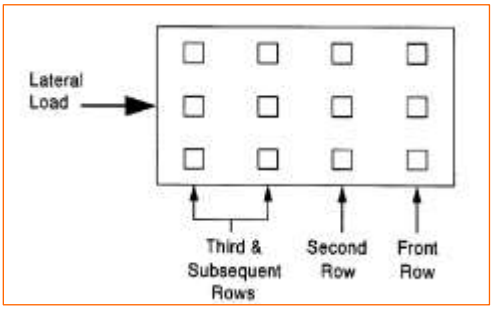
   ϕ: Internal friction angle

   γ: Moist unit weight (above groundwater), Saturated unit weight (below groundwater)

   ε_{50}: E50 strain

   K: Horizontal modulus of subgrade reaction
3. Saturated unit weight value of 50 pcf should be used below water table for sand soils.

When shafts are used in groups, the lateral capacities of the shafts in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent shaft. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of foundations within a group are as follows:



- Front row: $P_m = 0.8$;
- Second row: $P_m = 0.4$
- Third and subsequent row: $P_m = 0.3$.

For the case of a single row of shafts supporting a laterally loaded grade beam, group action for lateral resistance of shafts would need to be considered when spacing is less than three diameters (measured center-to-center). However, spacing closer than 3D (where D is the diameter of the shaft) is not recommended, due to potential for the installation of a new shaft disturbing an adjacent installed shaft, likely resulting in axial or lateral capacity reduction.

Drilled Shaft Construction Considerations

Drilling to design depths should be possible with heavy duty power augers equipped with rock teeth. Difficult drilling should be anticipated due to the presence of very hard bedrock, groundwater, and caving associated with sand soils. Casing, mud or slurry drilling, and other specialized installation techniques will be required to properly drill and clean shafts prior to concrete placement. Shaft concrete should be placed soon after completion of drilling and cleaning. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

A tremie or casing should be used for concrete placement. If casing is used for shaft construction, it should be withdrawn in a slow, continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or the creation of voids in pier concrete. Shaft concrete should have a relatively high fluidity when placed in cased shaft holes or through a tremie.

Free-fall of concrete is not considered acceptable for placement in shafts. The use of a bottom-dump hopper, or an elephant's trunk discharging near the bottom of the hole where concrete segregation will be minimized, is recommended. Shaft bearing surfaces must be free of loose materials prior to concrete placement.

The drilled shaft installation process should be performed under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the shaft installation process including soil/rock and groundwater conditions encountered, consistency with expected conditions, and details of the installed shaft.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil and bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is C**. Subsurface explorations at this site were extended to a maximum depth of 65 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

FLOOR SLABS

Design parameters for slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure.

Floor Slab Design Parameters

Item	Description
Slab Support [1]	Slabs should bear on undisturbed sandstone bedrock or a minimum of 8 inches of newly placed, structural fill, but not a combination of both (either bearing on sandstone or on structural fill.) Although not encountered in our boring, localized lenses of claystone bedrock have been known to be encountered. If observed at the time of construction, claystone will need to be removed from foundation excavations. We estimate up to 2 feet of additional excavation may be necessary to remove the claystone lens, if observed.
Estimated Modulus of Subgrade Reaction [2]	150 pounds per square inch per inch (psi/in) for point loads

1. Slabs should be structurally independent of foundations or walls to reduce the possibility of slab cracking caused by differential movements between the slab and foundation. It is critical to maintain moisture contents of slab subgrade as close to final preparation conditions as practical.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

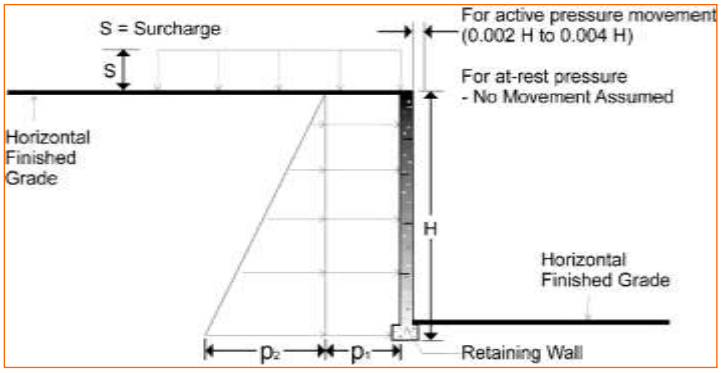
Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for this application and wet environments.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be

influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The “at-rest” condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	**Coefficient for Backfill Type** [2]	**Surcharge Pressure** [3, 4, 5] **p_1 (psf)**	**Effective Fluid Pressures (psf)** [2, 4, 5]	
			Unsaturated [6]	**Submerged** [6]
Active (Ka)	Granular - 0.36	(0.36)S	(45)H	(85)H
At-Rest (Ko)	Granular - 0.53	0.53)S	(65)H	(95)H
Passive (Kp)	Granular - 2.77	---	(330)H	(220)H

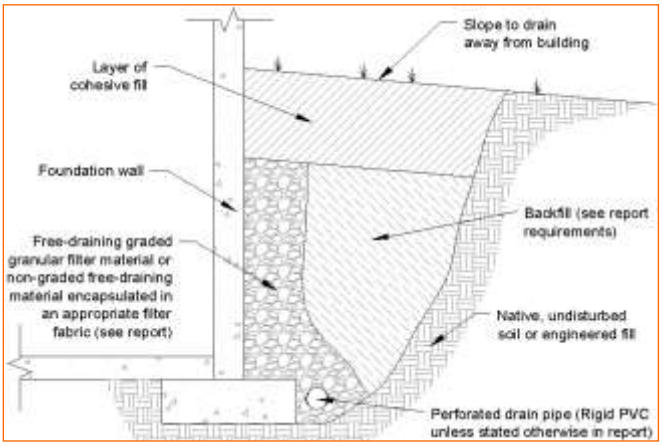
1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 98% of the ASTM D1557 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. To achieve “Unsaturated” conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. “Submerged” conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

The wall designer should perform standard wall design practices including analysis for overturning, sliding, bearing capacity, and global stability, and results of these analyses should be provided for our review. Additional sampling, laboratory testing and document review associated with retaining walls is beyond the original scope of work but can be performed as a separate scope, for a separate fee.

SLOPE STABILITY

Mechanics of Stability

Slope stability analyses take into consideration material strength, presence and orientation of weak layers, water, surcharge loads, and the slope geometry. Mathematical computations are performed using computer-assisted simulations to calculate a Factor of Safety (FS). Minor changes to slope geometry, surface water flow and/or groundwater levels could result in slope instability. Reasonable FS values are dependent upon the confidence in the parameters utilized in the analyses performed, among other factors related to the project itself.

Geometric Analysis Results

One slope stability analysis was performed for the pump station wet well using geometries obtained from the Intake Piping Profile, Sheet C1.2, dated October 2020. Parameters for the analyses were derived from our exploratory borings, experience, and laboratory tests. Stability analyses were conducted using the computer program Slide Version 6.033 developed by Rocscience Inc.

Soil and bedrock properties used in the analyses are shown below:

Material	Moist Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
Clayey Sand	120	25	28
New Compacted Sand Fill	120	25	32
Sandstone	120	500	34

Where encountered, we recommend that the existing fill soils be completely removed and replaced as compacted structural fill prior to placement of new fill soils. It appears the existing fill soils will be removed as part of remedial earthwork operations to construct the pump house and wet well. The existing fill soils were modeled as newly compacted fill soils in our analysis.

Based on the analyses, the calculated factor of safety (FS) for the critical surface identified at the section under several scenarios are shown below. The slope stability results are included in the **Supporting Information** of this report.

Cross-Section	Minimum Calculated FS
Section A-A' without groundwater	1.8
Section A-A' with groundwater	1.7
Section A-A' with rapid drawdown (short-term)	0.9

Cross-Section	Minimum Calculated FS
Section A-A' with rapid drawdown and reinforced zone (short-term)	1.3

The typically accepted minimum Factor of Safety (FS) for long-term global stability is 1.5, and the FS for short-term global stability is 1.2. Short-term conditions were considered when water from Woodmoor Lake would be drained and the adjacent soils remained saturated.

Results indicate that the slope section analyzed satisfies the conditions for long-term stability. Under conditions of rapid drawdown, the analysis shows that the slope does not satisfactorily provide short-term stability without modification.

Potential solutions to increase the stability of the slopes include installing a gravel or concrete keyway near the toe of the slope, flattening the slope by adding additional compacted soils near the toe, the use of ground improvement methods such rammed aggregate piers, or reinforcing the slopes with geotextiles. Given the area will be an open excavation at the time of construction, it is our opinion adding three layers of geogrid reinforcement spaced evenly throughout the fill at the time of fill placement would adequately reinforce the area for short-term stability.

Surficial Slope Stability

It is anticipated that vegetation will be disturbed during construction. We recommend that surficial stability be considered in the development of the property. Surficial slope instability typically impacts the upper 3 feet of the subsurface profile, predominantly during extended wet periods. Regular maintenance should be anticipated to identify and address changes in natural drainage creating potential for soil creep or erosion near improvements. This includes replacing or replanting trees and grasses, as necessary, and grading the slope to reduce soil creep and erosion. If future surficial slope erosion occurs near the crest of slopes, we recommend the slope face be restored as soon as practical. Irrigated landscaping should not be used on or near the crest of slopes. We recommend that the existing vegetation and native vegetation not requiring additional irrigation be used to vegetate slopes.

Fill slopes should be re-vegetated as soon as possible after grading and protected from erosion until vegetation is established. Slope planting should consist of ground cover, shrubs, and trees possessing deep, dense root structures that require minimal irrigation. It is the responsibility of the owner to maintain such planting.

CORROSIVITY

The table below lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-

site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary						
Boring	**Sample Depth (feet)**	**Soil Description**	**Soluble Sulfate (%)**	**Soluble Chloride (%)**	**Electrical Resistivity (Ω-cm)**	**pH**
SB-1	19	Sandstone Bedrock	0.004	0.0010	5,291	8.0
SB-3	4	Fill-Clayey Sand	0.002	0.0013	2,947	6.2
SB-6	1-5	Clayey sand/Silty Sandstone	<0.001	0.0011	7,077	7.4

We recommend a certified corrosion engineer be employed to determine the need for corrosion protection and to design appropriate protective measures. Results of water-soluble sulfate testing indicate that samples of the on-site soils have an exposure class of S0 when classified in accordance with Table 19.3.1.1 of the American Concrete Institute (ACI) Design Manual. The results of the testing indicate ASTM Type I Portland Cement is suitable for project concrete in contact with on-site soils. However, if there is little impact to cost, we recommend the use of ASTM Type I/II Modified Portland Cement for additional sulfate resistance of construction concrete. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur beyond the exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party

beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

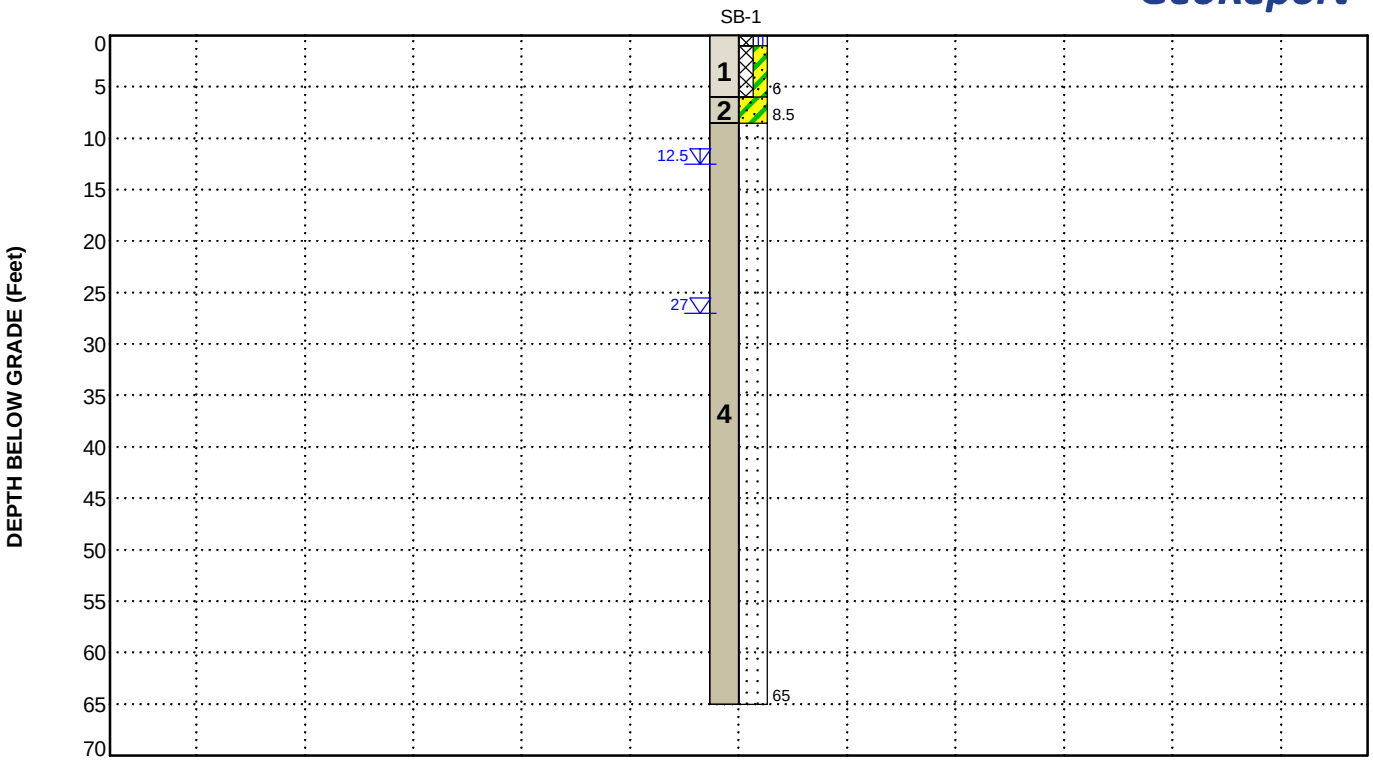
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

GEOMODEL

Woodmoor Lake Pump Station and Pipeline ■ Monument, CO
Terracon Project No. 23205117



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Fill	Generally consisting of sand with various amounts of clay and silt; fine to coarse grained; tan, brownish gray, gray, brown, and dark brown; very loose to medium dense.
2	Sand	With various amounts of clay and silt; fine to coarse grained; tan, light brown, brown, dark brown, reddish brown, light gray, and dark gray; loose to dense.
3	Weathered Sandstone Bedrock	With silt; fine to coarse grained; light brown; firm to medium hard.
4	Sandstone Bedrock	With various amounts of silt and clay; fine to coarse grained; tan, light brown, light grayish brown, and light gray; medium hard to very hard.

LEGEND

Well-graded Sand with Silt

Clayey Sand

Sandstone

First Water Observation

Second Water Observation

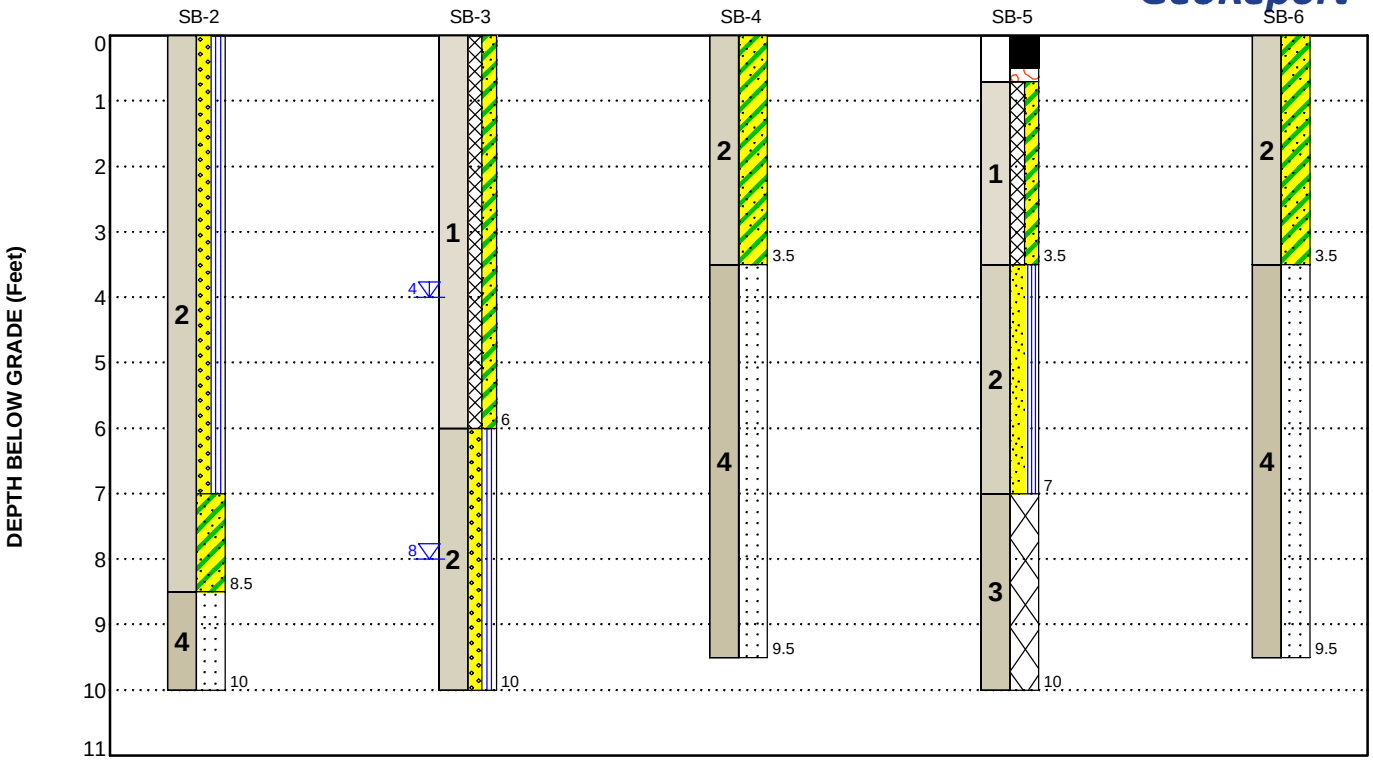
Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL

Woodmoor Lake Pump Station and Pipeline ■ Monument, CO
Terracon Project No. 23205117

Terracon GeoReport



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Model Layer	Layer Name	General Description
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3	Weathered Sandstone Bedrock	With silt; fine to coarse grained; light brown; firm to medium hard.
4	Sandstone Bedrock	With various amounts of silt and clay; fine to coarse grained; tan, light brown, light grayish brown, and light gray; medium hard to very hard.

LEGEND

- Well-graded Sand with Silt
- Asphalt
- Weathered Rock
- Clayey Sand
- Aggregate Base Course
- Sandstone
- Poorly-graded Sand with Silt

▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Location
1	65	Planned pump station
5	10	Planned water line

Boring Layout and Elevations: We used handheld GPS equipment to locate the borings with an estimated horizontal accuracy of ±20 feet. Elevations were not obtained in the field.

Subsurface Exploration Procedures: We advanced the soil borings with an ATV-mounted drill rig using continuous flight augers. Four samples were obtained in the upper 10 feet and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. A 3-inch outer diameter split-barrel sampling spoon with 2.5-inch inner diameter ring lined sampler was used for sampling in the upper 14 feet. Ring-lined, split-barrel sampling procedures were similar to standard split spoon sampling procedure; however, blow counts were recorded for 6-inch intervals for a total of 12 inches of penetration. The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. Groundwater was not encountered within the boring at the time of drilling and sampling.

Our exploration team prepared field boring logs as part of standard drilling operations which included the sampling depths, penetration distances, and other relevant sampling information. The field log includes visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. The final boring logs, prepared from the field logs, represents the geotechnical engineer's interpretation, and include modifications based on observations and laboratory tests.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. The following testing was performed:

- Water content
- Unit dry weight
- Atterberg limits

- Grain size analyses
- Consolidation/expansion
- Chemical Analyses – pH, Sulfates, Chloride Ion, Electrical Resistivity

The laboratory testing program included examination of the soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System. Rock classification was performed using locally accepted procedures.

PHOTOGRAPHY LOG

Near Boring SB-1 Facing Northwest

Near Boring SB-1 Facing East

Near Boring SB-1 Facing South

Near Boring SB-1 Facing Southwest

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Woodmoor Lake Pump Station and Pipeline ■ Monument, CO
December 14, 2020 ■ Terracon Project No. 23205117

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: PALMER LAKE, CO (1994) and MONUMENT, CO (1986). VICINITY OF PROPOSED WATER LINE ALIGNMENT PROVIDED BY JVA.

EXPLORATION PLAN

Woodmoor Lake Pump Station and Pipeline ■ Monument, CO
December 14, 2020 ■ Terracon Project No. 23205117

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

SLOPE STABILITY CROSS SECTION LOCATION PLAN

Woodmoor Lake Pump Station and Pipeline ■ Monument, CO
December 14, 2020 ■ Terracon Project No. 23205117

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. SB-1

PROJECT: Woodmoor Lake Pump Station and Pipeline

CLIENT: JVA Inc
Boulder, CO

SITE: Woodmoor Drive and Lake Woodmoor Drive
Monument, CO

LOCATION See Exploration Plan

Latitude: 39.098° Longitude: -104.8566°

MODEL LAYER	DEPTH		FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1	1.0	**FILL - WELL GRADED SAND WITH SILT (SW-SM)**, fine to coarse grained, tan	6-7	9	116		
1	6.0	**FILL - CLAYEY SAND (SC)**, fine to coarse grained, brownish gray, loose White fragment of plastic encounteerd in 2-foot sample.	5-8	7	117		
2	8.5	**CLAYEY SAND (SC)**, fine to coarse grained, light gray, medium dense	12-33	8	122		
4		**SANDSTONE**, with clay, light gray, hard to very hard	50/8"	10	117		
4			40-50/4"	11	123		
4			33-50/5" N=83/11"	16			
4			29-43-50/6" N=93	14			
4			33-50/5" N=50/5"	15			
4			40-50/2" N=50/2"	14			
4			36-34-44 N=78	12			
4			33-50/5" N=50/5"	16			
4			35-50/5" N=50/5"	14			
4			46-50/3" N=50/3"	16			
4			40-50/3" N=50/3"	14			
4	65.0		42-50/4" N=50/4"	18			
		Boring Terminated at 65 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch hollow stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings after subsequent groundwater readings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

27 feet while drilling

12.5 feet about 48 hours after drilling

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 11-12-2020 | Boring Completed: 11-12-2020

Drill Rig: CME-55 Track | Driller: Vine Laboratories

Project No.: 23205117

BORING LOG NO. SB-2

PROJECT: Woodmoor Lake Pump Station and Pipeline

CLIENT: JVA Inc
Boulder, CO

SITE: Woodmoor Drive and Lake Woodmoor Drive
Monument, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.0967° Longitude: -104.8572° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**WELL GRADED SAND WITH SILT (SW-SM)**, fine to coarse grained, light brown, medium dense to dense								
						21-32	1	122		
						33-48	5	115		
			5							
		7.0								
		CLAYEY SAND (SC), fine to coarse grained, reddish brown, medium dense				15-28	14	117	32-20-12	36
		8.5								
4		**SANDSTONE**, with silt, fine to coarse grained, light grayish brown, very hard				26-50/6"	11	120		
		10.0	10							
		Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings after subsequent groundwater readings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered while drilling

Not encountered about 48 hours after drilling

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 11-13-2020 | Boring Completed: 11-13-2020

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23205117

BORING LOG NO. SB-3

PROJECT: Woodmoor Lake Pump Station and Pipeline

CLIENT: JVA Inc
Boulder, CO

SITE: Woodmoor Drive and Lake Woodmoor Drive
Monument, CO

LOCATION See Exploration Plan

Latitude: 39.0969° Longitude: -104.859°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FILL - CLAYEY SAND (SC)**, medium to coarse grained, gray and dark brown, very loose to loose								
						10-8	6	107		
				▽						
						2-2	26	88		
			5							
2		6.0 **WELL GRADED SAND WITH SILT (SW-SM)**, fine to coarse grained, dark gray and dark brown, loose to medium dense								
		Rootlets and possible decomposed grass encountered in 7-foot sample.				2-8	20	103		
				▽						
						9-12	12	120	26-25-1	11
		10.0 ***Boring Terminated at 10 Feet***	10							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings after subsequent groundwater readings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *8 feet while drilling*

▽ *4 feet about 48 hours after drilling*

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 11-13-2020 | Boring Completed: 11-13-2020

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23205117

BORING LOG NO. SB-4

PROJECT: Woodmoor Lake Pump Station and Pipeline

CLIENT: JVA Inc
Boulder, CO

SITE: Woodmoor Drive and Lake Woodmoor Drive
Monument, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.0993° Longitude: -104.8591° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**CLAYEY SAND (SC)**, fine to coarse grained, tan, medium dense								
						12-21	11	124		
		3.5								
4		**SILTY SANDSTONE**, fine to coarse grained, tan, medium hard to very hard	5			26-50/6"	8	123	27-23-4	16
						50/5"	9	112		
		9.5				50/6"	10	106		
		Boring Terminated at 9.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings after subsequent groundwater readings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered while drilling

Not encountered about 48 hours after drilling

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 11-13-2020 | Boring Completed: 11-13-2020

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23205117

BORING LOG NO. SB-5

PROJECT: Woodmoor Lake Pump Station and Pipeline

CLIENT: JVA Inc
Boulder, CO

SITE: Woodmoor Drive and Lake Woodmoor Drive
Monument, CO

LOCATION See Exploration Plan

Latitude: 39.1023° Longitude: -104.8598°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.5								
		ASPHALT, approximately 5-inches thick								
		0.7								
		APPARENT AGGREGATE BASE COURSE, brown, approximately 2-inches thick								
1		**FILL - CLAYEY SAND (SC)**, trace gravel, fine to medium grained, brown, medium dense				12-12	6	125		
		3.5								
2		**POORLY GRADED SAND WITH SILT (SP-SM)**, light brown, medium dense	5			7-19	21	98		
		7.0								
3		**WEATHERED SANDSTONE**, with silt, fine to coarse grained, light brown, firm to medium hard				17-18	5	114		
		With clay at 9 feet.				25-38	10	119		
		10.0	10							
		Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings and capped with asphalt after subsequent groundwater readings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered while drilling

Not encountered about 48 hours after drilling

Terracon
4172 Center Park Dr
Colorado Springs, CO

Boring Started: 11-13-2020 | Boring Completed: 11-13-2020

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23205117

BORING LOG NO. SB-6

PROJECT: Woodmoor Lake Pump Station and Pipeline

CLIENT: JVA Inc
Boulder, CO

SITE: Woodmoor Drive and Lake Woodmoor Drive
Monument, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.1049° Longitude: -104.8589° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**CLAYEY SAND (SC)**, fine to coarse grained, brown, loose								
						5-11	4	104		
		3.5								
4		**SILTY SANDSTONE**, fine to coarse grained, light brown, hard to very hard	5			37-50/4"	9	119		
						50/6"	9	121	31-27-4	31
		9.5				50/4"	9	94		
		Boring Terminated at 9.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings after subsequent groundwater readings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered while drilling

Not encountered about 48 hours after drilling

Terracon
4172 Center Park Dr
Colorado Springs, CO

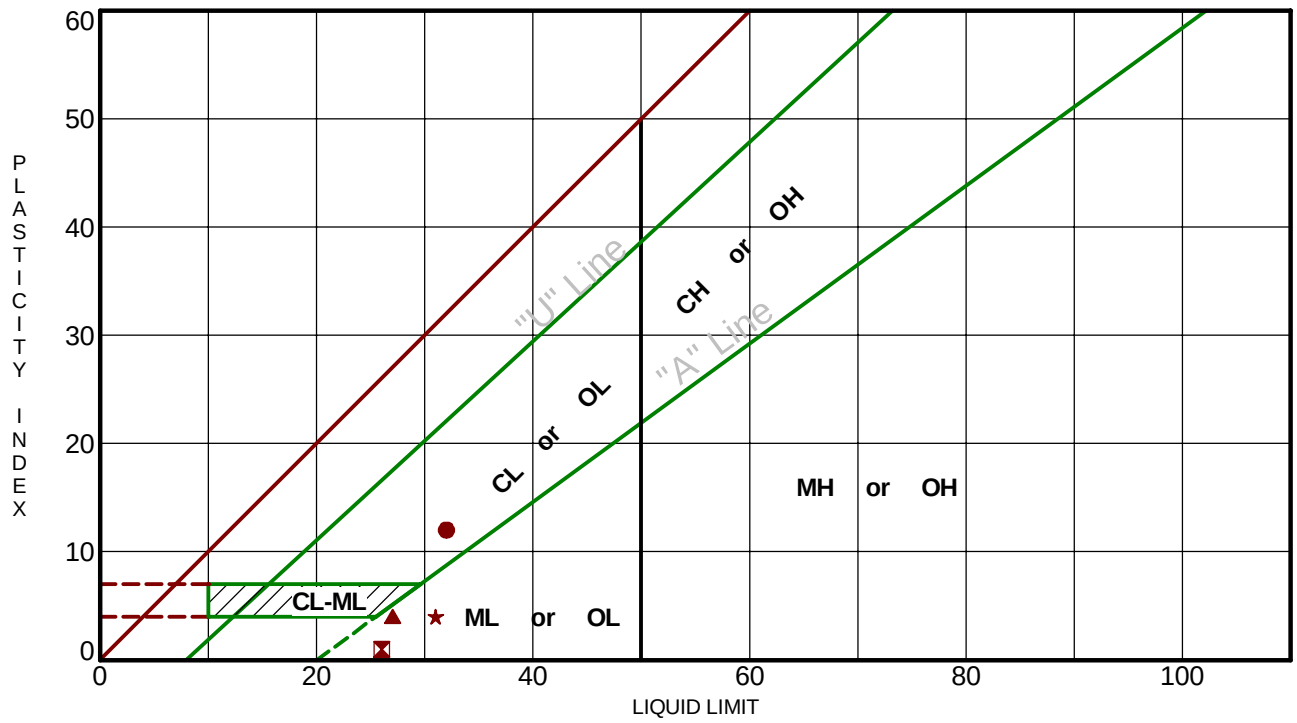
Boring Started: 11-13-2020 | Boring Completed: 11-13-2020

Drill Rig: CME-55 | Driller: Vine Laboratories

Project No.: 23205117

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	SB-2	7 - 8	32	20	12	35.6	SC	CLAYEY SAND
⊠	SB-3	9 - 10	26	25	1	10.8	SW-SM	WELL-GRADED SAND with SILT
▲	SB-4	4 - 5	27	23	4	16.3	SM	SILTY SAND
★	SB-6	7 - 7.5	31	27	4	31.3	SM	SILTY SAND

PROJECT: Woodmoor Lake Pump Station and Pipeline

SITE: Woodmoor Drive and Lake Woodmoor Drive
Monument, CO

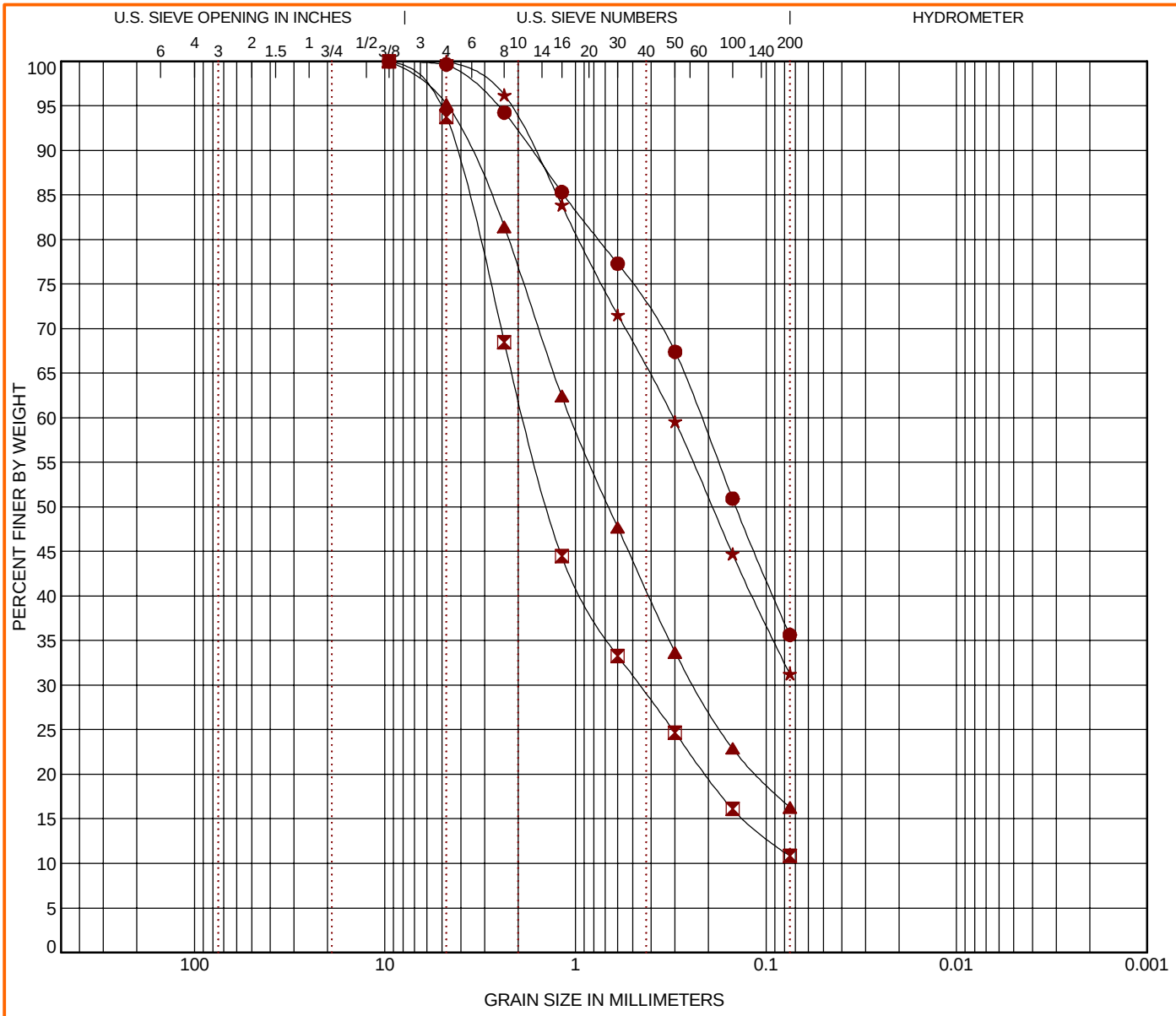
Terracon
4172 Center Park Dr
Colorado Springs, CO

PROJECT NUMBER: 23205117

CLIENT: JVA Inc
Boulder, CO

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	SB-2	7 - 8	CLAYEY SAND (SC)	14	32	20	12		
⊠	SB-3	9 - 10	WELL-GRADED SAND with SILT (SW-SM)	12	26	25	1	1.71	27.49
▲	SB-4	4 - 5	SILTY SAND (SM)	8	27	23	4		
★	SB-6	7 - 7.5	SILTY SAND (SM)	9	31	27	4		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	SB-2	7 - 8	9.5	0.22			0.0	0.3	64.0		35.6	
⊠	SB-3	9 - 10	9.5	1.848	0.461		0.0	6.2	82.9		10.8	
▲	SB-4	4 - 5	9.5	1.055	0.237		0.0	4.8	78.9		16.3	
★	SB-6	7 - 7.5	4.75	0.307			0.0	0.0	68.7		31.3	

PROJECT: Woodmoor Lake Pump Station and Pipeline

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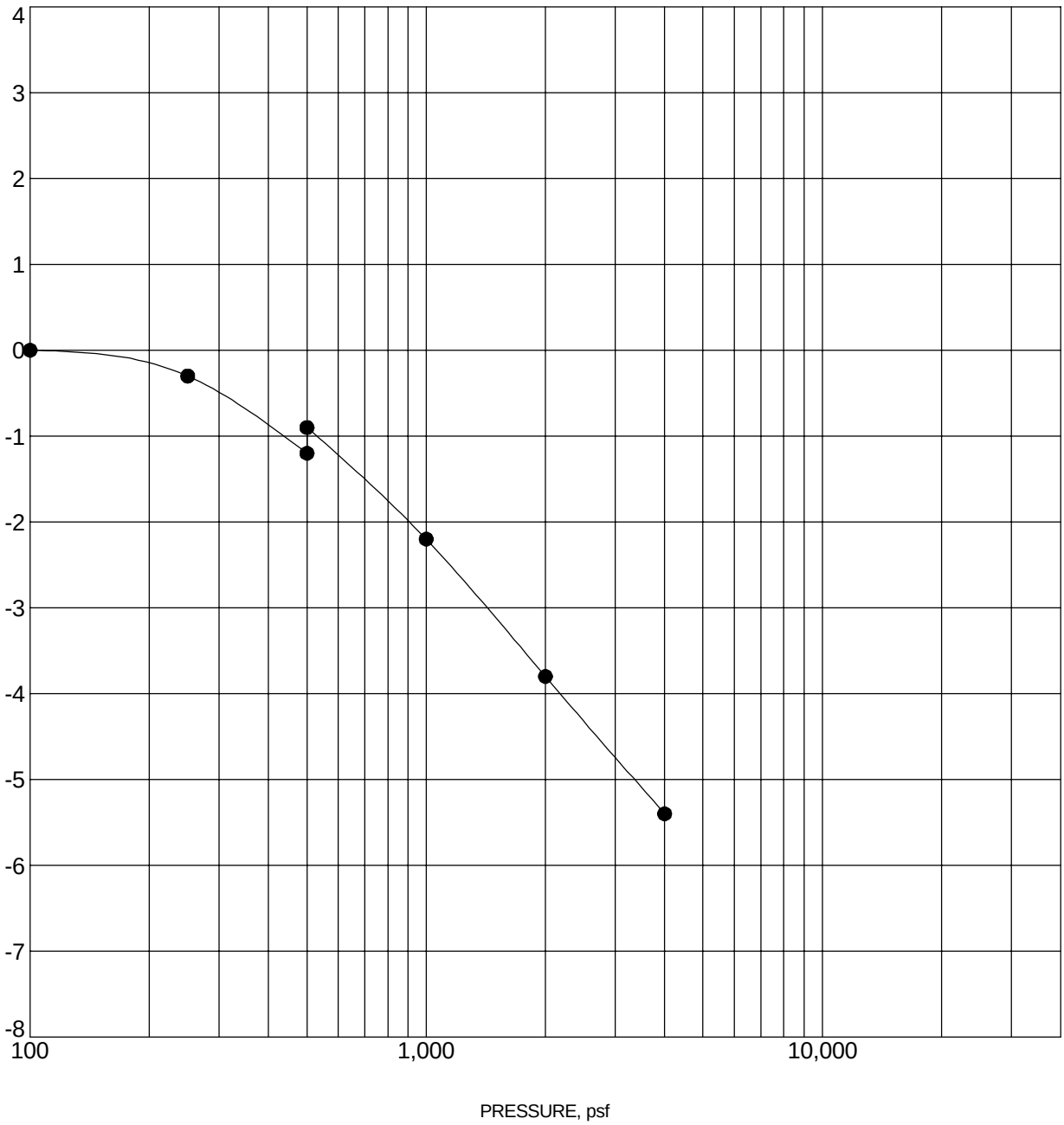
CLIENT: JVA Inc
Boulder, CO

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 23205117 WOODMOOR LAKE PUMP - CHECKEDOUTNDH.GPJ TERRACON_DATATEMPLATE.GDT 12/2/20

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d, pcf	WC, %
●	SB-2	7 - 8 ft	CLAYEY SAND(SC)	117	14

NOTES: Sample inundated with water at an applied pressure of 500 pounds per square foot (psf).

PROJECT: Woodmoor Lake Pump Station and Pipeline

SITE: Woodmoor Drive and Lake Woodmoor Drive Monument, CO

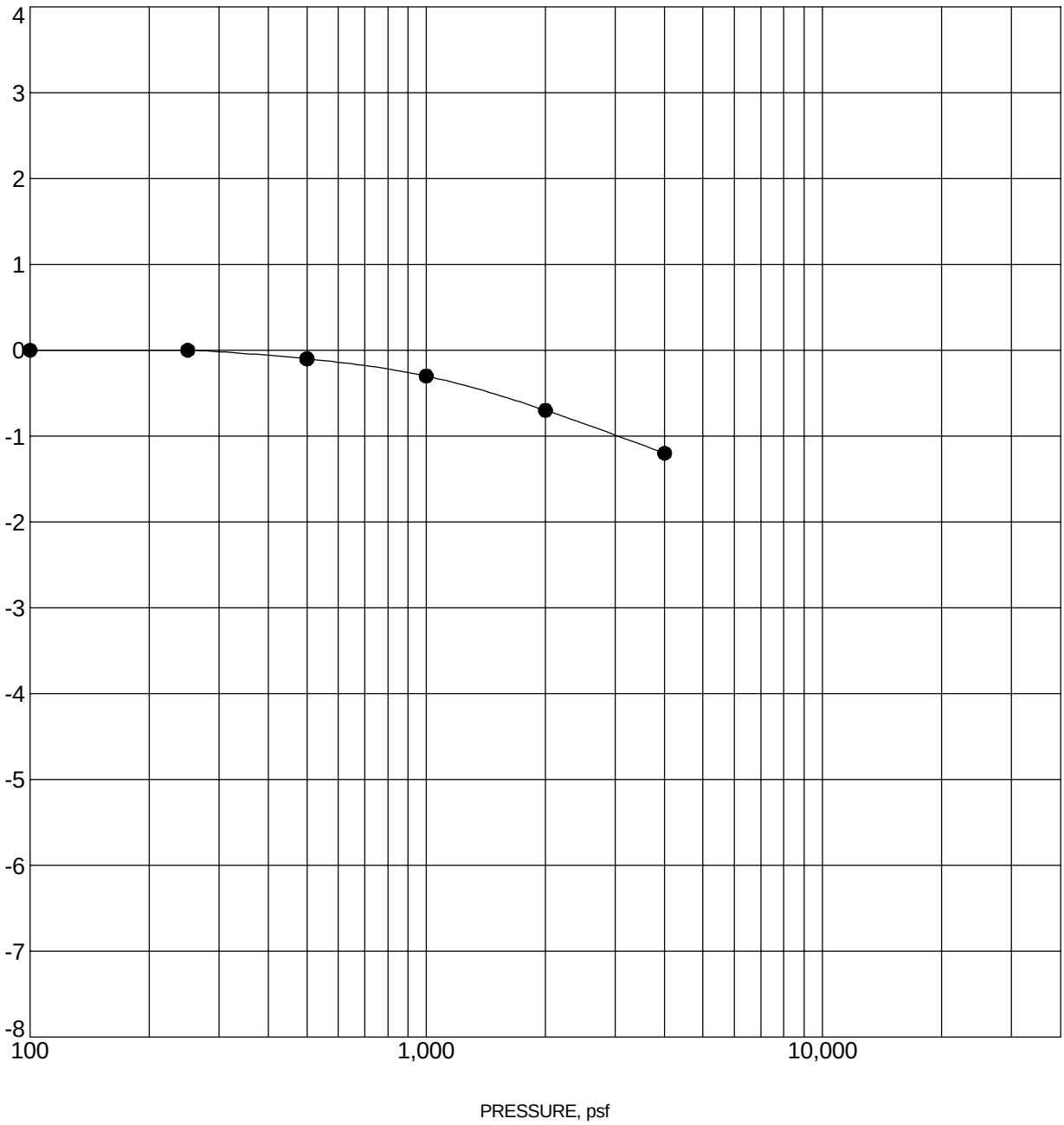
Terracon
4172 Center Park Dr
Colorado Springs, CO

PROJECT NUMBER: 23205117

CLIENT: JVA Inc
Boulder, CO

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d, pcf	WC, %
●	SB-3	7 - 8 ft	WELL-GRADED SAND WITH SILT (SW-SM)	103	20

NOTES: Sample inundated with water at an applied pressure of 500 pounds per square foot (psf).

PROJECT: Woodmoor Lake Pump Station and Pipeline

SITE: Woodmoor Drive and Lake Woodmoor Drive Monument, CO

Terracon
4172 Center Park Dr
Colorado Springs, CO

PROJECT NUMBER: 23205117

CLIENT: JVA Inc
Boulder, CO

Colorado Analytical LABORATORIES, INC.

Analytical Results

TASK NO: 201117056

Report To: Tyler Compton
Company: Terracon, Inc. - Colo Springs
4172 Center Park Drive
Colo. Springs CO 80916

Bill To: Tyler Compton
Company: Terracon, Inc. - Accounts Payable
18001 W. 106th St
Suite 300
Olathe KS 66061

Task No.: 201117056
Client PO:
Client Project: Woodmoor Lake Pump 23205117

Date Received: 11/17/20
Date Reported: 11/23/20
Matrix: Soil - Geotech

Customer Sample ID SB-1 @ 19
Lab Number: 201117056-01

Test	Result	Method
Chloride - Water Soluble	**0.0010 %**	AASHTO T291-91/ ASTM D4327
pH	**8.0 units**	AASHTO T289-91
Resistivity	**5291 ohm.cm**	AASHTO T288-91
Sulfate - Water Soluble	**0.004 %**	AASHTO T290-91/ ASTM D4327

Customer Sample ID SB-3 @ 4 Ft
Lab Number: 201117056-02

Test	Result	Method
Chloride - Water Soluble	**0.0013 %**	AASHTO T291-91/ ASTM D4327
pH	**6.2 units**	AASHTO T289-91
Resistivity	**2947 ohm.cm**	AASHTO T288-91
Sulfate - Water Soluble	**0.002 %**	AASHTO T290-91/ ASTM D4327

Customer Sample ID SB-6 @ 1 - 5 Ft
Lab Number: 201117056-03

Test	Result	Method
Chloride - Water Soluble	**0.0011 %**	AASHTO T291-91/ ASTM D4327
pH	**7.4 units**	AASHTO T289-91
Resistivity	**7077 ohm.cm**	AASHTO T288-91
Sulfate - Water Soluble	**< 0.001 %**	AASHTO T290-91/ ASTM D4327

Abbreviations/ References:

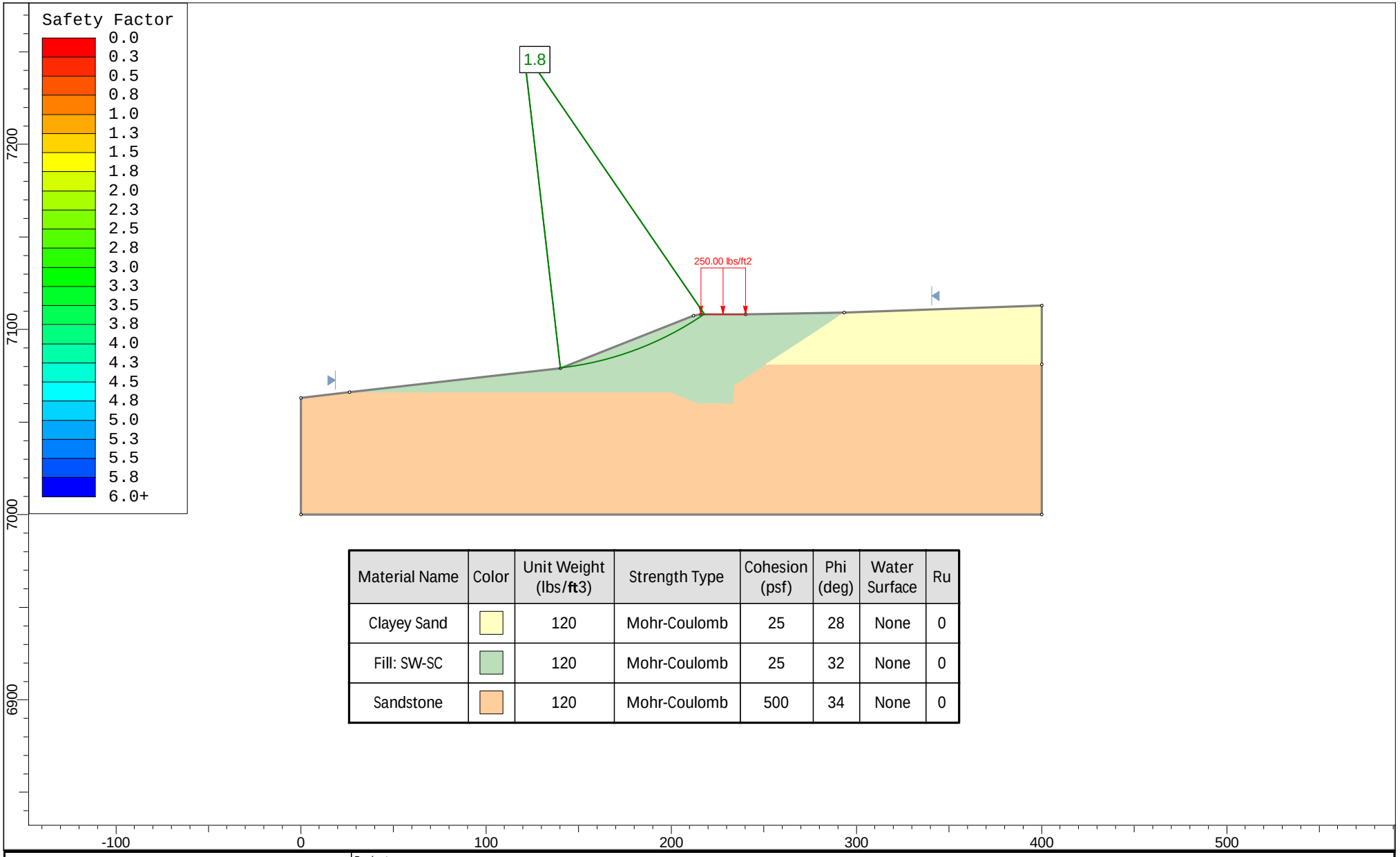
AASHTO - American Association of State Highway and Transportation Officials.
ASTM - American Society for Testing and Materials.
ASA - American Society of Agronomy.
DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe.

DATA APPROVED FOR RELEASE BY

SUPPORTING INFORMATION

Contents:

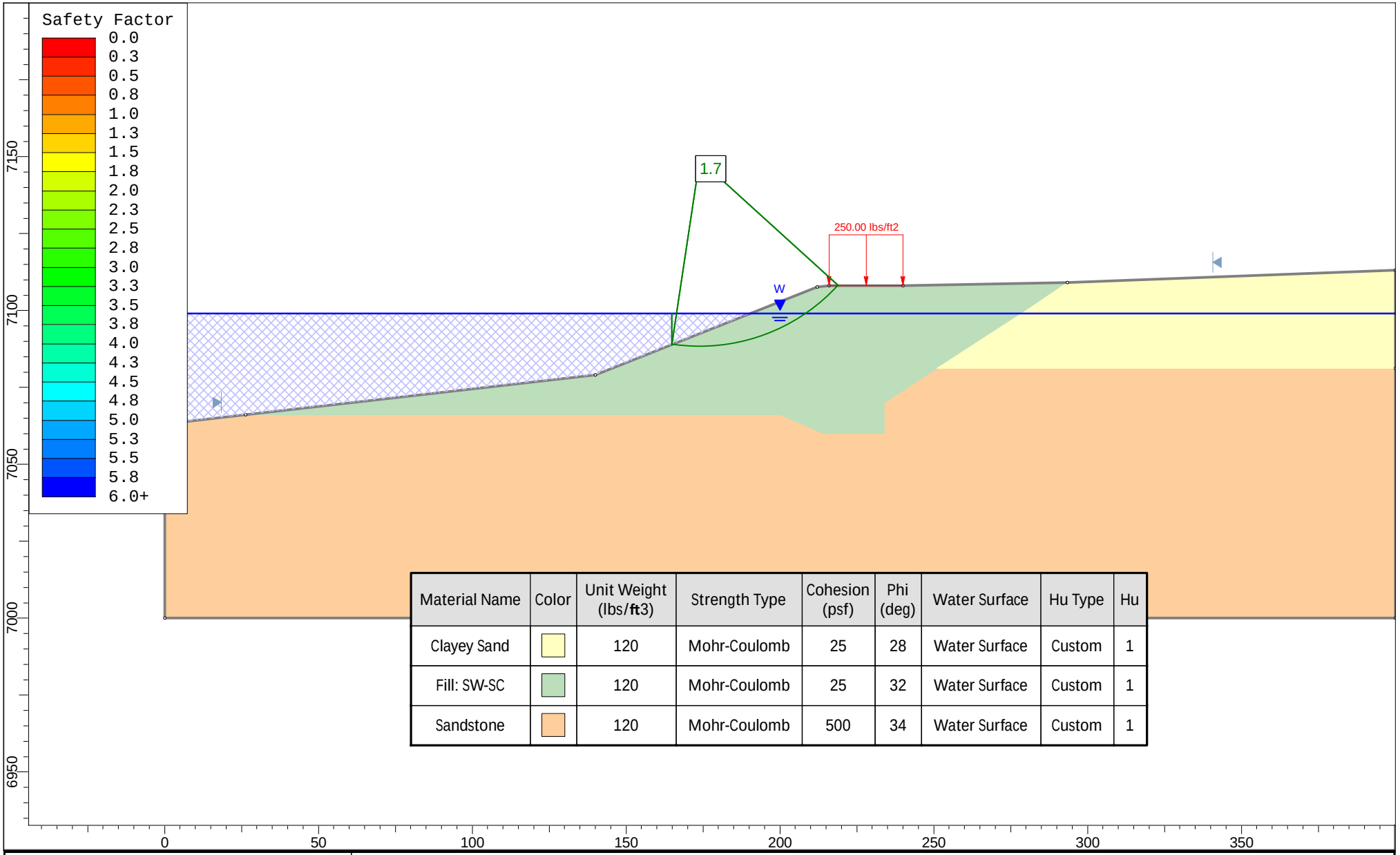
Note: All attachments are one page unless noted above.



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Clayey Sand		120	Mohr-Coulomb	25	28	None	0
Fill: SW-SC		120	Mohr-Coulomb	25	32	None	0
Sandstone		120	Mohr-Coulomb	500	34	None	0

SLIDEINTERPRET 6.038

Project	Woodmoor Lake Pump Station - Dry Lake		
Analysis			
Drawn By		Scale 1:860	Company
Date	12/11/2020, 11:25:44 AM		File Name Slide - Woodmoor Lake Pump Station Dry.slim

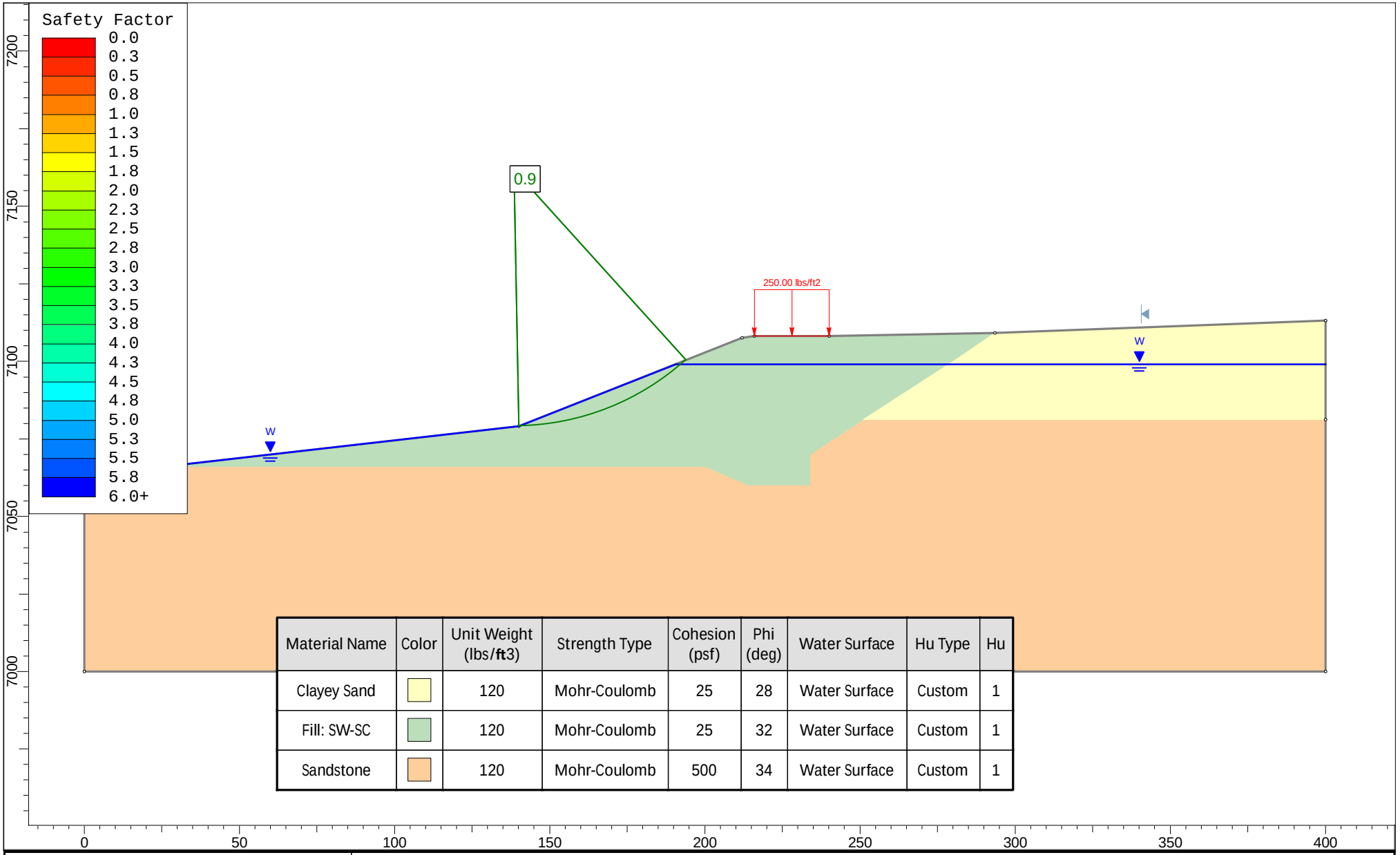


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Clayey Sand		120	Mohr-Coulomb	25	28	Water Surface	Custom	1
Fill: SW-SC		120	Mohr-Coulomb	25	32	Water Surface	Custom	1
Sandstone		120	Mohr-Coulomb	500	34	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 6.038

Project	Woodmoor Lake Pump Station - Full Lake		
Analysis			
Drawn By		Scale 1:517	Company
Date	12/11/2020, 11:25:44 AM		File Name Slide - Woodmoor Lake Pump Station.slim

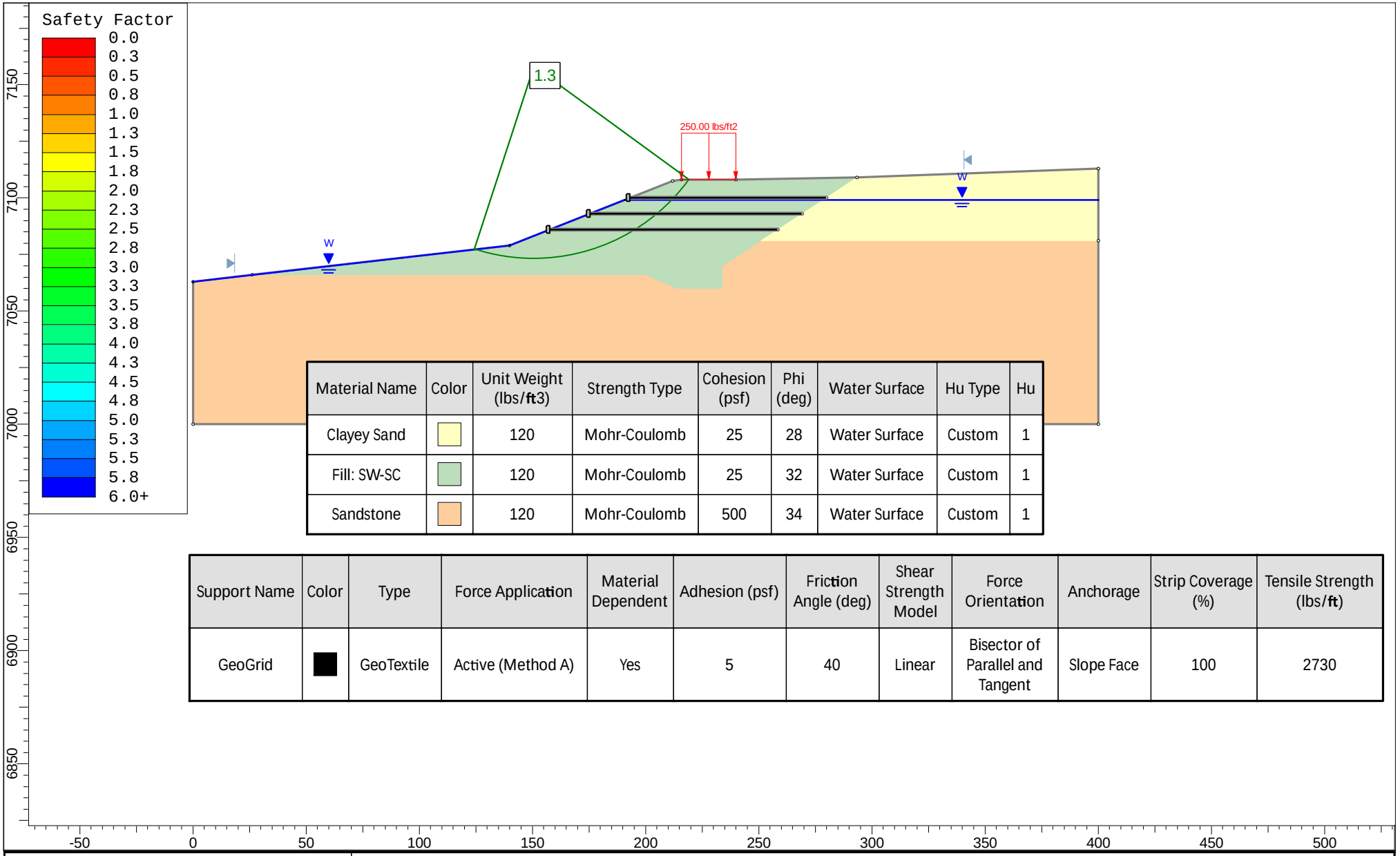


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Clayey Sand		120	Mohr-Coulomb	25	28	Water Surface	Custom	1
Fill: SW-SC		120	Mohr-Coulomb	25	32	Water Surface	Custom	1
Sandstone		120	Mohr-Coulomb	500	34	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 6.038

Project	Woodmoor Lake Pump Station - Rapid Lake Drain		
Analysis			
Drawn By		Scale 1:513	Company
Date	12/11/2020, 11:25:44 AM		File Name Slide - Woodmoor Lake Pump Station Rapid Lake Drain.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Clayey Sand		120	Mohr-Coulomb	25	28	Water Surface	Custom	1
Fill: SW-SC		120	Mohr-Coulomb	25	32	Water Surface	Custom	1
Sandstone		120	Mohr-Coulomb	500	34	Water Surface	Custom	1

Support Name	Color	Type	Force Application	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
GeoGrid		GeoTextile	Active (Method A)	Yes	5	40	Linear	Bisector of Parallel and Tangent	Slope Face	100	2730

SLIDEINTERPRET 6.038

Project: Woodmoor Lake Pump Station - Rapid Lake Drain with GeoGrid

Analysis:

Drawn By:

Scale: 1:703

Company:

Date: 12/11/2020, 11:25:44 AM

File Name: Slide - Woodmoor Lake Pump Station Rapid Lake Drain.slim

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS
Woodmoor Lake Pump Station and Pipeline ■ Monument, CO
Terracon Project No. 23205117

Terracon GeoReport

SAMPLING

Modified Dames & Moore Ring Sampler

Grab Sample

Standard Penetration Test

WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Cave In Encountered

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium Stiff	0.50 to 1.00	4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 4.00	> 30	> 42			

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.