SPIRIT MOUNTAIN RECREATION AREA
PROJECT SPECIFICATIONS

KNOWLTON CREEK BRIDGE (FURNISH ONLY)

Spirit Mountain Recreation Area
9500 Spirit Mountain Place
Duluth, MN 55810

SPECIAL PROVISIONS
SPIRIT MOUNTAIN RECREATION AREA
KNOWLTON CREEK BRIDGE (FURNISH ONLY)
SEH NO. SMRAA 125435
SEPTEMBER 2013

SPECIFICATIONS SIGNATURE PAGE

I HEREBY CERTIFY THAT THIS PLAN, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

______________________	Matt Bolf, PE
Signature	Typed or Printed Name
09/10/2013	43913
Date	Registration No.

SPECIAL PROVISIONS
SPIRIT MOUNTAIN RECREATION AREA
KNOWLTON CREEK BRIDGE (FURNISH ONLY)
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SEPTEMBER 2013

Table of Contents

SPECIAL PROVISIONS
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KNOWLTON CREEK BRIDGE (FURNISH ONLY)
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SB-1 (1502) PRE-FABRICATED BRIDGE SUPERSTRUCTURE AND ABUTMENTS (FURNISH ONLY)

SB-1.1 Description of Work

This work consists of the design, detailing, shop drawings, fabrication, and delivery to the site, the entire bridge superstructure and abutments for the maintenance road over Knowlton Creek at the Spirit Mountain Recreation Area in Duluth, Minnesota. The general layout and location of the bridge are shown in the attached Sheets 1/2 and 2/2. The bridge shall be pre-assembled in modular units to facilitate ease of unloading, filling of concrete in abutments, and erection by others. All units must utilize only bolted connections without field cutting or welding. The Contractor shall perform work in accordance with the applicable provisions of Mn/DOT 1502, 2401, 2402, 2403, 2471, the Plans, and the following special provisions:

A. The soils investigation report is included in these documents. The Contractor is directed to 1205 for limitations on use of this information.

SB-1.2 Materials

Acceptable materials for the superstructure and abutment weathering and hot-dip galvanized steel. Aluminum, timber and lightweight concrete are not acceptable materials for use in any portion of the structure.

Minimum structural steel thickness is 1/4" for pipe or tube sections, and 5/16" for all other sections. Decking shall be a minimum of 9-gauge thickness. Minimum thickness requirements do not apply to railing posts or abutment backwalls.

Structural tubing shall be either water tight or designed so that moisture is not trapped in the tubes.

The provisions of 2471 shall apply. Steel fabricators are required to be certified under the AISC Quality Certification Program Category, Simple Steel Bridge Structures (Sbr) or Major Bridge fabrication. Structural steel shapes, plates and bars shall conform to the provisions of 3309. Steel conforming to the provisions of 3306 may be used for minor components provided it is hot-dip galvanized. Structural steel tubing shall conform to the provisions of 3361, Type C.

SB-1.3 Bridge Substructure

The bridge substructure (abutments) shall consist of a steel stay-in-place form and cast-in-place concrete place on a spread footing as recommended in the soil investigation report. The substructure shall consist of two abutments. The Contractor is responsible for verifying the adequacy of the original substructure design with the proposed superstructure loads and dimensions to assure proper fit-up in the field. The Contractor is responsible for coordination with other suppliers, fabricators, and subcontractors who may be affected by changes in the substructure necessary to accommodate the bridge superstructure.

SB-1.4 Bridge Superstructure and Abutments

The Contractor shall furnish a superstructure consisting of weathering steel wide flange rolled section beams (unpainted) with a hot dip galvanized corrugated steel deck and aggregate surfacing. The abutments shall be weathering steel and steel hot-dip or epoxy/urethane coated corrugated steel backwall with concrete fill.

Use elastomeric or Teflon bearing assemblies as required by the design plans. The bearing design shall accommodate all bridge loads, translations and rotations. Alternate bearing assembly types will require approval by the owner.

SB-1.5 General Design Requirements

Design bridge in accordance with the 2012 Edition of the AASHTO LRFD Bridge Design Specifications, all current interims, the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, and the MnDOT LRFD Bridge Design Manual and the following design criteria:

Minimum bridge low member elevations and minimum span length and clear width are shown in the plan sheets. The depth of the superstructure is assumed to be 3’-0”. Any addition depth needed for design, up to a maximum of 4’-0”, shall be accounted for by raising the deck and profile grade line and not lowering the low member elevation.

The Fracture Critical requirements in Section 4.2 of the “LRFD Guide Specification for the Design of Pedestrian Bridges” are waived.

The superstructure design shall comply with the recommended deflection of L/800 when subjected to one design live load truck on the bridge acting on the total cross-section of the bridge.

Reinforced Concrete, Maximum Allowable Design Stresses:
f'_c = 4000 psi, Concrete shall be MnDOT 2401 Grade 3Y43, Air Entrianed
f_y = 60,000 (minimum) psi reinforcement

Structural Steel for Primary Beams and Decking
Fy =50,000 (minimum) psi

SB-1.6 Specific Design Requirements

The bridge span shall meet the following criteria:

A. Bridge shall have the following dimensions. The Bridge span listed below is from center of bearing to center of bearing of the bridge superstructure. The Rail height listed below is from top of aggregate surfacing on the deck to top of railing. Also listed is the residual camber at midspan.

Bridge Span	Rail Height	Clear Deck Width	Residual Camber
60’-0”	2-‘3” to 2’-8”	21’-0” to 22’-0”	2” to 4”

B. Design, fabricate, and install steel superstructure as a single simple span structure. General geometry of the bridge shall closely match that shown in the Plan.

C. The railing shall be a hot-dip galvanized or weathering steel 12-gauge guardrail plate W-beam with steel posts. Plate W-beam post spacing, posts and post attachments and shall be designed for a single 10,000 lb horizontal load applied at the mid height of the plate beam and any positioned at any location along the length of the railing.

A 6 inch high toe plate or side dam shall be utilized to retain the depth of the aggregate deck surfacing along the edge of the deck.

D. The bridge design shall meet the minimum design criteria as follows:

1. Vehicle Live Load: AASHTO HS-20 (or HL-93) vehicle, plus impact, applied and distributed in accordance with the AASHTO LRFD Bridge Design Specifications.

2. Horizontal Stream Flow Loading: The bearing anchors and end diaphragms shall be designed to resist a lateral load due to stream flow, debris and ice, of 100,000 lbs at each abutment, and in addition, the requirements below for temperature movement and restraint.

3. Dead Load: The dead load shall include all bridge elements and an aggregate surfacing weight resulting from a future thickness of 12 inches of aggregate, assuming a unit weight of of the aggregate of 140 pcf. This is to account for future overburden greater than the initial required 6 inches of aggregate surfacing

E. The bridge span shall have connections which securely fasten the spans to the abutments but also allow for the temperature expansion/contraction of the spans and these connections shall be fully detailed on plans and submitted for approval. The Contractor shall provide to the Engineer the anticipated lengths of the spans at the temperature extremes of -30º F and 120º F relative to the length at 70º F. Anchorages shall consist of hot dipped galvanized anchor bolts, nuts and washers, and are supplied by the bridge manufacturer and be incidental to the cost of the bridge.

F. All bridge plan sheets shall contain the signature of an Engineer who is currently licensed by the State of Minnesota as a Professional Engineer.

G. Assemble bridge spans into a solid unit with no loose members. Sand blast all weathering uncoated steel in accordance with the Steel Structures Painting Council Surface Preparation Specification No. 6 (SSPC-SP6) for Commercial Blast Cleaning.

H. A steel cover plate shall span the gap between the end of the bridge and the abutment at both ends of the bridge if necessitated by the bridge abutment backwall configuration, if a backwall is used. The plate shall have a rigid attachment to the bridge and extend a minimum of 4-inches beyond the front face of the abutment backwall. The cover plate shall have beveled edges or be recessed into the top of the abutment backwall with adequate allowance for thermal movement of the bridge.

I. Bridge Signs: Mark both ends of bridge with load limit of 36 tons.

J. Four lifting lugs shall be provided on each modular unit to facilitate lifting and placement on site. These lugs shall be integral with the bridge or temporary with bolted connections to facilitate removal without cutting.

SB1 .7 Steel Deck and Aggregate Surfacing

A. Deck shall be hot-dip galvanized corrugated steel decking designed to carry the full dead load of the steel deck, 12 inch future aggregate surface thickness and the live load vehicle. The deck thickness and corrugation dimensions shall be designed by the bridge manufacturer. The deck shall be attached to the beams by the use of hot-dip galvanized bolts through the beam flanges, or by shop welding and cold galvanize coating of weld areas. A spray applied bituminous waterproofing shall be applied in the shop to the installed steel deck top surface and inside faces of the side dams prior to delivery to the site and touched up in the field and handling scratches and field connections prior placement of the aggregate surfacing. The waterproofing material for the field application shall be supplied by the bridge fabricator and shipped with the bridge.

B. Consideration of composite action from the steel corrugated deck with the supporting beams for design of the beams is prohibited.

C. The surfacing aggregate shall be in conformance with MnDOT 3138, Class 5. The minimum thickness of the surfacing shall be 6 inches, measured from the high points of the deck corrugations, along the edge of the deck, and it shall be 8 ½ inches thick at the center of the bridge to create a crown. The surfacing shall be roller compacted in 3 inch maximum lifts. The aggregate surfacing will provided, placed and compacted in the field by others.

SB-1.8 Pre-fabricated Bridge Plan Requirements and Submittals

Pre-fabricated bridge plans are the certified design plans of the bridge superstructure and abutment, provided by the contractor, based on the details and performance criteria found in the Design Plan and the following Special Provisions.

A. Plan Preparation**:** Contractor shall provide superstructure and abutment plans that are complete and comprehensive, fully detailing the superstructure and abutment and its connection to the bridge. The plans shall reflect the requirements and intentions of the Final Design Plan and the Special Provisions. A Professional Engineer licensed in the State of Minnesota and experienced in bridge design shall certify all plan sheets, as well as the design calculations. All plan sheets shall also contain the initials of the designer, drafter, and checkers.

The plans shall include, but not be limited to the following;

1. General plan, elevation, and cross section views on the first sheet/s, providing span lengths between bearing points, skews, profile grade information, and critical clearance dimensions. The first sheet shall also include pertinent design data information.

2. Dimensioning of beam framing, member sizes, roadway clear width, height and spacing of guardrail and posts, edge dams, et cetera.

3. Details of all steel structural connections, the required welds, sizes of members, bearing assembly details, abutment concrete mix numbers, , materials data, and coating requirements.

4. Bridge camber and deflection information, and complete details of all member field splices.

5. Certified mill test for the bridge beams and deck material.
6. Complete details of the fixed and expansion bearings showing the connection of the superstructure to the substructure, including anchor bolt spacing and dimensioning necessary for proper placement on the substructures. The anchor bolts shall be detailed to avoid rebar and maintain minimum edge distances. The plans shall provide the dimensions from top of deck to bearing seat, the dimension (horizontally and along slope) from center of bearing to center of bearing, expansion joint details, cover plate details including any notches required in the backwalls, and all applied load information from the proposed bridge superstructure and required abutment foundation soil load bearing.

7. General list of weld inspection and testing requirements.

8. Bridge handling and installation instructions.

B. Plan Submittal and Review Process

Upon completion of the project letting and prior to the start of any fabrication or construction, the contractor shall submit, as described below, two sets of the Pre-fabricated bridge plans and one set of design computations to the owner/owner's consultant for review and acceptance.

Submittals shall be made no later than 6 weeks after date of notice of Contract Approval. The Contractor shall allow the following time period in his construction schedule: Allow 21 calendar days after the first receipt of plans by the owner/owner's consultant for a complete initial review of the design and plans submittal, and an additional 14 calendar days for any necessary review of revisions and/or corrections suggested by the reviewers.

The Plan review process shall consist of the following:

1. Review of the Pre-fabricated Bridge Plan and design computations shall verify general compliance with the Design Plans and all other information contained in the Special Provisions. The review shall verify that all standard design specifications, manuals and guidelines have been followed.

2. Following the review of the Pre-fabricated Bridge Plan and design computations, comments and concerns are returned to the contractor. After comments are addressed and plan corrections are made, the contractor shall submit a revised Pre-fabricated Bridge Plan for review and acceptance. Upon acceptance, the reviewing engineer or his/her supervisor, who is a Professional Engineer licensed in the State of Minnesota, shall sign, date and certify each sheet of the reviewed and accepted plan. This review does not relieve the engineer of record from the responsibility of his/her design, nor relieve the contractor of his/her contractual responsibility for any errors or deviation from contract requirements.

Upon acceptance of the Pre-fabricated Bridge Plan, the bridge fabricator shall commence shop drawing development and fabrication of the bridge. A shop drawing submittal will be required to submit to the owner for their information and records.

SB-1.9 Shop Drawings

After final Pre-fabricated Bridge Plan and design computations have been accepted by the owner, the contractor shall submit shop drawings and submit to the owner for his information and record file.

SB-1.10 Fabrication

Bridge fabrication shall not begin until the Pre-fabricated Bridge Plan and design computations have been approved by the owner. Any work performed prior to the owner’s approval, is subject to the requirements of Mn/DOT 1512.

SB-1.11 Delivery

Delivery of the superstructure spans and abutments shall be to a location selected by the owner that is accessible to over-the-road trucks. A representative of the manufacturer/fabricator of the steel bridge span assemblies shall be present at the time that the material is unloaded to instruct the owner in proper lifting procedures. The bridge fabricator shall provide notification to the owner of the delivery 14 days prior to the anticipated date of site delivery. The bridge should not be delivered on a weekend or holiday unless acceptable by the owner.

SB-1.12 Acceptable Products

The steel bridge shall have a steel deck beam style similar to the products of the following manufacturers: (Acceptable products are not limited to listed manufacturers.)

Potential suppliers of the prefabricated steel bridges are:

1. TrueNorth Steel, 5405 Momont Road, Missoula, MT 59808, Ph 406.542.0345, Web site: www.truenorthsteel.com

2. Wheeler Consolidated, Inc., 9330 James Ave. S., Bloomington, MN 55431, Ph. 1-800-328-3986 or Ph. 952-929-7854, ; Web site: www.wheeler-con.com

3. ConTech Construction Products, Inc. (Continental Bridge), 8301 State Highway 29 North, Alexandria, MN 56308 Ph. 1-800-328-2047; Web site: www.contech-cpi.com

SB-1.13 Method of Measurement

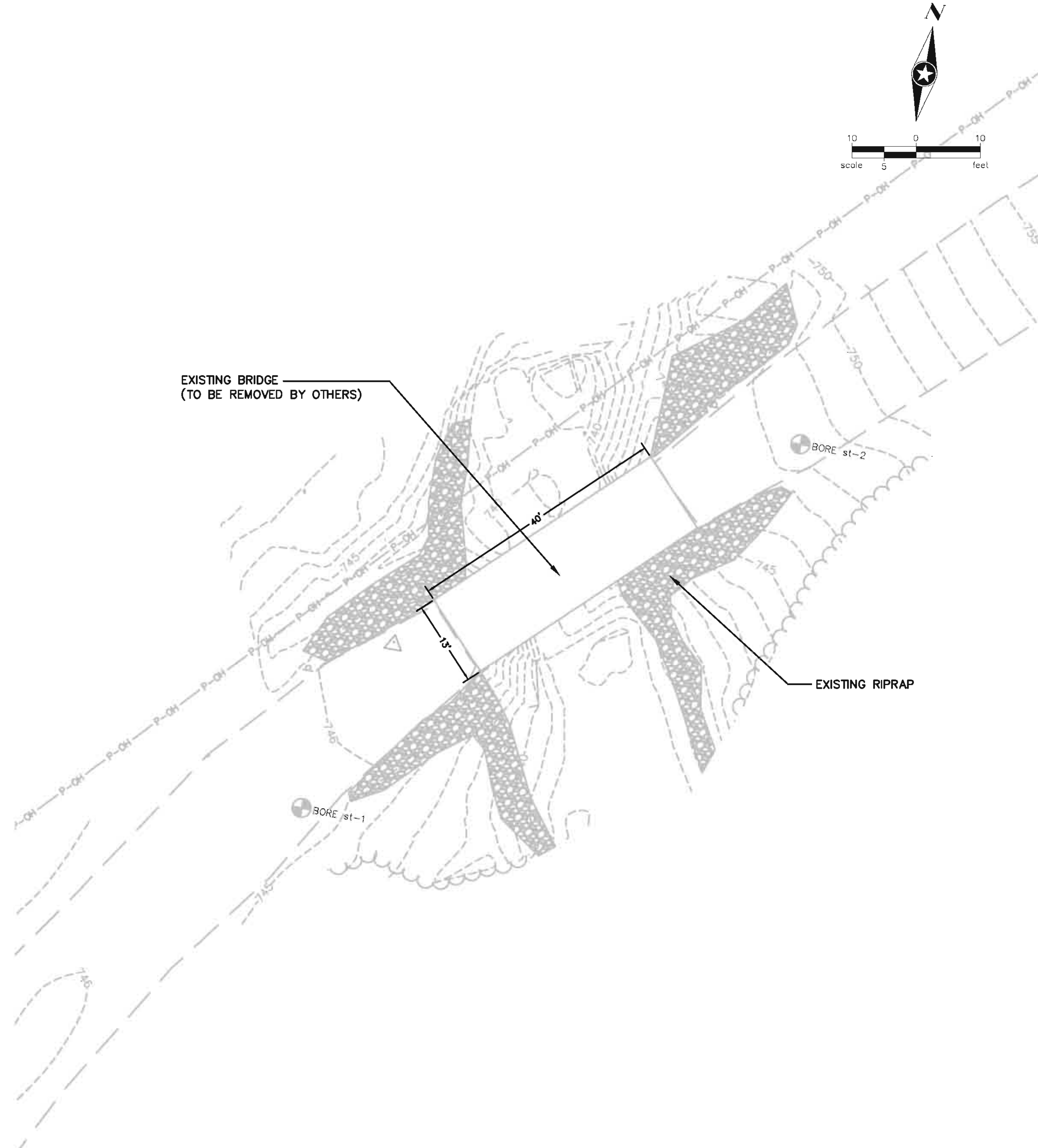
The entire bridge structure complete, delivered to the site, will be measured as a single lump sum except as otherwise provided for specific items in the Contract.

SB-1.14 Basis of Payment

Payment for Item No. 2100.601 "PRE-FABRICATED BRIDGE SUPERSTRUCTURE AND ABUTMENTS (FURNISH ONLY)" will be made at the Contract price per lump sum and shall be compensation in full for all costs of performing the work described above for furnishing the entire bridge complete to the site except as otherwise specifically provided in the Plan. Unloading from delivery trucks, erection, abutment concrete placement, deck aggregate surfacing and approach grading will be done by others.

EXISTING ROCKS TO BE REMOVED
AND REPLACE WITH CLASS IV RIPRAP
TO PROVIDE 20' CHANNEL WIDTH
(BY OTHERS)

EXISTING ABUTMENT FILL MATERIAL TO BE
REMOVED AND REPLACED WITH CLASS IV RIPRAP
(BY OTHERS)



DRAWN BY:	ACO	NO.	BY	DATE	REVISIONS
DESIGNER:	–				
CHECKED BY:	KLA				
DESIGN TEAM					

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name, P.E.

Date: --/--/-- Lic. No. –

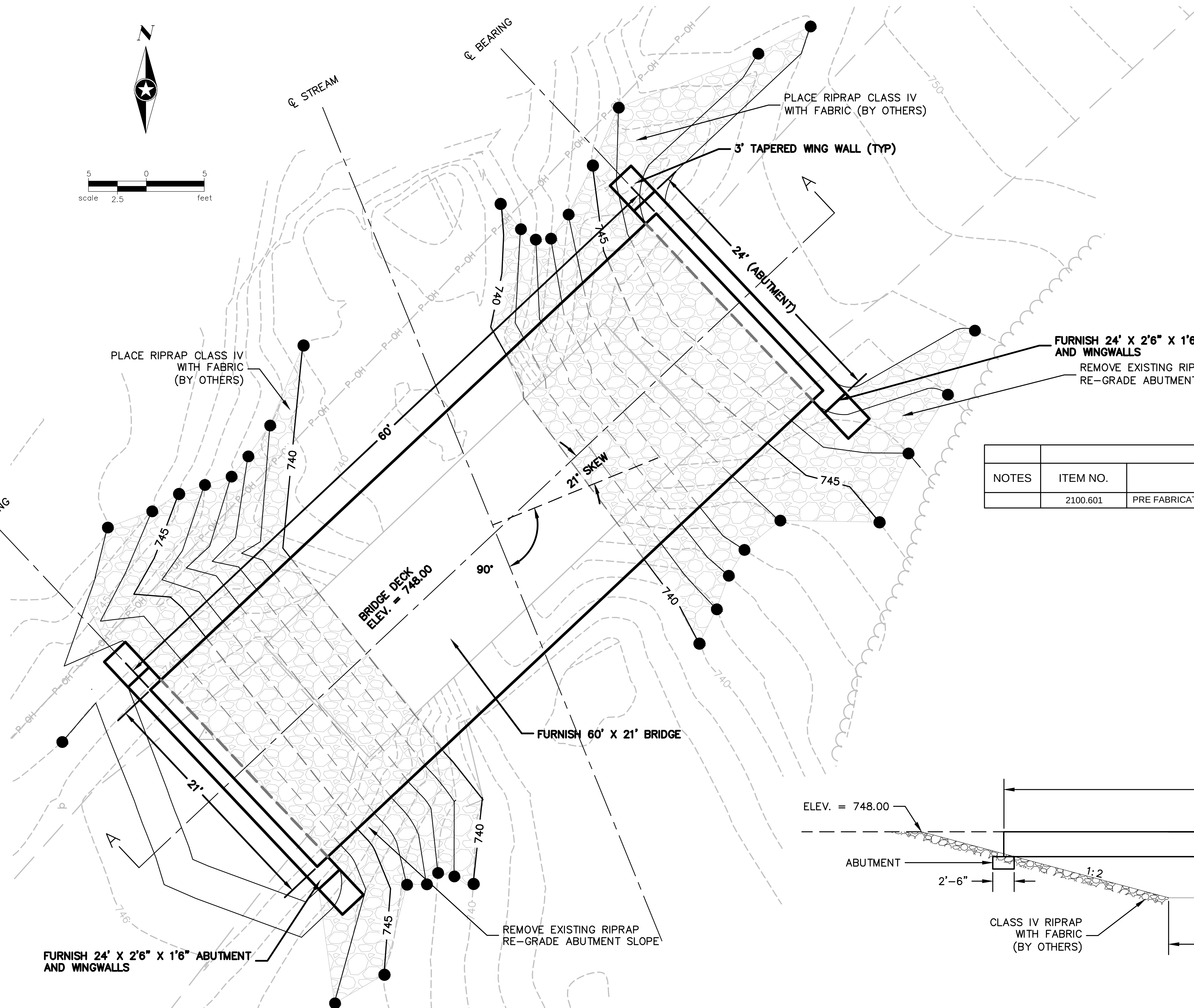
SEH
PHONE: 218.279.3000
418 W SUPERIOR ST STE 200
DULUTH, MN 55802-1512
www.sehinc.com

DULUTH, MINNESOTA

SPIRIT MOUNTAIN RECREATION AREA
KNOWLTON CREEK BRIDGE
EXISTING CONDITIONS

FILE NO. SMRAA-125435

1/2

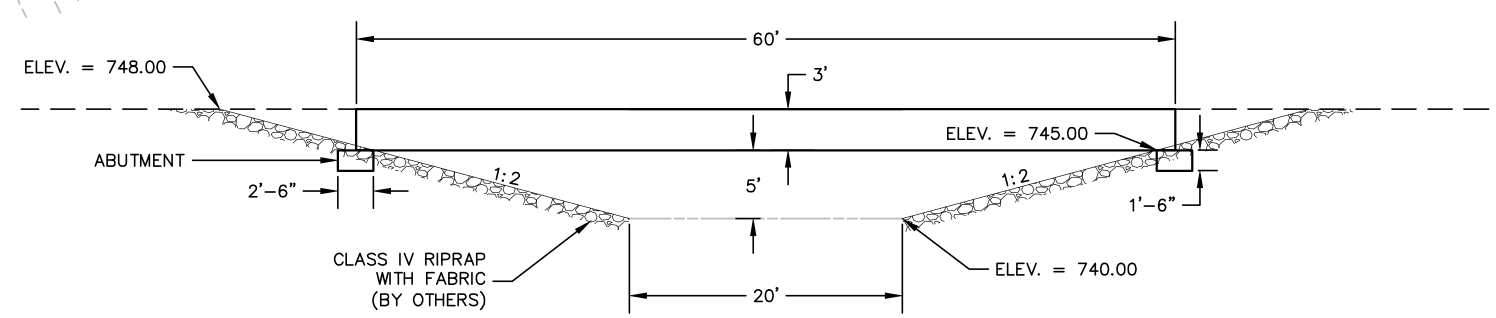


LEGEND

CLASS IV RIPRAP WITH FABRIC (BY OTHERS)

	STATEMENT OF ESTIMATED QUANTITIES				
NOTES	ITEM NO.	ITEM DESCRIPTION		UNIT	ESTIMATED QUANTITY
	2100.601	PRE FABRICATED BRIDGE SUPERSTRUCTURE AND ABUTMENTS (FURNISH ONLY)		LUMP SUM	1

SECTION A–A



NOTES:

BRIDGE – STEEL STRINGERS WITH GALVANIZED STEEL DECK AND 6" MINIMUM OF CLASS V AGGREGATE SURFACE
ABUTMENT – STEEL CRIB/CONCRETE FILLED ON COMPACTED AGGREGATE

BENCHMARK EL. 746.78
NORTHING = 3318342.59
EASTING = 4818080.76

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DRAWN BY: –
DESIGNER: –
CHECKED BY: –
DESIGN TEAM

NO.	BY	DATE	REVISIONS

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name, P.E.
Date: --/--/-- Lic. No. –

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DULUTH, MINNESOTA

SPIRIT MOUNTAIN RECREATION AREA
KNOWLTON CREEK BRIDGE

FILE NO. SMRAA-125435

2 / 2

Geotechnical Evaluation Report

Proposed Maintenance Road Bridge
Spirit Mountain Recreation Area
Duluth, Minnesota

Prepared for

SEH, Inc.

Professional Certification
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota

Joseph C. Butler, PE
Project Engineer
License Number: 47600
September 10, 2013

Project DU-13-05288

Braun Intertec Corporation

BRAUN INTERTEC

Braun Intertec Corporation
4511 West First Street, Suite 4
Duluth, MN 55807

Phone: 218.624.4967
Fax: 218.624.0196
Web: braunintertec.com

September 10, 2013 Project DU-13-05288

Matthew Bolf, PE
SEH, Inc.
418 West Superior Street
Duluth, MN 55802

Re: Geotechnical Evaluation
Proposed Maintenance Road Bridge
Spirit Mountain Recreation Area
Duluth, Minnesota

Dear Mr. Bolf:

We are pleased to present this Geotechnical Evaluation Report for the proposed bridge at Spirit Mountain Recreation Area in Duluth, Minnesota. A summary of our results and a summary of our recommendations in light of the geotechnical issues influencing design and construction are presented below. More detailed information and recommendations follow.

Summary of Results

The general soil profile at the west abutment consisted of 5 feet of fill consisting of poorly graded sand with silt, silty sand, and sandy silt with gravel. Beneath the fill, the boring encountered native glacial clayey sand (SC) and silty sand (SM) to auger refusal depth at a depth of 15 feet.

The general soil profile at the east abutment consisted of 3 feet of fill consisting of poorly graded sand with silt and gravel. Beneath the fill, the boring encountered native glacial silty sand (SM) with gravel to a refusal depth of 7 1/2 feet.

Penetration resistance values recorded in the native material ranged from 15 blows per foot (BPF) to 50 blows for 2 inches of spoon advancement indicating the material was medium dense to very dense.

Auger refusal can be caused by bedrock, hardpan, cobbles, or boulders. Based on the drilling action of the auger and the experience of our crew chief, we anticipate the refusal was caused by bedrock. Coring would be required for positive identification.

Groundwater was measured or estimated to be down in ST-01 to a depth of approximately 8.1 feet as our boring was advanced. We would expect the groundwater level to correspond closely with the water surface of the creek. Seasonal and annual fluctuations of groundwater should also be anticipated.

Summary of Recommendations

The geologic materials present below the fill, a depth of up to 5 feet, generally appear suitable for support of the proposed conventional spread footings. However, the silty sand soils encountered in the borings are considered highly scourable and frost susceptible. We recommend scour be analyzed and the bridge footing/wall design take scour into account. Based on our experience with similar bridges, we recommend scour protection (rip rap) be provided. Also, the silty sand soils encountered in the boring should be considered highly frost susceptible. We recommend frost protection be provided for all spread footings.

The apparent bedrock encountered at boring refusal depths is also suitable for support of the proposed bridge. While bedrock is not easily scoured, we recommend the rock footing interface be protected.

Debris and organic soils will have to be removed from the existing fill before it can be reused; this will not only limit the reusable volume, but will also increase the time required to handle the existing fill. Because there are no such resources on the site, sands or gravels will have to be imported to backfill the balance of excavations which will facilitate drainage behind below walls.

Dewatering of the footing excavations will be required. Also, sub excavation of the footing subgrades and replacement with 1 1/2 inch “rock” may be necessary depending on the stability of the exposed silty sands.

Remarks

Please refer to the attached report for a more detailed summary of our analyses and recommendations. If you have any questions regarding this report, please contact Joe Butler at 218.624.4967 or jbutler@braunintertec.com.

Sincerely,

BRAUN INTERTEC CORPORATION

Alex J. Peritz, EIT
Engineer-in-Training

Joseph C. Butler, PE
Associate Principal / Project Engineer

Mark W. Gothard, PE
Principal Engineer

Attachment:
Geotechnical Evaluation Report

Table of Contents

Description **Page**

Table of Contents (continued)

Description **Page**

BRAUN
INTERTEC

A. Introduction

A.1. Project Description

Spirit Mountain is planning to replace a bridge on their maintenance road at the base of the Spirit Mountain Recreation Area in Duluth, Minnesota. The previous bridge was destroyed in the flooding that occurred on June 20, 2012. Spirit Mountain is currently using a temporary bridge over this area. The proposed bridge will be a single span bridge supported on spread footings. The bridge will carry minimal traffic that will be associated with the operations of the ski hill.

A.2. Purpose

The purpose of a geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and construction of the proposed bridge abutments.

A.3. Scope of Services

Our scope of services for this project was originally submitted as a verbal Proposal to Matt Bolf, PE of SEH, Inc. We subsequently submitted a cost estimate to Mr. Bolf on August 8, 2013. We subsequently received authorization to proceed from Mr. Bolf. Tasks performed in accordance with our authorized scope of services included:

- Performing a reconnaissance of the site to evaluate equipment access to exploration locations.
- Staking and clearing the exploration location of underground utilities.
- Performing two penetration test borings to 40 feet or refusal on apparent bedrock.
- Preparing this report containing a boring location sketch, exploration log, and a summary of the geologic materials encountered, and recommendations for abutment subgrade preparation and the design of the proposed abutments.

Our scope of services was performed under the terms of our Master Services Agreement between SEH and Braun Intertec Corporation dated July 2, 2008.

A.4. Boring Location and Ground Surface Elevation

The borings were staked in the field by SEH. The drilled locations are shown on the boring location sketch in the appendix of this report. The ground surface elevations at the boring locations were interpolated from the sketch provided by SEH.

B. Results

B.1. Exploration Logs

B.1.a. Log of Boring Sheets

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance and other in-situ tests performed within them, laboratory tests performed on penetration test samples retrieved from them, and groundwater measurements.

Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

B.1.b. Geologic Origins

Geologic origins assigned to the materials shown on the logs and referenced within this report were based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

B.2. Geologic Profile

We completed two (2) soil borings, one on each bridge abutment.

Boring ST-1 was completed in the general area of the west abutment. The general soil profile at this location consisted of 5 feet of fill consisting of poorly graded sand with silt, silty sand, and sandy silt with gravel. Beneath the fill, the boring encountered native glacial clayey sand (SC) and silty sand (SM) to auger refusal depth at 15 feet.

Boring ST-2 was completed in the general area of the east abutment. The general soil profile at this location consisted of 3 feet of fill consisting of poorly graded sand with silt and gravel. Beneath the fill, the boring encountered native glacial silty sand (SM) with gravel to a refusal depth of 7 1/2 feet.

Penetration resistance values recorded in the native material ranged from 15 blows per foot (BPF) to 50 blows for 2 inches of spoon advancement indicating the material was medium dense to very dense.

Auger refusal can be caused by bedrock, hardpan, cobbles, or boulders. Based on the drilling action of the auger and the experience of our crew chief, we anticipate the refusal was caused by bedrock. Coring would be required for positive identification.

B.2.a. Groundwater

Groundwater was measured or estimated to be down in ST-01 to a depth of approximately 8.1 feet, corresponding to an elevation of 737 feet, as our boring was advanced. We would expect the groundwater level to correspond closely with the water surface of the creek.

Seasonal and annual fluctuations of groundwater should also be anticipated.

C. Basis for Recommendations

C.1. Design Details

C.1.a. Bridge Configuration

The proposed bridge will be a single span bridge constructed of either concrete or prefabricated steel structure. The design team has requested that the proposed abutments be supported by shallow spread footings.

C.1.b. Abutment Loads and Grades

We have assumed that abutment loads associated with the bridge will be less than 10 kips per lineal foot (klf). We have also assumed grades adjacent to the abutment will remain within 2 feet of existing grades.

C.1.c. Precautions Regarding Changed Information

We have attempted to describe our understanding of the proposed construction to the extent it was reported to us by others. Depending on the extent of available information, assumptions may have been made based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, we should be notified. New or changed information could require additional evaluation, analyses and/or recommendations.

C.2. Design and Construction Considerations

The geologic materials present below the fill, a depth of up to 5 feet, generally appear suitable for support of the proposed conventional spread footings. However, the silty sand soils encountered in the borings are considered highly scourable and frost susceptible. We recommend scour be analyzed and the bridge footing/wall design take scour into account. Based on our experience with similar bridges, we recommend scour protection (rip rap) be provided. Also, the silty sand soils encountered in the boring should be considered highly frost susceptible. We recommend frost protection be provided for all spread footings.

The apparent bedrock encountered at boring refusal depths is also suitable for support of the proposed bridge. While bedrock is not easily scoured, we recommend the rock footing interface be protected.

Debris and organic soils will have to be removed from the existing fill before it can be reused; this will not only limit the reusable volume, but will also increase the time required to handle the existing fill. Because there are no such resources on the site, sands or gravels will have to be imported to backfill the balance of excavations which will facilitate drainage behind below walls.

Dewatering of the footing excavations will be required. Also, sub excavation of the footing subgrades and replacement with 1 1/2 inch “rock” may be necessary depending on the stability of the exposed silty sands.

D. Recommendations

D.1.a. Embedment Depth

For frost and scour protection, we recommend embedding footings 72 inches below the channel bottom.

D.1.b. Excavation Dewatering

Excavations will penetrate the groundwater surface at depths approximately equal to the surface water elevation in the creek. Dewatering will be required to facilitate an evaluation of the geologic materials exposed in the excavation sides and bottoms, and the placement and compaction of backfill.

D.1.c. Subgrade Improvement

The silty sands encountered at bottom of footing elevation may be wet, depending on groundwater conditions at the time of construction. If wet, these soils will become disturbed and unstable if walked upon during construction. To facilitate placement of forms and reinforcement, it may be necessary to over excavate the wet silty sands to a depth of 2 feet and replace them with 1 1/2-inch stone.

D.1.d. Net Allowable Bearing Pressure

We recommend sizing spread footings to exert a net allowable bearing pressure of 4,000 pounds per square foot (psf), including all transient loads. This value includes a safety factor of at least 3.0 with regard to bearing capacity failure.

If the footings are designed to bear on bedrock, We recommend sizing spread footings to exert a net allowable bearing pressure of 10,000 pounds per square foot (psf).

D.1.e. Settlement

We estimate that total and differential settlements among the footings will amount to less than 1 and 1/2 inch, respectively, under the assumed loads.

D.2. Abutment

D.2.a. Drainage Control

We recommend installing subdrains behind the abutment walls, adjacent to the footings. Preferably the subdrains should consist of perforated pipes embedded in washed gravel, which in turn is wrapped in filter fabric. Perforated pipes encased in a filter “sock” and embedded in washed gravel, however, may also be considered. The pipes should then be “daylighted.”

D.2.b. Selection, Placement and Compaction of Backfill

Unless a drainage composite is placed against the backs of the abutment walls, we recommend that backfill placed within 2 horizontal feet of those walls consist of sand having less than 50 percent of the particles by weight passing a #40 sieve and less than 5 percent of the particles by weight passing a #200 sieve. Sand meeting this gradation will likely need to be imported. We recommend that the balance of the backfill placed against exterior perimeter walls also consist of sand, though it is our opinion that the sand may contain up to 20 percent of the particles by weight passing a #200 sieve.

Because subsurface conditions do not favor the accumulation of water against interior below-grade walls, it is our opinion that those walls may be backfilled exclusively with sand containing up to 20 percent of the particles by weight passing a #200 sieve.

We recommend a walk behind compactor be used to compact the backfill placed within about 5 feet of the abutment walls. Further away than that, a self-propelled compactor can be used.

D.2.c. Configuring and Resisting Lateral Loads

Below-grade wall design can be based on active earth pressure conditions if the walls are allowed to rotate slightly. If rotation cannot be tolerated, then design should be based on at-rest earth pressure conditions. Rotation up to 0.002 times the wall height is generally required to mobilize active earth pressures when walls are backfilled with sand. For the active case, we recommend designing for an equivalent fluid pressure of 50 pounds per square foot per foot of depth (pcf). For the at-rest case, we recommend designing for an equivalent fluid pressure of 70 pcf.

Our recommended design values are based on a wet unit backfill weight for sand of 125 pcf, an internal friction angle of 25 degrees, and assume a level backfill with no surcharge. Our design values will need to be revised for sloping backfill or other dead or live loads that are placed within a horizontal distance behind the walls that is equal to the height of the walls. Our design values also assume that the walls are drained so that water cannot accumulate behind the walls.

Resistance to lateral earth pressures will be provided by passive resistance against the retaining wall footings, and by sliding resistance along the bottoms of the wall footings. We recommend assuming a passive pressure equal to 250 pcf and a sliding coefficient equal to 0.5. These values are un-factored.

D.3. Construction Quality Control

D.3.a. Excavation Observations

We recommend close observations be made by a geotechnical engineer or a Mn/DOT-certified grading and base (soils) technician on the subgrade soils prior to the placement of fills or pavements.
The engineer or technician should verify that the soils are similar to those found in the soil borings and that they are suitable for support of the proposed construction.

D.3.b. Materials Testing

We recommend density tests be taken in excavation backfill and additional required fill placed below spread footings, slab-on-grade construction, beside foundation walls behind basement walls, and below pavements.

We recommend Marshall tests on bituminous mixes to evaluate strength and air voids, and density tests to evaluate compaction.

We also recommend slump, air content and strength tests of Portland cement concrete.

D.3.c. Cold Weather Precautions

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed on frozen subgrades. Concrete should be protected from freezing until the necessary strength is attained. Frost should not be permitted to penetrate below footings.

E. Procedures

E.1. Penetration Test Borings

The penetration test borings were drilled with a truck-mounted core and auger drill equipped with hollow-stem auger. The borings were performed in accordance with ASTM D 1586. Penetration test samples were taken at 2 1/2- or 5-foot intervals. Actual sample intervals and corresponding depths are shown on the boring logs.

E.2. Material Classification and Testing

E.2.a. Visual and Manual Classification

The geologic materials encountered were visually and manually classified in accordance with ASTM Standard Practice D 2488. A chart explaining the classification system is attached. Samples were placed in jars or bags and returned to our facility for review and storage.

E.2.b. Laboratory Testing

The results of the laboratory tests performed on geologic material samples are noted on or follow the appropriate attached exploration logs. The tests were performed in accordance with ASTM or AASHTO procedures.

E.3. Groundwater Measurements

The drillers checked for groundwater as the penetration test borings were advanced, and again after auger withdrawal. The boreholes were then backfilled or allowed to remain open for an extended period of observation as noted on the boring logs.

F. Qualifications

F.1. Variations in Subsurface Conditions

F.1.a. Material Strata

Our evaluation, analyses and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected to vary in depth, elevation and thickness away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

F.1.b. Groundwater Levels

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. It should be noted that the observation periods were relatively short, and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

F.2. Continuity of Professional Responsibility

F.2.a. Plan Review

This report is based on a limited amount of information, and a number of assumptions were necessary to help us develop our recommendations. It is recommended that our firm review the geotechnical aspects of the designs and specifications, and evaluate whether the design is as expected, if any design changes have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs and specifications.

F.2.b. Construction Observations and Testing

It is recommended that we be retained to perform observations and tests during construction. This will allow correlation of the subsurface conditions encountered during construction with those encountered by the borings, and provide continuity of professional responsibility.

F.3. Use of Report

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

F.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

BRAUN INTERTEC

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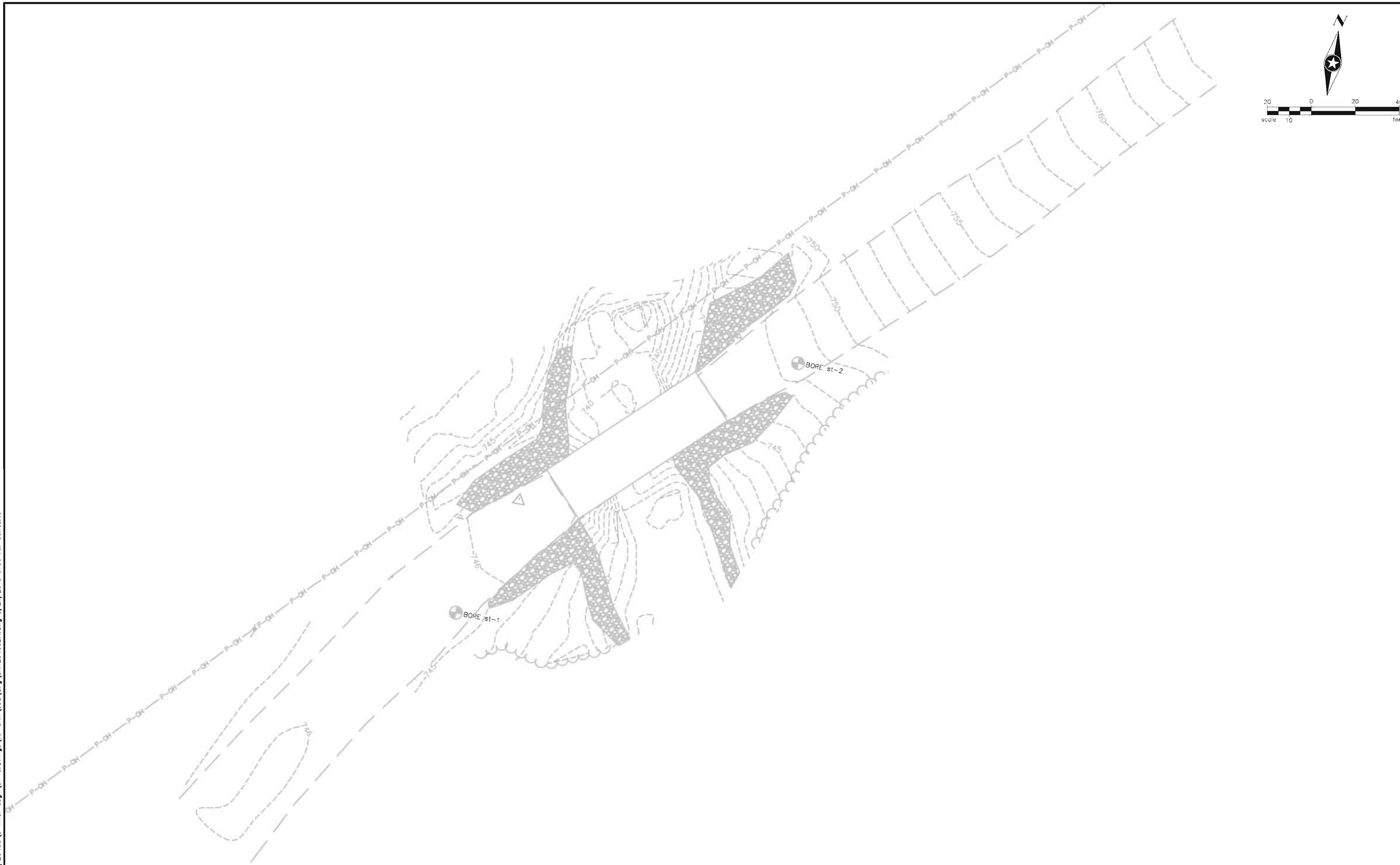

DRAWN BY: ACO	NO.	BY	DATE	REVISIONS
DESIGNER: –				
CHECKED BY: KLA				
DESIGN TEAM				

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Name, P.E.

Date: --/--/-- Lic. No. –

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DULUTH, MINNESOTA

SPIRIT MOUNTAIN TEMPORARY BRIDGE

FILE NO. SMRAA-125435

1/1

BRAUN INTERTEC

LOG OF BORING

Braun Project DU-13-05288 Geotechnical Evaluation Proposed Maintenance Road Bridge Spirit Mountain Recreation Area Duluth, Minnesota	BORING: ST-01 LOCATION: See attached sketch.

DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: 8/19/13	SCALE: 1" = 4'

Elev. feet 745.5	Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
743.0	2.5	FILL	FILL: Poorly Graded Sand with Silt and Gravel, fine- to medium-grained, brown, moist.			Ground surface elevations at the boring locations were determined by SEH, Inc.
741.5	4.0	FILL	FILL: Sandy Silt, with a trace of Gravel, brown, moist.	8		
740.5	5.0	FILL	FILL: Silty Sand, with a trace of Gravel, fine- to medium-grained, brown, moist.			
736.5	9.0	SC	CLAYEY SAND, with a trace of Gravel, fine- to medium-grained, brown, medium dense, wet. (Glacial Till)	10 15	▽	An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. Groundwater levels fluctuate.
730.5	15.0	SM	SILTY SAND, with a trace of Gravel, fine- to medium-grained, brown, very dense, moist. (Glacial Till)	57 50/4" 50/2"		
			END OF BORING. Water observed at a depth of 8.1 feet while drilling. Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\DULUTH\2013\05288.GPJ BRAUN_V8_CURRENT.GDT 9/9/13 15:32

BRAUN INTERTEC

LOG OF BORING

Braun Project DU-13-05288 Geotechnical Evaluation Proposed Maintenance Road Bridge Spirit Mountain Recreation Area Duluth, Minnesota	BORING: ST-02 LOCATION: See attached sketch.

DRILLER: M. Heinzen	METHOD: 3 1/4" HSA, Autohammer	DATE: 8/19/13	SCALE: 1" = 4'

Elev. feet 748.5	Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
		FILL	FILL: Poorly Graded Sand with Silt, fine- to medium-grained, with a trace of Gravel, brown, moist.			
745.5	3.0			52		
		SM	SILTY SAND, with a trace of Gravel, fine- to medium-grained, brown, very dense, moist. (Glacial Till)			
				82/7"		
741.0	7.5					
			END OF BORING. Water not observed while drilling. Boring then backfilled.	50/2"		

(See Descriptive Terminology sheet for explanation of abbreviations)

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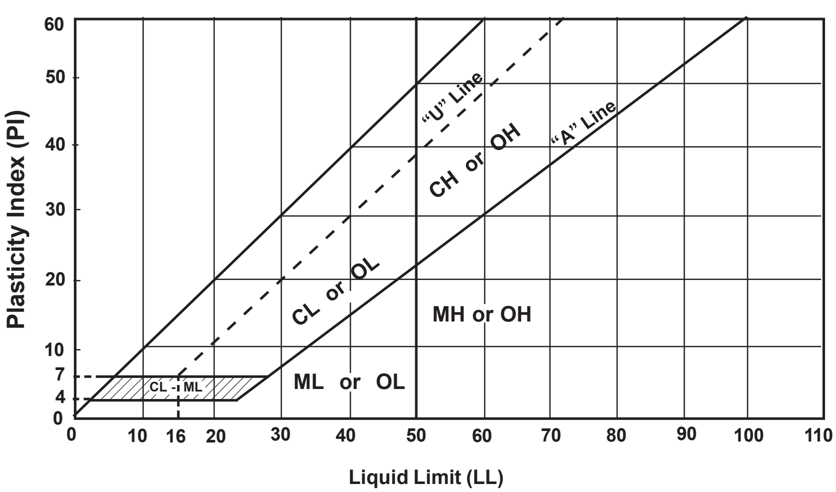
BRAUN INTERTEC

Descriptive Terminology of Soil

Standard D 2487 - 00
Classification of Soils for Engineering Purposes
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification: Group Symbol	Soils Classification: 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** 5% or less fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands** 5% or less fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	**Silts and Clays** Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay [k l m n]
				OL	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	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay [k l m p]
				OH	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-in (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. 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
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines" to group name.
h. If soil contains ≥ 15% gravel, add "with gravel" to group name.
i. 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
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 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.



Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %
WD	Wet density, pcf	**S**	Percent of saturation, %
MC	Natural moisture content, %	**SG**	Specific gravity
LL	Liqiuid limit, %	**C**	Cohesion, psf
PL	Plastic limit, %	∅	Angle of internal friction
PI	Plasticity index, %	**qu**	Unconfined compressive strength, psf
P200	% passing 200 sieve	**qp**	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders .... over 12"
Cobbles .... 3" to 12"
Gravel
  Coarse .... 3/4" to 3"
  Fine .... No. 4 to 3/4"
Sand
  Coarse .... No. 4 to No. 10
  Medium .... No. 10 to No. 40
  Fine .... No. 40 to No. 200
Silt .... < No. 200, PI < 4 or below "A" line
Clay .... < No. 200, PI ≥ 4 and on or above "A" line

Relative Density of Cohesionless Soils

Very loose .... 0 to 4 BPF
Loose .... 5 to 10 BPF
Medium dense .... 11 to 30 BPF
Dense .... 31 to 50 BPF
Very dense .... over 50 BPF

Consistency of Cohesive Soils

Very soft .... 0 to 1 BPF
Soft .... 2 to 3 BPF
Rather soft .... 4 to 5 BPF
Medium .... 6 to 8 BPF
Rather stiff .... 9 to 12 BPF
Stiff .... 13 to 16 BPF
Very stiff .... 17 to 30 BPF
Hard .... over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise, Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube). All samples were taken with the standard 2" OD split-tube sampler, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous-flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B."

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H."

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.