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Transportation
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GEOTECHNICAL ENGINEERING REPORT
I-15 DMS Signs
KEY No. 25186
ONEIDA & BANNOCK COUNTIES

Submitted To: Idaho Department of Transportation
5151 S 5th Ave.
Pocatello, Idaho 83204
Attn:

Subject: GEOTECHNICAL ENGINEERING REPORT

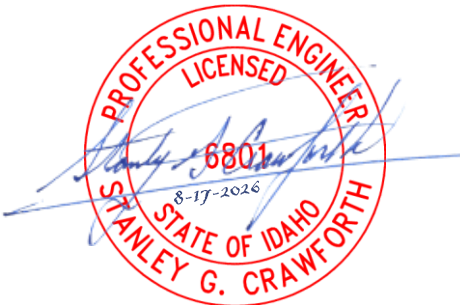
I-15 DMS SIGNS
KEY NO. 25186
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Shannon & Wilson prepared this report as a consultant to the Idaho Transportation Department. Our scope of services was specified in Agreement No. 97631 with the Idaho Transportation Department, dated July 28, 2026, and in the Scope of Services dated July 23, 2026. This report presents the results of our field exploration, laboratory testing, geotechnical analyses, and reporting and was prepared by the undersigned.

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

Sincerely,

SHANNON & WILSON



Stanley G. Crawford, PE
Geotechnical Engineer

A handwritten signature in black ink, appearing to read "Tri Buu".

Tri Buu, P.E.
Geotechnical Engineer

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Important Information

GEOTECHNICAL ENGINEERING REPORT

230.00 Introduction

This Geotechnical Engineering Report presents the results of a subsurface site exploration performed by Shannon & Wilson and provides recommendations for the design of foundations for two proposed Digital Message Signs (DMS) along Interstate 15 (I-15). One DMS is located near MP 6.22 in the northbound lane, south of Pocatello, and the other is located near MP 60.0 in the southbound lane, west of Inkom, Idaho.

Vicinity maps showing the sign locations are provided in Appendix A.

LRFD Design Methodology

Recommendations presented in this report are intended for use with the Load and Resistance Factor Design (LRFD) method outlined in the 1st edition of the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (2015), including current interims; the 10th edition of the AASHTO LRFD Bridge Design Specifications (2024), including current interims; the ITD Standard Specifications for Highway Construction (2023); and the 2025 ITD Supplemental Specifications for the 2023 ITD Standard Specifications for Highway Construction.

Proposed Structures

The proposed Digital Message Sign locations are shown on the Exploration Location Map in Appendix A and are summarized in the following table.

Structure Type and Location	
Structure No. and Type	Location
Digital Message Sign #1 (DMS #1)	I-15, MP. 60.0, SBL
Digital Message Sign #2 (DMS #2)	I-15, MP. 6.22, NBL

Each Digital Message Sign will be supported by a drilled shaft foundation.

It is anticipated that the Contractor or sign manufacturer will design the drilled shaft foundations for the Digital Message Signs.

Estimated foundation loads for the Digital Message Signs are not available. Vertical loads acting on the drilled shaft foundations are expected to be relatively low, and the drilled

shaft foundation design is expected to be controlled by lateral loads or overturning moments acting at the tops of the drilled shafts.

230.01 Field Exploration and Laboratory Testing

Borings

Shannon & Wilson conducted subsurface explorations in July 2026. The explorations included drilling two borings, SW-01 and SW-02, to obtain subsurface information at the proposed DMS locations. The boring locations are shown on the Exploration Location Map in Appendix B and summarized in the following table.

Summary of Subsurface Explorations				
Structure No. and Type	Location	Boring No.	Collar Elevation (feet)	Depth (feet)
Digital Message Sign # 1 (DMS 1)	I -15, SBL, MP. 60.0	SW - 01	4644.0	31.5
Digital Message Sign # 2 (DMS 2)	I -15, NBL, MP. 6.22	SW - 02	4618.5	31.5

The collar elevations shown in the above table were estimated from Google Earth and are provided for general reference only.

Shannon & Wilson performed the drilling with a Simco 2800 drill rig using hollow-stem augers to advance the borings. The subsurface soils encountered in the borings were sampled using a split-spoon sampler.

A Shannon & Wilson representative classified the soils encountered in the borings in general accordance with ASTM D2488 visual-manual classification procedures. The exploration boring logs, including sampling depths and descriptions of the materials encountered, are included in Appendix B.

The boring locations were marked in the field by a Shannon & Wilson representative at locations provided by the Idaho Transportation Department. Boring coordinates and elevations were determined by Shannon & Wilson. The elevation datum is NAVD88.

Field Tests

Field testing included Standard Penetration Tests (SPT) performed with an automatic hammer in accordance with ASTM D1586 to evaluate the relative density of cohesionless soils and the stiffness of cohesive soils. The SPT N-values are included on the exploration boring logs in Appendix B.

Geophysical Exploration

A geophysical survey was not performed.

Laboratory Tests

Soil samples were selected for laboratory testing to evaluate pertinent physical and engineering properties. The following laboratory tests were performed on samples obtained during the subsurface exploration:

- Gradation (ASTM C136 & C422): for grain size distribution
- Classification (ASTM D2487): to classify soil using the USCS system
- Moisture Content (ASTM D2216): for in-situ water content of soil
- Atterberg Limits (ASTM D4318): to determine the Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI) of soil
- Direct Shear (ASTM D3080): to evaluate soil shear strength under consolidated drained conditions

The laboratory test results are shown on the exploration boring logs in Appendix B and on the laboratory test data sheets in Appendix C. The soil classifications shown on the boring logs are based on ASTM D2487 laboratory test methods.

230.02 Surface Conditions

At DMS #1 (Boring SW-01), the ground slopes downward away from the roadway at about a 16-degree angle from horizontal. At DMS #2 (Boring SW-02), the ground surface is relatively flat.

Manmade features include the existing interstate I-15 embankments, a center median, and roadway drainage ditches.

Stormwater drainage is provided by roadside drainage ditches.

230.03 Subsurface Conditions

Subsurface conditions encountered at the boring locations are shown on the exploration boring logs in Appendix B.

Stratification boundaries shown on the logs indicate the approximate locations of changes in subsurface strata. In situ, transitions between strata may be gradual or abrupt, and subsurface conditions may vary between boring locations.

Based on the results of the site exploration, generalized subsurface profiles were developed to support discussion of subsurface conditions at the proposed digital message sign locations. The generalized subsurface profiles are described in the following sections.

Soil Profiles

Soil Profile at DMS #1 (I-15, MP 60.0, Boring SW-01)

Asphalt Concrete

Asphalt concrete was encountered from the ground surface to a depth of about 0.75 foot below the ground surface (BGS).

Silt with Sand (ML)

Medium dense silt with sand existed below the asphalt concrete to a depth of about 5 feet BGS. The Standard Penetration Test (SPT) N-value was 25 blows per foot of penetration (bpf).

Lean Clay with Sand (CL)

Stiff lean clay with sand existed below the silt with sand to a depth of 7.5 feet BGS. The SPT N-value was 11 blows per foot of penetration.

Fat Clay with Gravel (CH)

Very stiff fat clay with gravel existed below the lean clay with sand. This stratum extended to a depth of about 10 feet BGS. The SPT N-value was 23 blows per foot of penetration.

Silt with Sand (ML)

Medium dense silt with sand existed below the fat clay with gravel to a depth of about 11 feet BGS. The SPT N-value was 16 blows per foot of penetration.

Lean Clay (CL)

Lean clay existed below the silt with sand to a depth of about 12.5 feet BGS.

Gravelly Fat Clay with Sand (CH)

Very stiff to hard gravelly fat clay with sand existed below the lean clay to a depth of about 18 feet BGS. SPT N-values ranged from 24 to 46 blows per foot of penetration, with an average N-value of about 35 blows per foot of penetration.

Fat Clay (CH)

Fat clay existed below the gravelly fat clay with sand to a depth of about 20 feet BGS.

Silt with Gravel (ML)

Loose to medium dense silt with gravel existed below the lean clay with sand to a depth of about 30 feet BGS. SPT N-values ranged from 5 to 13 blows per foot of penetration, with an average N-value of about 9 blows per foot of penetration.

Silt with Sand (ML)

Loose silt with sand existed below the silt with gravel to a depth of 31.5 feet BGS, the bottom of Boring SW-01. The SPT N-value was 6 blows per foot of penetration.

Soil Profile at DMS #2 (I -15, MP 6.22, Boring SW- 02)Clayey Sand with Gravel (SC)

Medium dense clayey sand with gravel existed from the ground surface to a depth of about 7.5 feet BGS. SPT N-values ranged from 12 to 17 blows per foot of penetration, with an average N-value of about 12 blows per foot of penetration.

Lean Clay with Sand (CL)

Firm lean clay with sand existed below the clayey sand to a depth of about 9.2 feet BGS. The SPT N-value was 8 blows per foot of penetration.

Gravel with Sand (GP)

Dense gravel with sand existed below the lean clay with sand. This stratum extended to a depth of about 13 feet BGS. The SPT N-value was 32 blows per foot of penetration.

Poorly Graded Sand with Silt and Gravel (SP-SM)

Dense to very dense poorly graded sand with silt and gravel existed below the gravel with sand to a depth of about 18 feet BGS. SPT N-values ranged from 39 to 75 blows per foot of penetration, with an average N-value of about 57 blows per foot of penetration. The high SPT N-values may have been affected by larger-diameter gravel in the stratum.

Fat Clay with Sand (CH)

Stiff fat clay with sand existed below the sand with silt and gravel to a depth of about 25 feet BGS. The SPT N-value was 15 blows per foot of penetration.

Gravelly Lean Clay with Sand (CL)

Stiff gravelly lean clay with sand existed below the fat clay with sand to a depth of about 30.8 feet BGS. The SPT N-value was 14 blows per foot of penetration.

Lean Clay with Sand (CL)

Very stiff lean clay with sand existed below the gravelly lean clay with sand to a depth of 31.5 feet BGS, the bottom of Boring SW-02. The SPT N-value was 19 blows per foot of penetration.

Groundwater

Groundwater was not encountered in the two borings to a depth of 31.5 feet below ground surface at the time of the site exploration in July 2026.

Groundwater levels at this site could fluctuate due to rainfall runoff or other factors. Observation of seasonal groundwater fluctuations was beyond the scope of this report.

Frost

The recommended frost depth in the project area is 2.5 feet.

Corrosion

According to the USDA NRCS Soil Resource Report, the corrosion potential of the surface soils is moderate for concrete and moderate for uncoated steel.

The corrosion potential mentioned herein is only applicable to concrete and steel structures placed in direct contact with site subgrade soils. Corrosion potential may be mitigated for structures by soil separation using imported aggregates.

230.04 Conclusions and Recommendation

General

Based on the subsurface conditions encountered at the boring locations, the two proposed Digital Message Signs can be supported by drilled shaft foundations.

The following sections provide recommended design parameters and construction considerations for the drilled shaft foundations. If the nature, design, location, or construction of the proposed digital message signs changes after this report is submitted, Shannon & Wilson should review the recommendations and modify them as necessary.

Foundations

Spread Footings

Due to past preference and performance of drilled shaft foundations in the region, spread footing foundations are not recommended.

Deep Foundations

Drilled shaft foundations are recommended for support of the two digital message signs.

It is recommended that the drilled shafts have a minimum diameter of 3 feet and a minimum embedment of 12 feet below final grade at the digital message sign locations. It is also recommended that axial side resistance of the drilled shafts be neglected in the upper 2 feet of the soil profile.

Axial Drilled Shaft Resistance

Recommended soil design parameters and nominal, unfactored unit side resistance and unit tip resistance values for Strength and Extreme Limit State design are provided in the following tables. The soil properties were estimated based on reference tables by Hough (1957) and field test results. The design parameters are conservative, and axial movement at the shaft tip is expected to be small due to the anticipated low axial loads for the digital message signs.

Digital Message Sign #1 (I-15, MP 60.0, Boring SW-01)

Recommended Design Parameters for Axial Resistance of Drilled Shafts							
Soil Type (Consistency)	Depth (Elevation) (ft)	Effective Unit Weight ⁽¹⁾ (pcf)	Ave. SPT N- Value	Undrained Shear Strength (ksf)	Friction Angle (deg)	Nominal (Unfactored) Axial Unit Resistance	
						Unit Side Resistance (ksf)	Unit Tip Resistance (ksf)
Silt with Sand (Med. Dense)	0 - 5 ⁽²⁾	115	25	N/A	32	0.50 σ_v ⁽³⁾	18
Lean Clay with Sand / Fat Clay / Fat Clay with Gravel and Sand (Stiff to Hard)	5 - 20	115	24	3	N/A	1.0	15
Silt with Sand and Gravel (Loose to Med. Dense)	20 - 31.5	95	8	N/A	27	0.30 σ_v ⁽³⁾	6

NOTES:

- 1 Groundwater was not encountered to depth of 31.5 feet during site exploration.
- 2 Ignore upper 2 feet of soil profile for drilled shaft axial resistance.
- 3 σ_v is the effective vertical stress (ksf) at the midpoint of the drilled shaft length in the soil stratum.

Digital Message Sign # 2 (I-15, MP 6.22, Boring SW-02)

Recommended Design Parameters for Axial Resistance of Drilled Shafts							
Soil Type (Consistency)	Depth (Elevation) (ft)	Effective Unit Weight ⁽¹⁾ (pcf)	SPT N- Value	Undrained Shear Strength (ksf)	Friction Angle (deg)	Nominal (Unfactored) Axial Unit Resistance	
						Unit Side Resistance (ksf)	Unit Tip Resistance (ksf)
Clayey Sand with Gravel / Lean Clay with Sand (Loose to Med. Dense)	0 – 9 ⁽²⁾	100	12	N/A	29	0.30 σ_v ⁽³⁾	6
Gravel with Sand / Sand with Silt and Gravel (Dense to Very Dense)	9 – 18	115	35	N/A	34	0.70 σ_v ⁽³⁾	20
Fat, Lean Clay with Sand (Stiff to Very Stiff)	18 – 31.5	110	16	1.75	N/A	0.60	10

NOTES:

- 1 Groundwater was not encountered to depth of 31.5 feet during site exploration.
- 2 Ignore upper 2 feet of soil profile for drilled shaft axial resistance.
- 3 σ_v is the effective vertical stress (ksf) at the midpoint of the drilled shaft length in the soil stratum.

For Strength Limit State design, a resistance factor of 0.50 can be assumed for nominal tip resistance, and a resistance factor of 0.55 can be assumed for nominal side resistance of a drilled shaft.

Lateral Drilled Shaft Resistance

Lateral deflection at the top of the drilled shaft should be evaluated in accordance with Articles 10.4.1 and 10.4.2 of the latest version of the *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. It is recommended that lateral resistance of the drilled shafts be neglected in the upper 2 feet of the soil profile.

Based on the information obtained from the borings and subsequent laboratory testing, the design parameters provided in the following tables may be assumed for analysis of drilled shafts under horizontal loading at the digital message sign locations.

Digital Message Sign #1 (I-15, MP 60.0, Boring SW- 01)

Recommended Design Parameters for Lateral Resistance of Drilled Shafts							
Soil Type	Depth (Elevation) (ft)	Effective Unit Weight ⁽¹⁾ (pcf)	SPT N- Value	Undrained Cohesion (psf)	Friction Angle (deg)	Modulus of Lateral Subgrade Reaction k (pci)	Strain at 50% Peak Stress ϵ_{50}
Silt with Sand (Med. Dense)	0 - 5 ⁽²⁾	115	25	N/A	32	90	N/A
Lean Clay with Sand / Fat Clay / Fat Clay with Gravel and Sand (Stiff to Hard)	5 - 20	115	24	3000	N/A	N/A	0.005
Silt with Sand and Gravel (Loose to Med. Dense)	20 – 31.5	95	8	N/A	27	25	N/A

NOTES:

1. Groundwater was not encountered to depth of 31.5 feet during site exploration.
2. Ignore upper 2 feet of soil profile for drilled shaft axial resistance.
3. Modeled as Stiff Clay without Free Water in LPILE analysis.

Digital Message Sign #2 (I-15, MP 6.22, Boring SW-02)

Recommended Design Parameters for Lateral Resistance of Drilled Shafts							
Soil Type	Depth (Elevation) (ft)	Effective Unit Weight ⁽¹⁾ (pcf)	SPT N- Value	Undrained Cohesion (psf)	Friction Angle (deg)	Modulus of Lateral Subgrade Reaction k (pci)	Strain at 50% Peak Stress ϵ_{50}
Clayey Sand with Gravel / Lean Clay with Sand (Loose to Med. Dense)	0 – 9 ⁽²⁾	100	12	N/A	29	25	N/A
Gravel with Sand / Sand with Silt and Gravel (Dense to Very Dense)	9 – 18	115	35	N/A	34	225	N/A
Lean Clay with Sand (Stiff to Very Stiff)	18 – 31.5	110	16	1750	N/A	N/A	0.02

NOTES:

1. Groundwater was not encountered to depth of 31.5 feet during site exploration.
- 2.. Ignore upper 2 feet of soil profile for drilled shaft axial resistance.
3. Modeled as Stiff Clay without Free Water in LPILE analysis.

The design parameters provided in the tables above are for use in the LPILE computer analysis program, version 2022 or later. If a computer program other than LPILE is used for lateral load analysis, Shannon & Wilson should be contacted to re-evaluate the parameters or initial lateral subgrade modulus values (k).

The sign foundation designer should perform an LPILE analysis for the drilled shaft foundations based on the actual shaft diameter and depth, shaft properties and steel reinforcement, and loading conditions, including overturning moments. The designer should assess whether cracking of the drilled shaft concrete is expected under the design loads, because cracking could affect the drilled shaft properties and lateral load analysis.

Torsional Resistance

To calculate nominal shaft torsional resistance for drilled shafts embedded in cohesionless soils, use a soil-drilled shaft interface friction angle of $2/3\Phi$, where Φ is the soil friction angle.

To calculate nominal torsional resistance for drilled shafts embedded in cohesive soils, use a soil-drilled shaft interface adhesion equal to 0.40 times the undrained shear strength.

A resistance factor of 0.5 can be used for Strength Limit State design. Neglect torsional resistance at the base of the shaft.

Uplift Resistance

Drilled shaft nominal uplift resistance can be considered equivalent to the shaft nominal side resistance. A resistance factor of 0.40 can be used for Strength Limit State design. Uplift resistance should include the weight of the drilled shaft.

230.05 Lateral Pressures and Backfill

Not applicable to this project.

230.06 Anchors

Not applicable to this project.

230.07 Erosion Control

An erosion and sediment control plan should be prepared for this project.

230.08 Seismic Design

The coordinates for DMS #1 are latitude 42.7998°N and longitude 112.3067°W. The coordinates for DMS #2 are latitude 42.08914°N and longitude 112.2184°W.

Based on the field exploration results, the site geology, and Table 3.10.3.1-1 of the *AASHTO LRFD Bridge Design Specifications*, the subsurface profile at the project site can be designated as Site Class D.

The following table provides the Peak Ground Acceleration coefficient (PGA), short- and long-period spectral acceleration coefficients (S_s and S_1) for Site Class B, site factors for Site Class D (F_{pga} , F_a , and F_v), and modified accelerations for Site Class D that can be used for seismic design of the digital message signs.

Acceleration Coefficients for Response Spectrum – DMS # 1 (7% probability of being exceeded in 75 years) (1,000-year return period and 5% critical damping)			
Period (Seconds)	Standard Acceleration Coefficients for Site Class B	Site Factor for Site Class D	Modified Acceleration Coefficients for Site Class D
0.0	PGA = 0.167	F _{pga} = 1.47	A _s = 0.25
0.2	S _s = 0.40	F _a = 1.48	SD _s = 0.59
1.0	S ₁ = 0.125	F _v = 2.36	SD ₁ = 0.29

Acceleration Coefficients for Response Spectrum – DMS # 2 (7% probability of being exceeded in 75 years) (1,000-year return period and 5% critical damping)			
Period (Seconds)	Standard Acceleration Coefficients for Site Class B	Site Factor for Site Class D	Modified Acceleration Coefficients for Site Class D
0.0	PGA = 0.197	F _{pga} = 1.40	A _s = 0.28
0.2	S _s = 0.478	F _a = 1.41	SD _s = 0.68
1.0	S ₁ = 0.154	F _v = 2.18	SD ₁ = 0.34

The risk of liquefaction or seismic settlement at this project site is low due to the density of the subsurface soils, the depth to groundwater, the high fines content of the soils, and the relatively low seismic acceleration values.

230.09 Construction

Drilled Shaft Construction

Drilled shaft construction should be in accordance with ITD's SP – Drilled Shaft for Digital Message Signs.

Open excavations, precast foundations, and formed cast-in-place foundations requiring excavation backfill should not be allowed.

The recommendations provided in this report are for properly constructed drilled shafts with full-time observation of the drilling and concrete placement procedures by the Engineer.

The design parameters are based on the assumption that the shaft excavation will be advanced with a conventional flight auger. If other shaft or pile excavation methods are proposed, the shaft design parameters provided herein may not be applicable.

The coarse-grained nature of the subsurface soils could result in caving conditions. Temporary steel casing will be required to prevent excessive raveling or caving soil from entering the shaft.

The bottom of the drilled shaft excavations should be cleaned of loose soil material before the reinforcement cage and concrete are placed. The Contractor should have a pump available to remove water that may flow into the drilled shaft due to storm events or surface drainage at locations where groundwater is not present.

Concrete placed in dry shafts should not strike the reinforcing steel or sidewall during free fall, as this may cause segregation. A tremie pipe or concrete pump can be used to place the concrete in the drilled shaft excavation.

When temporary steel casing is used, the concrete should be poured to the top of the shaft before the temporary casing is pulled. The casing should be pulled immediately, or as soon as possible, after concrete placement is complete.

If water is present in the drilled shaft excavation at the time of concrete placement, a rigid steel tremie pipe is required. The Contractor must verify that the rigid steel tremie pipe extends to the bottom of the drilled shaft excavation before concrete placement begins. The bottom of the tremie pipe or concrete pump line should be kept at least 8 feet below the top of the concrete during placement.

The Contractor will need to pump or direct water displaced by concrete placement in the drilled shaft excavations, or water pumped from temporary casing, to an approved collection area.

The geotechnical engineer should be on site during shaft excavation to evaluate construction methods and confirm that significant sloughing, caving, or other sidewall disturbance does not occur. If such disturbance occurs, excavation activities must stop until the drilling methods are modified to provide sufficient lateral confinement.

Temporary Cuts

Construction site safety and evaluation of appropriate temporary excavation and construction slopes are the sole responsibility of the Contractor, who selects and directs the means, methods, and sequencing of construction operations. The Contractor must be familiar with and comply with applicable local, state, and federal safety regulations, including current OSHA Excavation and Trench Safety Standards for temporary excavations and construction slopes.

Utilities

Existing utility lines will need to be protected, relocated, replaced, or otherwise monitored by the Contractor so that excavation and construction of the drilled shafts, or other project-related activities, do not cause damage or settlement to the existing utility lines.

230.10 Appendices

- Appendix A: Vicinity Map
- Appendix B: Exploration Location Map, Exploration Boring Logs
- Appendix C: Laboratory Test Data

230.11 Foundation Investigation Plat

Not applicable to this project.

230.12 Current Specifications and Minimum Testing Requirements

This Geotechnical Engineering Report is based on the following documents:

- Idaho Transportation Department (ITD). 2021. Materials Manual.
- Idaho Transportation Department (ITD). 2019. Quality Assurance Manual.
- Idaho Transportation Department (ITD). 2023. Standard Specifications for Highway Construction.
- Idaho Transportation Department (ITD). 2025. 2025 Supplemental Specifications for 2023 Standard Specifications for Highway Construction.

230.13 Modifications to Standard Specifications

There will be no modifications to the 2023 Standard Specifications for Highway Construction or the 2025 Supplemental Specifications for the 2023 Standard Specifications for Highway Construction.

230.14 Special Provision Items

Just before PS&E, obtain the Special Provision for Drilled Shaft Foundations for Digital Message Signs from Anthony Beauchamp, State Geotechnical Engineer at ITD Headquarters, phone number 208-334-8554, email anthony.beauchamp@itd.idaho.gov, or from Tyler Coy, phone number 208-334-8436, email tyler.coy@itd.idaho.gov.

230.15 References

Guides, Specifications, and Textbooks

American Association of State Highway and Transportation Officials. 2024. *AASHTO LRFD Bridge Design Specifications*. 10th Edition.

American Association of State Highway and Transportation Officials. 2015. *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. 1st Edition.

Hough, B.K. 1957. *Basic Soils Engineering*. New York: Ronald Press.

ITD Sources

Idaho Transportation Department (ITD). 2023. *Standard Specifications for Highway Construction*.

Idaho Transportation Department (ITD). 2025. *Supplemental Specifications for 2023 Standard Specifications for Highway Construction*.

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Reports

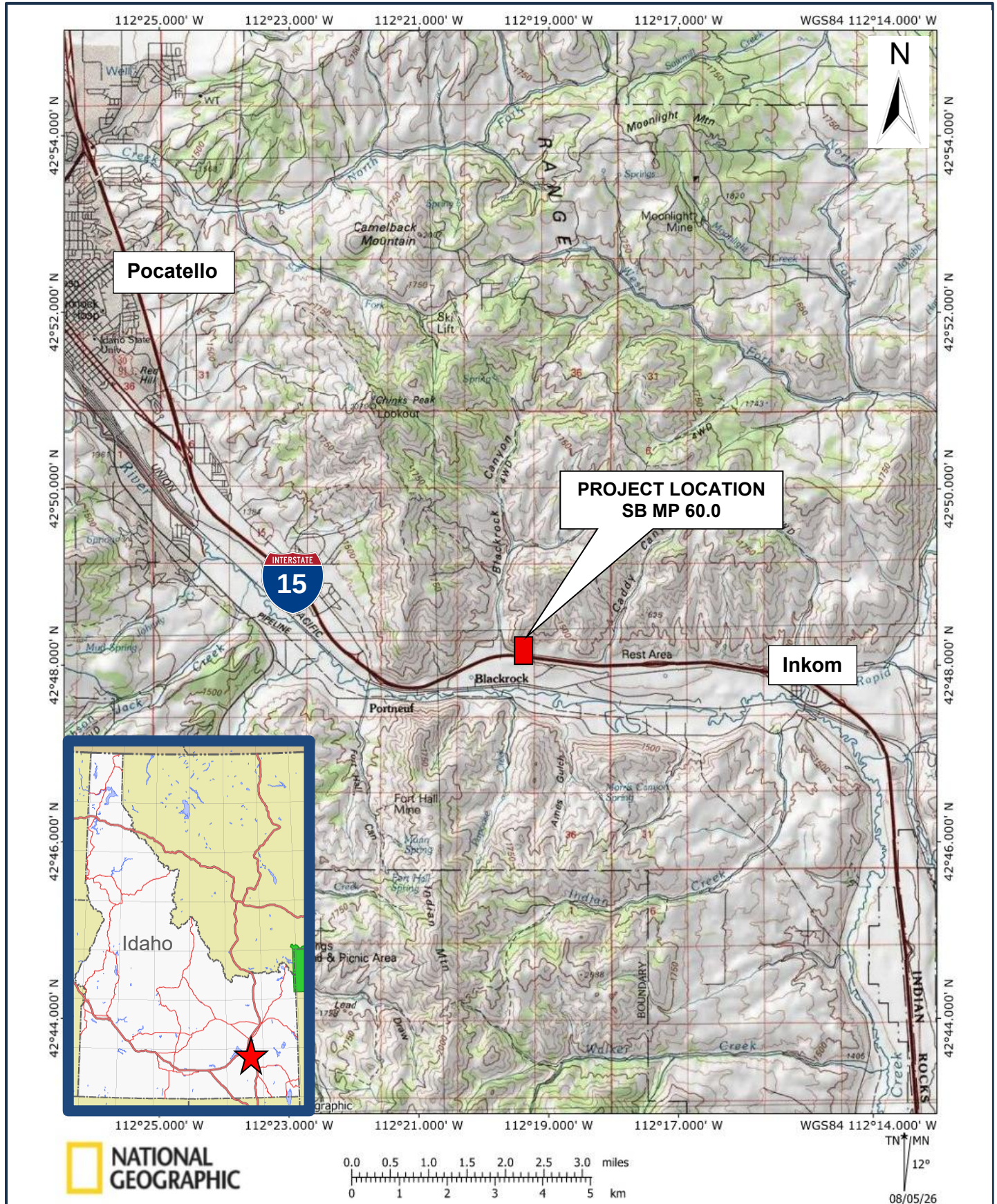
USDA NRCS. "Soil Resource Report for Oneida and Bannock County Area, Idaho." Web Soil Survey. [https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home /](https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/)

Appendix A

General Information & Site Data

CONTENTS

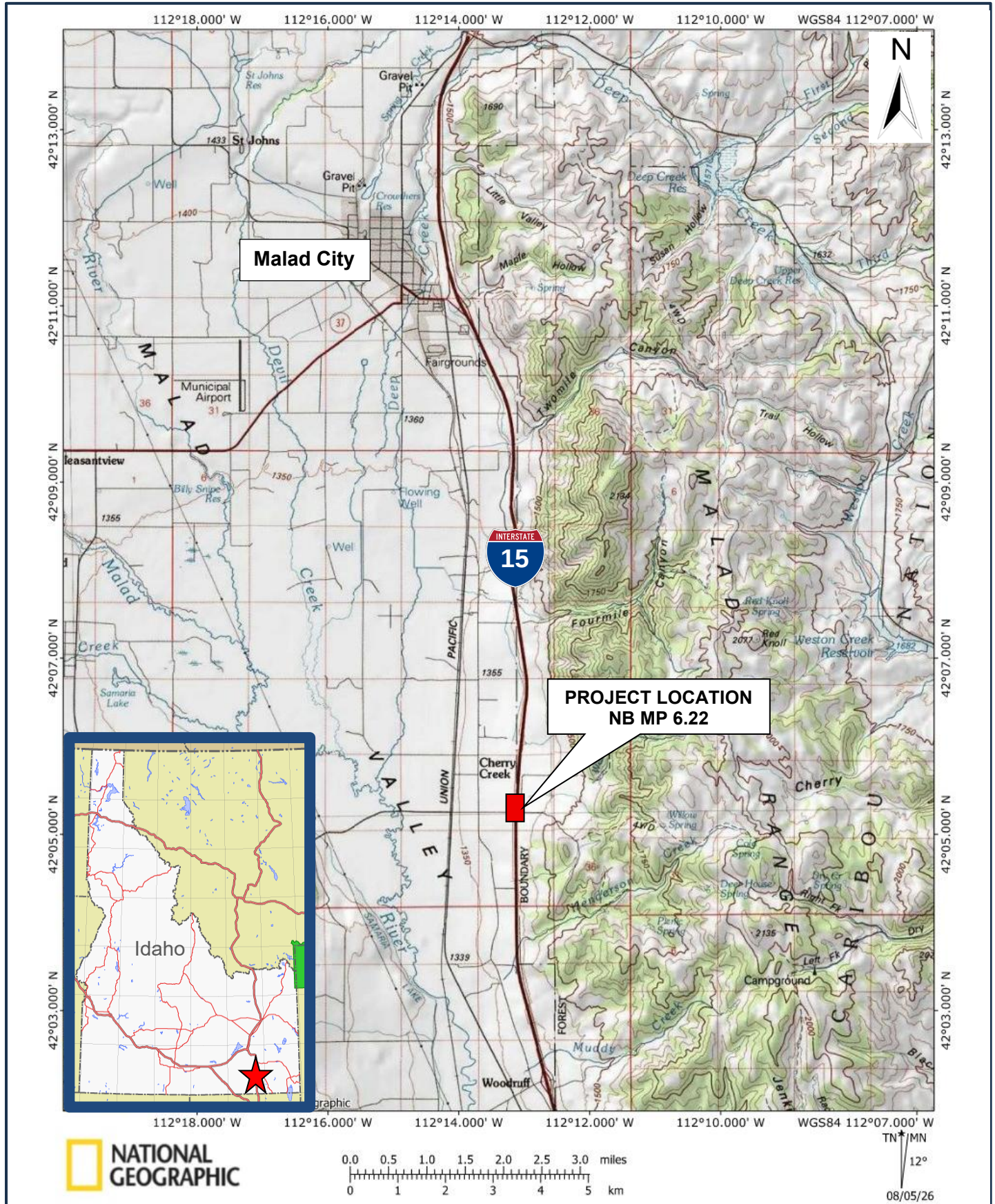
Vicinity Maps



VICINITY MAP

August 2026

FIGURE 1.0



VICINITY MAP
August 2026
FIGURE 1.2

Appendix B

Subsurface Exploration Data

CONTENTS

Exploration Location Map

Boring Logs

APPENDIX B: SUBSURFACE EXPLORATION DATA

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User: FAC Plot Date: 8/17/2026 11:11:13 AM File Name: 71-118021 Exploration Location Map t1 PREP 08-17-26.dwg



LEGEND

SW-01

 Boring Designation and Approximate Location

DMS #1

 Foundation Designation and Approximate Location

Checked: SGC

User: FAC Plot Date: 8/17/2026 11:11:13 AM File Name: 71-118021 Exploration Location Map t1 PREP 08-17-26.dwg

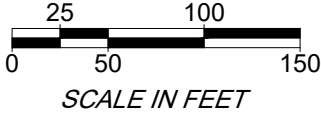


LEGEND

SW-02

DMS #2

Foundation and Boring Designation and Approximate Location



SOIL CLASSIFICATION

Shannon & Wilson uses a soil identification system modified from the Unified Soil Classification System (USCS) as described on this Key. Soil descriptions are based on visual-manual procedures (ASTM D2488) and available laboratory index test results (ASTM D2487).

Exhibit A: Unified Soil Classification System (USCS)¹

Major Divisions		Symbol / Graphic		Typical Identifications (USCS Group Names) ^{2,4}	
COARSE-GRAINED SOILS ($> 50\%$ of soil is retained on the No. 200 sieve ³)	GRAVELS ($> 50\%$ of coarse fraction retained on the No. 4 sieve ³)	Gravel ($< 5\%$ fines ³)	GW		Well-graded Gravel; Well-Graded Gravel with Sand
			GP		Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel ($> 12\%$ fines ³)	GM		Silty Gravel; Silty Gravel with Sand
			GC		Clayey Gravel; Clayey Gravel with Sand
	SANDS ($\geq 50\%$ of coarse fraction passes the No. 4 sieve ³)	Sand ($< 5\%$ fines ³)	SW		Well-graded Sand; Well-graded Sand with Gravel
			SP		Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand ($> 12\%$ fines ³)	SM		Silty Sand; Silty Sand with Gravel
			SC		Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS ($\geq 50\%$ of soil passes the No. 200 sieve ³)	SILTS AND CLAYS (liquid limit < 50)	Inorganic	ML		Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL		Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly, Lean Clay
		Organic	OL		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly, Organic Silt or Clay
	SILTS AND CLAYS (liquid limit ≥ 50)	Inorganic	MH		Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly, Elastic Silt
			CH		Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly, Fat Clay
		Organic	OH		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly, Organic Silt or Clay
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT		Peat or other Highly Organic Soils (see ASTM D4427)

EXHIBIT A NOTES:

- Adapted, with permission, from USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488.
- Borderline symbols (symbols separated by a slash) indicate that the soil characteristics are close to the defining boundary between two groups (e.g., CL/ML = Lean Clay to Silt; SP-SM/SM = Sand with Silt to Silty Sand).
- No. 4 size = 4.75 millimeters (mm) = 0.187 inch; No. 200 sieve size = 0.075 mm = 0.003 inch. Particles smaller 0.075 mm are termed "fines".
- Poorly graded indicates a narrow range or missing grain sizes. Well-graded indicates a full-range and even distribution of grain sizes.
- If cobbles and/or boulders are observed, "with cobbles" or "with boulders" or "with cobbles and boulders" is added to the Group Name.

Exhibit B-1: Standard Penetration Test (SPT)

Term	Description
Hammer	140-pound weight with a 30-inch free fall. Hammer types vary (e.g., automatic, rope and cathead). If available, the hammer type and energy ratio (E-ratio) is noted on the boring log.
Sampler	Barrel I.D. / O.D. = 1.5 inches / 2 inches (liner not used) Barrel Length = 30 inches; Shoe I.D. = 1.375 inches
N-Value (N)	Sum of the count of hammer blows to penetrate the second and third 6-inch increments in blows per foot (bpf). Refusal: 50 blows for 6 inches or less or 10 blows for 0 inch.

EXHIBIT B NOTES:

- N-values shown on boring logs are as recorded in the field and have not been corrected for hammer energy, overburden, or other factors. Where the hammer E-ratio is available, the N-value normalized to a ratio of 60% (N_{60}) is listed.
- Based on ASTM Standard D1586. Relative densities/consistencies noted on the boring logs are based on uncorrected N-values.
- PP = pocket penetrometer; TV = torvane, tsf = tons per square foot. Correlations based on experience and multiple published references.

Exhibit C: Soil Structure¹

Term	Description
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Fissured	Breaks along definite planes or fractures with little resistance.
Homogeneous	Same color and appearance throughout.
Interbedded	Alternating layers at least 1/4 inch thick of varying material or color. <i>Singular: bed</i>
Laminated	Alternating layers less than 1/4 inch thick of varying material or color. <i>Singular: lamination</i>
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.

EXHIBIT C NOTE:

- Adapted, with permission, from ASTM D2488.

Exhibit E: Soil Moisture Content¹

Term	Description
Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, from below water table.

EXHIBIT E NOTE:

- Adapted, with permission, from ASTM D2488 (Figure 2).

Exhibit F: Soil Cementation¹

Term	Description
Weak	Crumbles or breaks with handling or slight finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

EXHIBIT F NOTE:

- Adapted, with permission, from ASTM D2488.

Exhibit B-2: Relative Consistency of Cohesive Soils

Term	N ² (bpf)	PP ³ (tsf)	TV ³ (tsf)
Very Soft	0 - 2	0 - 0.25	0 - 0.12
Soft	2 - 4	0.25 - 0.5	0.12 - 0.25
Medium Stiff	4 - 8	0.5 - 1	0.25 - 0.5
Stiff	8 - 15	1 - 2	0.5 - 1
Very Stiff	15 - 30	2 - 4	1 - 2
Hard	> 30	> 4	> 2

Exhibit B-3: Relative Density of Cohesionless Soils

Term	N ² (bpf)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Exhibit D: Soil Plasticity¹

Term	Description
Nonplastic	Cannot roll a 1/8-inch thread at any water content.
Low Plasticity	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.
Medium Plasticity	A thread is easy to roll and not much time in rolling is required to reach the plastic limit. The thread cannot be rolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.
High Plasticity	It takes considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.

EXHIBIT D NOTE:

- Adapted, with permission, from ASTM D2488.

Exhibit G: Percentages

Term	Percent ¹
Trace	<5
Few	5 to 10
Little	15 to 25
Some	30 to 45
Mostly	>50

EXHIBIT G NOTE:

- Percent estimated by weight for sand and gravel, and by volume for cobbles, organics, and other non-soil material (e.g., rubble, debris).

SOIL CLASSIFICATION (continued)

See Page 1 for Soil Classification Exhibits A through G

Exhibit H: Particle Angularity and Shape¹

Term	Description
Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width to thickness ratio > 3.
Elongated	Width to thickness ratio < 3.

EXHIBIT H NOTE:

1. Adapted, with permission, from ASTM D2488.

Exhibit I: Additional Descriptive Terms

Term	Description
Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling action.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

SOIL CLASSIFICATION REFERENCES:

ASTM International, [current edition], Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, available: www.astm.org

U.S. Army Corps of Engineers, 1953, The unified soil classification system: Vicksburg, Miss., Waterways Experiment Station, Technical Memorandum 3-357, 2 v., March.

SYMBOLOLOGY AND GRAPHICS**Exhibit J: Sample and Run Graphics**

Graphic	Description	Graphic	Description	Graphic	Description
	SPT split spoon (2-inch OD)		Split spoon (SS) (diameters vary)		Core run (typically rock)
	Grab (GB) from cuttings or excavation		Modified California (MC) sampler		Sheath (SH) (used for geoprobes)
	Tube (TB) (e.g., Shelby, piston)		Sonic core (SC) run (typically soil)		

Exhibit K: Hole Backfill and Instrument Graphics

Graphic	Description	Graphic	Description	Graphic	Description
	Bentonite-cement grout		Surface cement seal		Blank pipe or instrument casing
	Bentonite grout		Sand filter pack		Perforated or slotted pipe
	Bentonite chips		Slough (hole caved)		VWP and electric lead

Exhibit L: Other Log Symbols

Sample Number		Environmental Sample Taken		Water Level Measured at Date in Well or VWP		Well/VWP ID No.	
Sample Type		Gray bar indicates percent of sample length recovered.		Measurement Date (M-D-YY)		Water Level During Drilling	

ROCK CLASSIFICATION

Shannon & Wilson uses a rock classification system modified from the system recommended by the International Society for Rock Mechanics (ISRM). Copyright limitations prevent us from reproducing summary tables from the ISRM system on this Key. General descriptions are provided in Exhibit M.

Exhibit M: General Rock Descriptive Terms - ISRM

Term	General Description
Strength	Ranges from extremely weak ($q_u = 36$ to 135 psi) to extremely strong ($q_u > 36,250$ psi), and is based on the ability to break the rock with a hammer or scrape the rock with a knife.
Weathering	Ranges from fresh (no visible signs of weathering) to completely weathered, based on observed degree of discoloration, decomposition, and/or disintegration. When the rock material has completely converted to soil, it is termed a residual soil.
Fabric	Describes the rock structure based on observed layering, tendency to break, and distribution of minerals (e.g., massive, bedded, foliated).
Roughness	For discontinuities: Includes rough, smooth, and slickensided, and includes other descriptive terms (e.g., stepped, undular, irregular, planar).
Spacing	For discontinuities: Ranges from extremely close (< 1 inch) to extremely wide (> 20 feet).
Persistence	For discontinuities: Ranges from very low to very high.
Other	Description of discontinuities (joints, fractures, bedding planes, etc.), observations of potential displacement, gouge, shear, etc.

REFERENCE: Brown, E. T., ed., 1981, Rock characterization, testing & monitoring: International Society of Rock Mechanics (ISRM) suggested methods: Oxford, Pergamon Press, 211 p.

Exhibit N: Rock Name Graphics*No rock names defined for this Project***Exhibit O: Recovery and RQD Equations¹**

Term	Equation
Core Recovery (REC) in %	$100\% \times \frac{\text{Length of Core Recovered}}{\text{Length of Core Run}}$
Rock Quality Designation (RQD) in %	$100\% \times \frac{\text{Length of Core in Pieces > 4 in}}{\text{Length of Core Run}}$

REFERENCE: Loehr, J. E.; Lutenecker, A.; Rosenblad, B.; and Boeckmann, A., 2016, Geotechnical site characterization: U.S. Federal Highway Administration Report FHWA NHI-16-072, Geotechnical Engineering Circular no. 5, 1 v.

ACRONYMS AND ABBREVIATIONS

ATD	at time of drilling	N	field (uncorrected) SPT N-value	REF	refusal
bpf	blows per foot	N ₆₀	SPT N-value corrected for 60% ETR	RQD	rock quality designation (ASTM D6032)
dia, diam	diameter	NA, n/a	not applicable or not available	SC	sonic core
Elev.	elevation	NE	northeast	SE	sand equivalent
ENV	environmental sample	NP	nonplastic	SPT	Standard Penetration Test (ASTM D1586)
ETR	energy transfer ratio (hammer)	NR	no recovery	SW	southwest
FC	finer content (< 0.075 mm)	NW	northwest	TP	test pit
FeO	iron oxide	OC	organic content	tsf	tons per square foot
ft or'	foot or feet	OD	outside diameter	TV	tor vane reading
gal	gallons	OW	observation well	UCS, q _u	unconfined compressive strength
GP	geoprobe	pcf	pounds per cubic foot	USCS	Unified Soil Classification System
GWT	groundwater table	PI	plasticity index	VST	vane shear test
HSA	hollow-stem auger	PID	photoionization detector	VWP	vibrating wire piezometer
ID	inside diameter or identification	PL	plastic limit	WC	natural water content
in or"	inch	PMT	pressuremeter test	WOH	weight of hammer
incl	inclinometer	PP	pocket penetrometer reading	WOR	weight of rods
ksf	kips per square foot	ppm	parts per million		
lbs	pounds	psi	pounds per square inch		
LL	liquid limit	PT	nonstandard penetration test N-value		
mm	millimeter	REC	recovery		

I-15 DMS Signs

Bannock and Onieda County

SW-01

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EXPLORATION INFORMATION

Total Depth: 31.5 feet

Top Elevation: 4643.95 feet

Vertical Datum: WGS84

Latitude: 42.79988

Longitude: -112.30669

Horizontal Datum: WGS84

Hole Start Date: 07/29/2026

Hole Finish Date: 07/29/2026

DRILLING INFORMATION

Drilling Method: Auger

Drilling Company: S&W

Drill Rig Equipment: Simco 2800

Hole Diameter: 8 inches

Rod Type/Dia.: 4-1/4" Hollow Stem Auger

Hammer Wt. / Drop: 140lbs / 30"

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

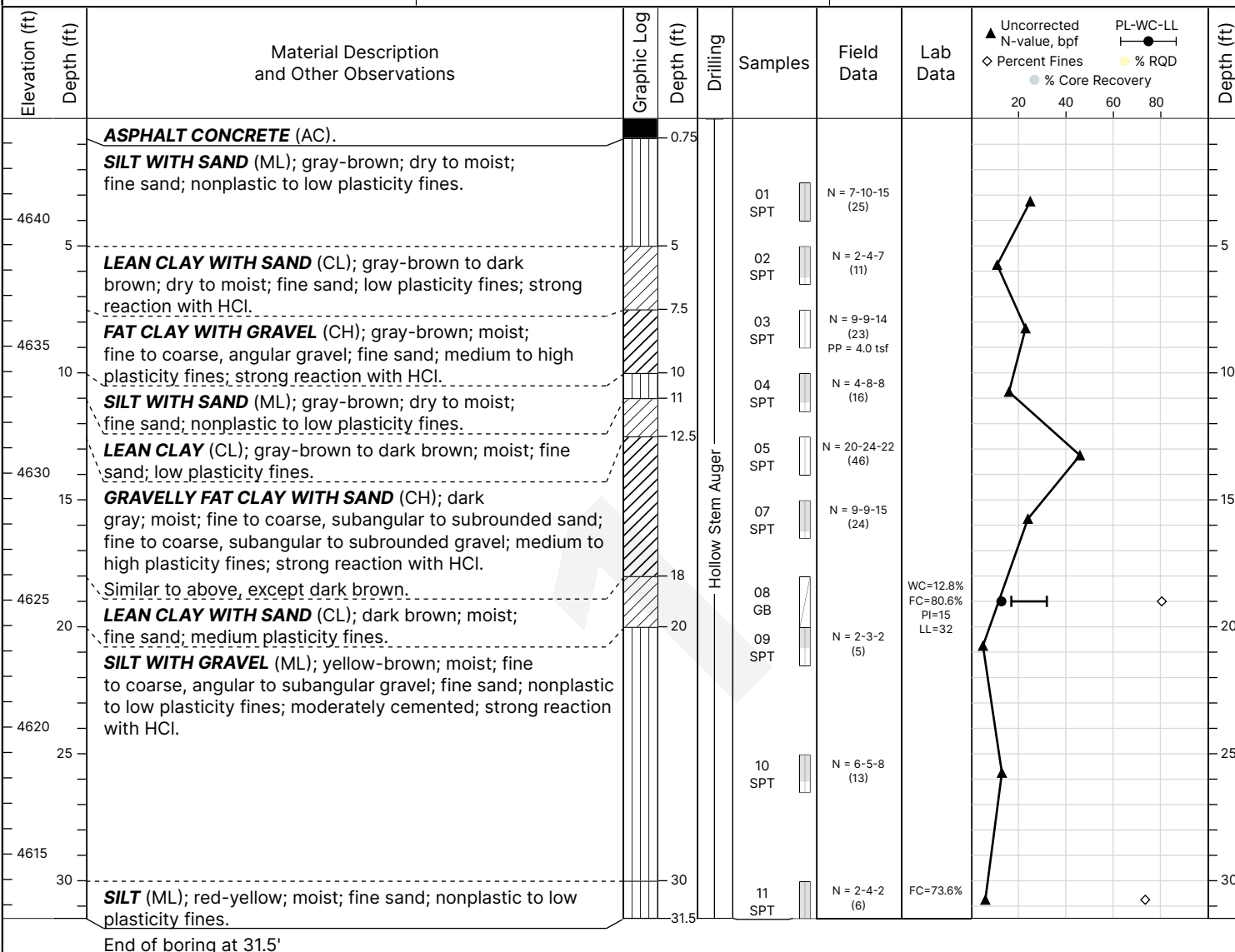
Abbreviations

N	Standard Penetration Test (SPT) blows per 6-inch increment
PT	Penetration test (not SPT) blows per 6-inch increment
bpf	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
PI	Plasticity index (Atterberg Limits)

Symbols

Sample Number → S-5
Sample Type (SPT) →  Gray bar indicates percent of sample length recovered.

Water Level
During Drilling → 



NOTES:

- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- Group symbol is based on visual-manual identification and laboratory index testing (if performed).
- Report text contains limitations and information needed to contextually understand this log.

Logged By:	KLS
Review By:	SGC
Version:	1

I-15 DMS Signs

Bannock and Onieda County

SW-02

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EXPLORATION INFORMATION

Total Depth: 31.5 feet

Top Elevation: 4618.50 feet

Vertical Datum: WGS84

Latitude: 42.08914

Longitude: -112.21839

Horizontal Datum: WGS84

Hole Start Date: 07/29/2026

Hole Finish Date: 07/29/2026

DRILLING INFORMATION

Drilling Method: Auger

Drilling Company: S&W

Drill Rig Equipment: Simco 2800

Hole Diameter: 8 inches

Rod Type/Dia.: 4-1/4" Hollow Stem Auger

Hammer Wt. / Drop: 140lbs / 30"

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

Abbreviations

N	Standard Penetration Test (SPT) blows per 6-inch increment
PT	Penetration test (not SPT) blows per 6-inch increment
bpf	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
PI	Plasticity index (Atterberg Limits)

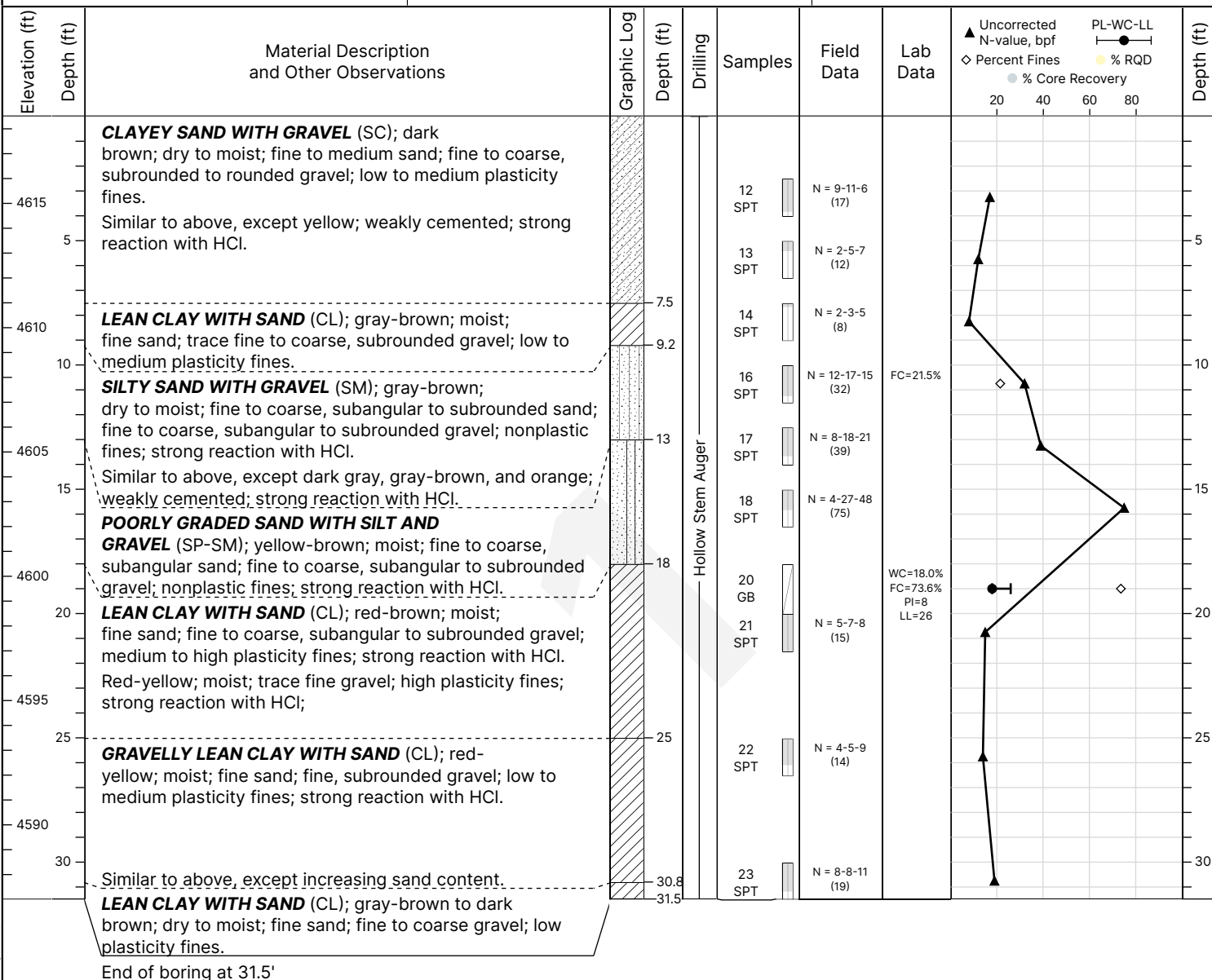
Symbols

Sample Number
Sample Type

S-5 (SPT)

Gray bar indicates percent of sample length recovered.

Water Level
During Drilling



NOTES:

- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- Group symbol is based on visual-manual identification and laboratory index testing (if performed).
- Report text contains limitations and information needed to contextually understand this log.

Logged By:	KLS
Review By:	SGC
Version:	1

Appendix C

Laboratory Test Data

APPENDIX C: LABORATORY TEST DATA

Table 1: Laboratory Test Summary

Exploration Name	Depth (feet)	Sample No.	Sample Type	Elevation (feet)	N60 (bpf)	Unified Soil Classification System Group Name	USCS Symbol	MC (%)	LL	PL	PI	Gravel Content (%)	Sand Content (%)	Fines Content (%)
SW-01	18	08	GB			LEAN CLAY with SAND	CL	12.8	32	17	15	7.0	12.4	80.6
SW-01	30	11	SPT			SILT	ML					1.0	8.1	90.9
SW-02	10	16	SPT			SILTY SAND with GRAVEL	SM					35.0	43.5	21.5
SW-02	18	20	GB			LEAN CLAY with SAND	CL	18.0	26	18	8	2.0	24.4	73.6

NOTES:

- Blank cells indicate that the test was not performed or no information is available.
- Refer to the main text, exploration logs, and laboratory test result plots for more information.
- **N60** is the equivalent Standard Penetration Test (SPT) N-value corrected for sampler size and hammer energy.
- See log key for explanation of USCS symbols.

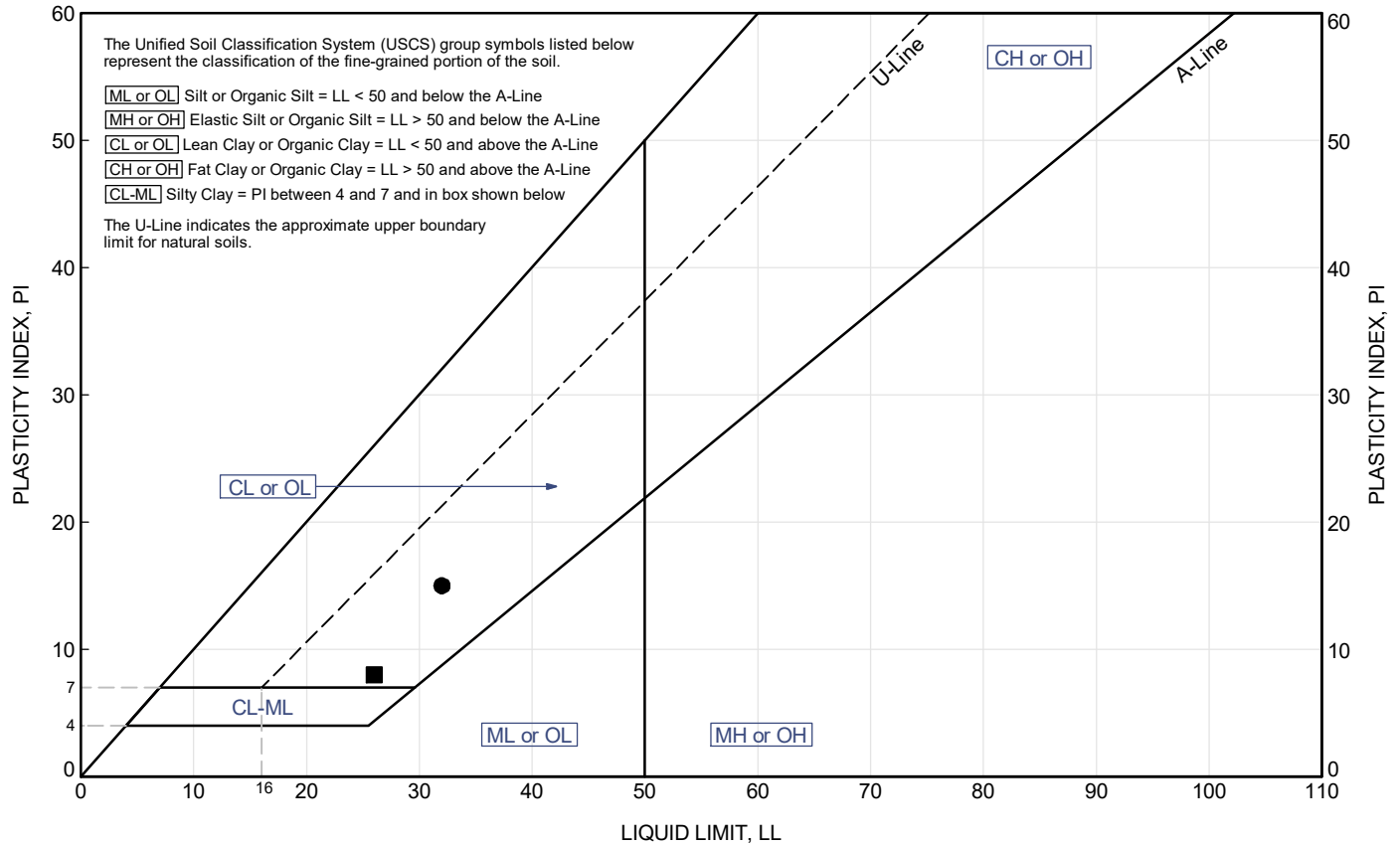
- **Gravel Content** represents the percent of particle sizes in the sample that are greater than 4.75 mm.
- **Sand Content** represents the percent of particle sizes in the sample that are between 0.075 mm and 4.75 mm.
- **Fines Content** represents the percent of particle sizes in the sample that are less than 0.075 mm and includes both silt and clay.

ACRONYMS: bpf = blows per foot; mm = millimeter; pcf = pounds per cubic foot; tsf = tons per square foot; USCS = Unified Soil Classification System

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SW-01, SW-02

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EXPLORATION AND SAMPLE NUMBER	DEPTH (feet)	UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GROUP NAME	USCS SYMBOL	LL	PL	PI	FINES (%)	NAT MC %	TEST BY/RVW	TEST STD	TEST NOTE
● SW-01, S-08	18.0	LEAN CLAY with SAND	CL	32	17	15	80.6	12.8	REB KRB	D4318	
■ SW-02, S-20	18.0	LEAN CLAY with SAND	CL	26	18	8	73.6	18.0	REB KRB	D4318	

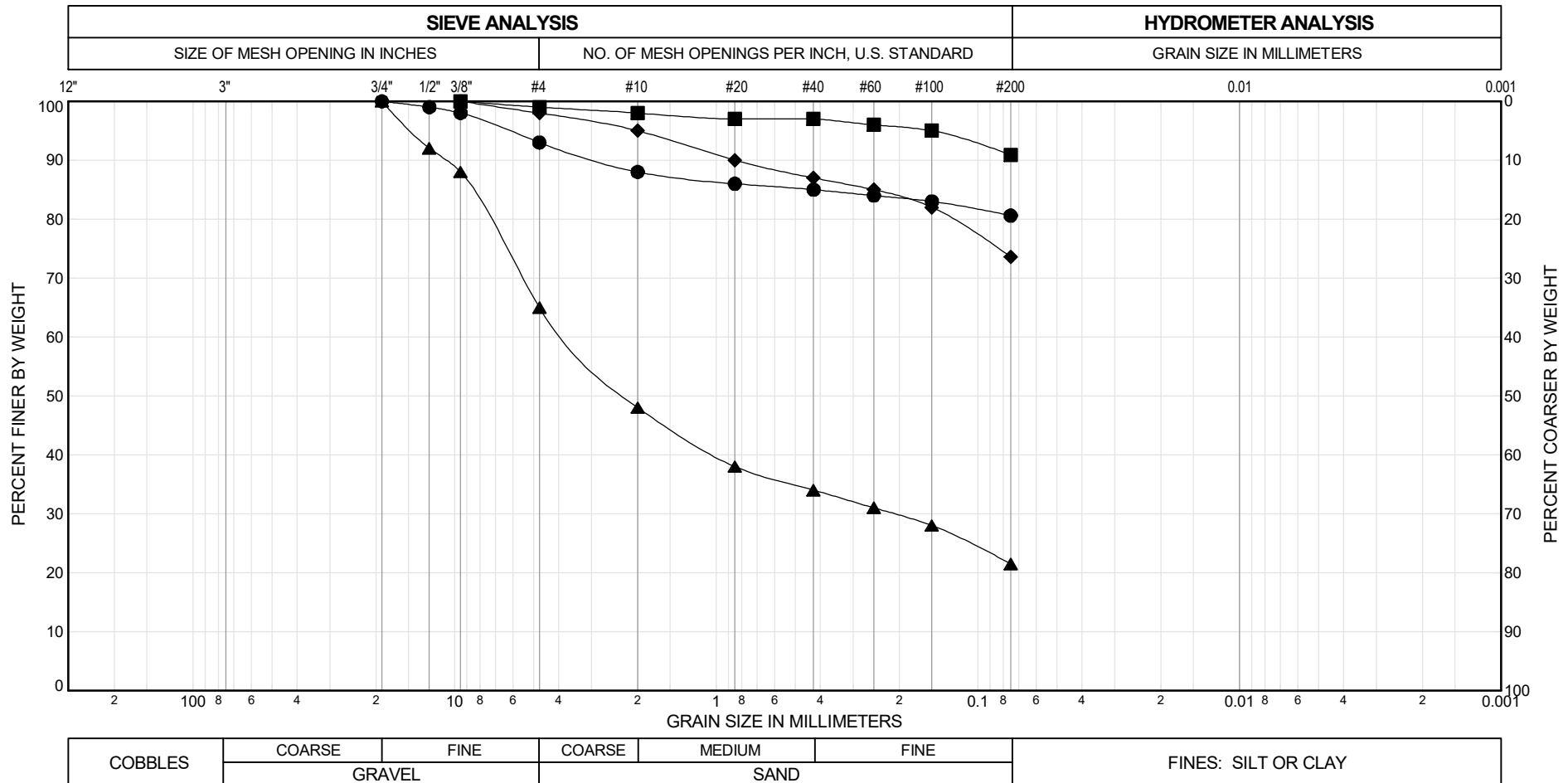
* Where indicated by *, the USCS Group Name was based on visual-manual examination procedures (ASTM D2488) and the Atterberg Limits test results.

ABBREVIATIONS: LL = liquid limit; NAT MC = natural moisture content; n/a = test attempted; NP = nonplastic; PI = plasticity index; PL = plastic limit; STD = standard; RVW = reviewed by; USCS = Unified Soil Classification System symbol

I-15 DMS Signs
Bannock and Onieda County

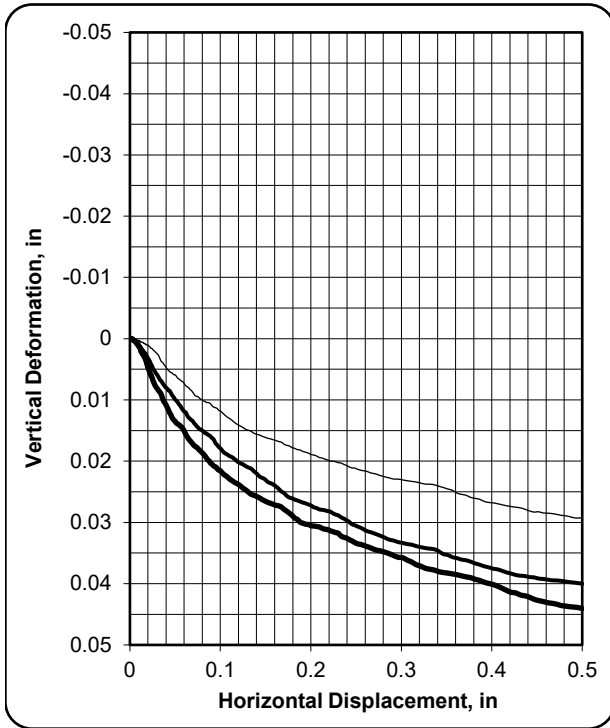
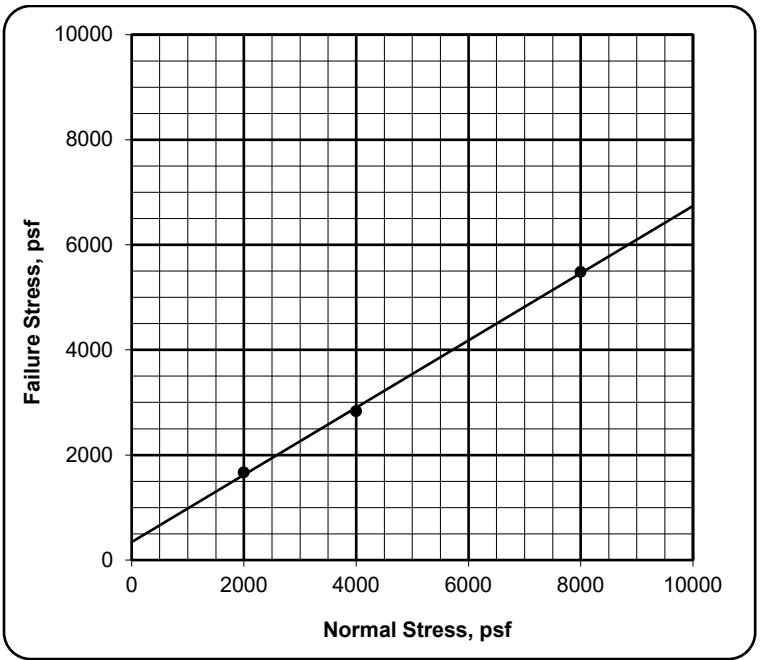
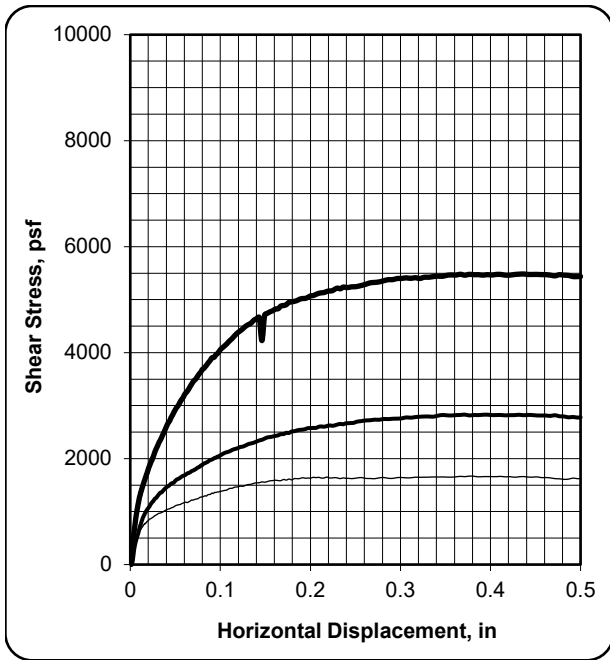
SW-01, SW-02

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* Where indicated by *, the USCS Group Name was based on visual-manual examination procedures (ASTM D2488) and the grain size distribution test results.
ABBREVIATIONS: NAT WC = natural moisture content; RVW = reviewed by; STD = Standard; USCS = Unified Soil Classification System code; ~ = approximately (used when measured but not greater than 0.5%)

Direct Shear Test Report - ASTM D-3080



Sample Number		1	2	3
Initial	Water Content, %	16.4	16.4	16.4
	Dry Density, pcf	107.8	107.8	107.8
	Saturation, %	81.7	81.6	81.6
	Void Ratio	0.53	0.53	0.53
	Diameter, in	2.502	2.502	2.502
	Height, in (before consol.)	0.990	0.990	0.990
At Test	Water Content, %	18.4	17.9	16.9
	Dry Density, pcf	108.6	109.4	111.7
	Saturation, %	93.1	93.0	93.4
	Void Ratio	0.52	0.51	0.48
	Diameter, in	2.502	2.502	2.502
	Height, in (prior to shear)	0.983	0.975	0.955
Normal Stress, psf		2000	4000	8000
Failure Stress, psf		1669	2830	5484
Displacement @ Failure, in		0.38	0.37	0.44
Time to Failure, min		75.3	74.3	87.3
Ultimate Stress, psf		1608	2774	5435
Displacement @ Ultimate, in		0.48	0.50	0.49
Rate of Strain, in/min		0.0050	0.0050	0.0050

Client	ITD District 5	Sample Type	Remolded							
Project	I-15 DMS Signs	Description	Lean Clay with Sand (CL)							
Project Number	118021	Sp. Gravity (assumed)	2.650							
Sample Location	SW-02, GB-20; 18.0'-20.0'	<table><tr><td>C, psf</td><td>342</td></tr><tr><td>ϕ , deg</td><td>32.6</td></tr><tr><td>$\tan \phi$</td><td>0.640</td></tr></table>			C, psf	342	ϕ , deg	32.6	$\tan \phi$	0.640
C, psf	342									
ϕ , deg	32.6									
$\tan \phi$	0.640									
Lab Number	26-0820									
Date	8/17/2026									
Testing performed on minus #10 material. Samples remolded with standard effort near optimum moisture.		 SHANNON & WILSON								
Tested by: PC	Reviewed by: Roxanne Boucher									

IMPORTANT INFORMATION

Important Information

About Your Geotechnical Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons

for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland