City of Duluth
DEPARTMENT OF PUBLIC WORKS/UTILITIES
Engineering Division
211 City Hall • Duluth MN 55802
(218) 730-5200 Fax: (218) 730-5907

Date: May 21, 2013

City of Duluth Bid # 13-0335
Job Description: 2012 Flood Repairs – Hawthorne Rd., Vermilion Rd., St. Marie St. and Bridge No. L8517
City Project No. 1172

Addendum #3

NOTICE TO ALL BIDDERS:

The addendum is issued to modify, explain or correct the original drawings specification and/or previous addendums and hereby made part of the Contract Documents. Please attach this Addendum to the specifications in your possession and note receipt of this Addendum on the Request for Bid.

Bid Form:

N/A

Specifications:

REPLACE the Federal Wage Decision - Highway dated May 3, 2013 (Addendum #1) with the attached updated Federal Wage Decision dated May 10, 2013.

ADD (1910) Fuel Escalation Clause to Appendix B.

ADD the project Geotechnical Evaluation Report (34 pgs) by Braun Intertec (Project DU-12-06362) dated March 20, 2013.

ADD the following to SP-53.2.1, "The temporary water service shall be buried at driveways and otherwise protected from resident and construction traffic throughout the project by aggregate surfacing, pipe sleeves, or other means acceptable to the Engineer. Such protective measures shall be included for payment under the lump sum Temporary Water Service item."

REVISE SP.41.1 to read to read as follows:

Mix Designation Numbers for the bituminous mixtures on this Project are as follows:

Type SP 9.5 Wearing Course	SPWEA340C
Type SP 12.5 Wearing Course	SPWEB340C
Type SP 12.5 Non-Wearing Course	SPNWB330C

Plan sheets:

REVISE Sheet 2, Statement of Estimated Quantities, Line 33, Spec. No. from 2360.501 to 2360.502.

All other items remain the same.

Sincerely,

Patrick Mlakar
Project Manager

General Decision Number: MN130105 05/10/2013 MN105

Superseded General Decision Number: MN20120105

State: Minnesota

Construction Type: Heavy

County: St Louis County in Minnesota.

HEAVY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	01/04/2013
1	02/22/2013
2	03/29/2013
3	05/03/2013
4	05/10/2013

BOIL0647-004 01/01/2013

	Rates	Fringes
BOILERMAKER	$ 32.40	25.37

CARP0361-020 07/11/2011

ST LOUIS COUNTY (Southern 1/3 including Cotton, Floodwood, Fond Du Lac, and Proctor)

	Rates	Fringes
CARPENTER (Including Form Work)	$ 31.07	15.80

CARP0361-021 07/11/2011

ST LOUIS (Duluth)

	Rates	Fringes
CARPENTER (Including Form Work)	$ 31.47	15.80

CARP0606-010 05/01/2011

ST LOUIS COUNTY (Northeast 2/3 including Cook, Cusson, Ely; and Western part including Chisholm, Greaney, and Orr)

	Rates	Fringes
CARPENTER (Including Form Work)	$ 31.07	15.80

ELEC0242-012 06/03/2012

UNNELS, SHAFTS, ETC. - $ .25 PREMIUM
UNDER AIR PRESSURE - $ .50 PREMIUM

HAZARDOUS WASTE PROJECTS (PPE Required):
LEVEL A - $1.25 PREMIUM
LEVEL B - $ .90 PREMIUM
LEVEL C - $ .60 PREMIUM

IRON0512-028 05/01/2012

	Rates	Fringes
IRONWORKER, STRUCTURAL AND REINFORCING	$ 29.24	21.20

LABO0132-038 05/01/2009

	Rates	Fringes
LABORER		
Common or General (Natural Gas Pipeline only)	$ 16.70	10.49

LABO0563-034 05/01/2012

ST LOUIS (South of T. 55 N)

	Rates	Fringes
LABORERS		
(1) Common or General	$ 26.14	15.33
(2) Mason Tender Cement/Concrete	$ 26.34	12.94
(6) Pipe Layer	$ 28.14	15.33

LABO0563-035 05/01/2012

ST LOUIS (North of T. 55 N)

	Rates	Fringes
LABORERS		
(1) Common or General	$ 24.26	17.21
(2) Mason Tender Cement/Concrete	$ 24.46	17.21
(6) Pipe Layer	$ 26.26	17.21

PLAS0633-036 05/01/2012

ST. LOUIS COUNTY (North of T 55N)

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 26.71	14.64

PLAS0633-039 05/01/2012

ST. LOUIS COUNTY (South of T 55N)

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 32.78	16.80

SUMN2009-072 09/28/2009

	Rates	Fringes
LABORER: Landscape	$ 12.88	4.61

* TEAM0160-018 05/01/2013

	Rates	Fringes
TRUCK DRIVER (DUMP)		
(1) Articulated Dump Truck	$ 26.85	14.45
(2) 3 Axles/4 Axles; 5 Axles receive $0.30 additional per hour	$ 26.30	14.45
(3) Tandem Axles; & Single Axles	$ 26.20	14.45

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e.,

Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

FCA = [(CFI/BFI) – 0.85] x Q x BFI

Where FCA = Fuel Cost Adjustment (cents)
CFI = Current Fuel Index (cents per gallon)
BFI = Base Fuel Index (cents per gallon)
Q = Monthly total gallons of fuel

Basis of Payment

A Fuel Cost Adjustment payment to the Contractor will be made as a lump sum each payment period based on the last published CFI. A Fuel Cost Adjustment credit to the Department will be deducted as a lump sum each payment period from any monies due the Contractor. Upon completion of the work under the Contract, any difference between the estimated quantities previously paid and the final quantities will be determined. The CFI in effect on the day of completion of the Contract will be applied to the quantity differences in accordance with the procedures set forth above.

Schedule of Work Items
(Only items shown will be considered for compensation adjustments.)

	Item	Unit	Gallons of Fuel per Unit	Unit	Gallons of Fuel per Unit
(1) Earthwork:					
2105.501	Common Excavation	Cu. Yd	0.17	m^3	0.22
2105.503	Rock Excavation	Cu. Yd	0.27	m^3	0.35
2105.505	Muck Excavation	Cu. Yd	0.17	m^3	0.22
2105.507	Subgrade Excavation	Cu. Yd	0.17	m^3	0.22
2105.515	Unclassified Excavation	Cu. Yd	0.23	m^3	0.30
2105.521	Granular Borrow (EV)	Cu. Yd	0.17	m^3	0.22
	Granular Borrow (CV)	Cu. Yd	0.19	m^3	0.25
	Granular Borrow (LV)	Cu. Yd	0.14	m^3	0.18
2105.522	Select Granular Borrow (EV)	Cu. Yd	0.17	m^3	0.22
	Select Granular Borrow (CV)	Cu. Yd	0.19	m^3	0.25
	Select Granular Borrow (LV)	Cu. Yd	0.14	m^3	0.18
2105.523	Common Borrow (EV)	Cu. Yd	0.17	m^3	0.22
	Common Borrow (CV)	Cu. Yd	0.19	m^3	0.25
	Common Borrow (LV)	Cu. Yd	0.14	m^3	0.18
2105.535	Topsoil Borrow (EV)	Cu. Yd	0.17	m^3	0.22
	Topsoil Borrow (CV)	Cu. Yd	0.19	m^3	0.25
	Topsoil Borrow (LV)	Cu. Yd	0.14	m^3	0.18
2106.607	Common Embankment (CV)	Cu. Yd	0.19	m^3	0.25
2106.607	Granular Embankment (CV)	Cu. Yd	0.19	m^3	0.25
2106.607	Select Granular Embankment(CV)	Cu. Yd	0.19	m^3	0.25
2106.607	Select Granular Embankment Modified (__ %) (CV)	Cu. Yd	0.19	m^3	0.25
2106.607	Excavation – Rock	Cu. Yd	0.27	m^3	0.35
2106.607	Excavation – Muck	Cu. Yd	0.17	m^3	0.22

January 28, 2009

(1910) FUEL ESCALATION CLAUSE

The provisions set forth in Mn/DOT 1910 are hereby deleted, and the following is substituted therefore:

These provisions provide for compensation adjustments in the cost of motor fuels (diesel and gasoline) consumed in prosecuting the Contract work. The Engineer will calculate the Fuel Cost Adjustments. Payments or credits will be applied to partial and final payments for work items set forth herein.

For this purpose, the Department will establish a Base Fuel Index (BFI) for fuel to be used on the Project. The Base Fuel Index will be the average of the high and low rack prices shown for No. 2 ultra low sulfur fuel oil in the "OPIS Energy Group" tabulation titled "RackFax, Minneapolis, MN, OPIS Direct Gross No. 2 Distillate Fuels" ***for the day of the Contract letting***.

A Current Fuel Index (CFI) in cents per gallon will be established for each month. The CFI will be the average of the high and low rack prices shown for No. 2 ultra low sulfur fuel oil in the "OPIS Energy Group" tabulation titled "RackFax, Minneapolis, MN, OPIS Direct Gross No. 2 Distillate Fuels" averaged for the beginning and ending dates of the monthly period being adjusted.

The Engineer will compute the ratio of the Current Fuel Index to the Base Fuel Index (CFI/BFI) each month. If that ratio falls between 0.85 and 1.15, no fuel adjustment will be made that month. If the ratio is less than 0.85, a credit to the Department will be computed. If the ratio is greater than 1.15, additional payment to the Contractor will be computed.

Credit or additional payment will be computed as follows:

(1) The Engineer will estimate the quantity of work done in that month under each of the Contract items listed below.

(2) The Engineer will compute the gallons of fuel used in that month for each of the Contract items listed below by applying the unit fuel usage factors shown.

(3) The Engineer will summarize the total gallons (Q) of fuel used in that month for the applicable items.

(4) The Engineer will determine the Fuel Cost Adjustment (FCA) from the following formulas:

If the Current Fuel Index (CFI) is greater than the Base Fuel Index (BFI), the following formula shall be used to determine the amount of Fuel Cost Adjustment to be paid to the Contractor.

$$FCA = [(CFI/BFI) - 1.15] \times Q \times BFI$$

If the Current Fuel Index (CFI) is less than the Base Fuel Index (BFI), the following formula shall be used to determine the amount of Fuel Cost Adjustment to be credited to the Department.

Item		Unit	Gallons of Fuel per Unit	Unit	Gallons of Fuel per Unit
(2) Aggregate Base:					
2211.501	Aggregate Base	Ton	0.55	t	0.61
2211.502	Aggregate Base (LV)	Cu. Yd	0.77	m^3	1.01
2211.503	Aggregate Base (CV)	Cu. Yd	0.99	m^3	1.29
2211.607	Open Graded Aggregate Base (CV)	Cu. Yd	0.99	m^3	1.29
(3) Aggregate Shouldering:					
2221.501	Aggregate Shouldering	Ton	0.55	t	0.61
2221.502	Aggregate Shouldering (LV)	Cu. Yd	0.77	m^3	1.01
2221.503	Aggregate Shouldering (CV)	Cu. Yd	0.99	m^3	1.29
(4) Concrete Pavements:					
2301.511	Structural Concrete	Cu. Yd	0.98	m^3	1.28
2301.513	Structural Concrete HE	Cu. Yd	0.98	m^3	1.28
2301.604	Structural Concrete	Sq. Yd.	0.027*t	m^2	0.00128*t
(5) Bituminous Pavements:					
2350.501	Type ( ) Wearing Course Mixture ( )	Ton	0.90	t	0.99
2350.502	Type ( ) Non-Wearing Course Mixture ( )	Ton	0.90	t	0.99
2350.503	Type ( ) ( ) Course ( ), (t)" Thick	Sq. Yd	0.051*t		
2350.503	Type ( ) ( ) Course (,), (t) mm Thick			m^2	0.0024*t
2360.501	Type SP ( ) Wearing Course Mixture ( )	Ton	0.90	t	0.99
2360.502	Type SP ( ) Non-Wearing Course Mixture (,)	Ton	0.90	t	0.99
2360.503	Type SP ( ) ( ) Course (,), (t)" thick	Sq. Yd	0.051*t		
2360.503	Type SP ( ) ( ) Course (,), (t) mm thick			m^2	0.0024*t
(6) Pipe: ***					
2501.511	__ ____ Pipe Culvert ___	Lin. Ft.	0.70	m	2.30
2501.521	__ ____ Pipe Arch Culvert ___	Lin. Ft.	0.70	m	2.30
2501.561	__ ____ Pipe Culvert Des 3006 ___	Lin. Ft.	0.70	m	2.30
2501.603	__ Pipe Culvert	Lin. Ft.	0.70	m	2.30
2503.511	__ ____ Pipe Sewer ___	Lin. Ft.	0.70	m	2.30
2503.521	__ ____ Pipe Arch Sewer ___	Lin. Ft.	0.70	m	2.30
2503.541	__ ____ Pipe Sewer Des 3006 ___	Lin. Ft.	0.70	m	2.30
2503.603	__ ____ Pipe Sewer	Lin. Ft.	0.70	m	2.30

t = thickness (in inches or mm)

NOTE: No price adjustments will be made on fuel used for drying and heating aggregates.
*** No price adjustment will be made for pipes less than 12" in diameter or jacked pipes.

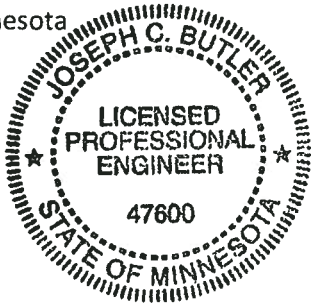
Geotechnical Evaluation Report

Proposed Street Reconstructions
Hawthorne Road – Vermilion Road – St. Marie Street
Duluth, Minnesota

Prepared for

LHB, 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
March 20, 2013

Project DU-12-06362

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

March 20, 2013

Project DU-12-06362

Brad Scott, PE
LHB, Inc.
21 West Superior Street, Suite 500
Duluth, MN 55802

Re: Geotechnical Evaluation
Proposed Street Reconstructions
Hawthorne Road – Vermilion Road – St. Marie Street
Duluth, Minnesota

Dear Mr. Scott:

We are pleased to present this Geotechnical Evaluation Report for the City of Duluth Hawthorne Road – Vermillion Road – St. Marie Street, Street Reconstruction project. A summary of our results, and a summary of our recommendations in light of the geotechnical issues influencing design and construction, is presented below. More detailed information and recommendations follow.

Summary of Results

Thirteen borings were ultimately completed for the project. All of the borings were completed through the concrete pavement surface. Below the pavement the borings generally encountered lean to fat clay and/or silty sand to their termination depths.

Pavement
Most of the borings encountered 8 inches of concrete over 8 inches of aggregate base. Boring ST-05, however, encountered 1-inch of bituminous at the surface.

Subgrade Soil
Below the pavements, the borings generally encountered lean clay, fat clay or silty sand. Some of these soils appeared to be filled. The filled soils were generally silty sand; some were mixed with clayey sands and clays. Borings ST-01 through ST-03 encountered fat clay lacustrine deposits below the fill. Borings ST-04 and ST-06A encountered lean clay below the fill. Borings ST-05 and ST-07 encountered native silty sand below the fill.

Bedrock
Auger refusal was encountered in 7 of the 13 borings; auger refusal can be caused by cobbles, boulders, hardpan, debris or bedrock. Based on our experience in the area, and our offset borings, it is our opinion the refusal was caused by bedrock.

Summary of Recommendations

Utility Installations
The silty sand, fat clay and lean clay soils encountered in the borings appear suitable for support of the proposed utilities.

Pavement Subgrades
Silty sands, lean clays and fat clays were encountered at anticipated subgrade locations. It is our opinion the silty sand soils are marginal pavement subgrade soils. It is our opinion the lean clay and fat clay soils are poor subgrade soils. The lean clays (CL), fat clays (CH) and silty sands (SM) are frost-susceptible soils. Mn/DOT design standards require minimum thicknesses of frost-free materials (FFMs) over these subgrade soils.

Bedrock
Apparent bedrock was encountered above anticipated utility invert elevations. We understand rock trenches are already present and will be reused. If rock excavation is required, blasting is generally the preferred method of excavation, however, mechanical breaking methods, such as drilling relief holes and a use of a large breaker may be considered. Alternatively, insulation can be considered for frost protection. If insulation is pursued, we recommend the insulation manufacturer be consulted; they can provide typical sections and specifications for their products.

Remarks

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Joe Butler at 218.624.4967 or jbutler@braunintertec.com.

Sincerely,

BRAUN INTERTEC CORPORATION

Joseph C. Butler, PE
Associate Principal/Project Engineer

Mark W. Gothard, PE
Principal Engineer

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Appendix

A. Introduction

A.1. Project Description

The City of Duluth is planning to reconstruct pavements and utilities along the Hawthorne Road – Vermilion Road – St. Marie Street alignments between East 4th Street and Wallace Avenue. The proposed project includes pipe bursting 6-inch water main to 8-inch HDPE water main; water service replacement and selective storm sewer replacement. Existing VCP sanitary sewer main will be lined as part of a separate city project. The sidewalks and pavements will be reconstructed. The pavements will have a 10-ton bituminous section with curb and gutter.

The project is denoted as City of Duluth project 01172 TR and is being designed to state aid standards.

A.2. Purpose

The purpose of this geotechnical evaluation is to provide subsurface soil and groundwater information and geotechnical recommendations for use in design and construction of the proposed street and utility reconstruction project.

A.3. Provided Documents

Brad Scott, PE, project manager for LHB, Inc. (LHB), provided us with preliminary plan and profile drawings from the project plans. The plans were prepared by LHB and were undated. LHB also provide partial plans from the 1983 construction of the alignment. We also reviewed topographic maps and aerial photos of the project area.

A.4. Site Conditions

The project is currently a concrete paved roadway with curb and gutters. The alignment is about 2300 feet mile in length and is on a hillside. The alignment along Hawthorne Road is relatively steep. The alignment covers about 150 feet of vertical alignment ranging from elevation 888 at Boring ST-01 near 4th Street East up to 1047 at the intersection of St. Marie Street and Wallace Avenue. The pavement surfaces have slopes of less than 12 percent, and the steepest slope is on Hawthorne Road just south of the intersection of Vermilion Street.

A.5. Scope of Services

Our scope of services for this project was originally submitted as a Proposal to LHB on November 1, 2012. We received authorization to proceed from LHB on November 5, 2012. Tasks performed in accordance with our authorized scope of services included:

- Staking the prospective boring locations.
- Coordinating the locating of underground utilities near the boring locations.
- Performing ten standard penetration test borings to a depth of 10 feet, and ten flight auger borings to 10 feet.
- Preparing this report containing a sketch, boring logs, a summary of the geologic materials encountered, results of laboratory tests, and recommendations for street and utility subgrade preparation, and a recommended pavement section.

Prior to our field work, LHB deleted 9 of the borings from this project. Several borings encountered auger refusal during the first mobilization, therefore two additional borings to a depth of 10 feet or refusal were added to further evaluate the presence of bedrock.

A.6. Boring Locations and Elevations

The desired boring locations were selected by LHB. We staked the locations in the field and LHB surveyed the drilled locations and ground surface elevations.

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, organic vapor screening, 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. Subsurface Profile

Thirteen borings were ultimately completed for the project. All of the borings were completed through the concrete pavement surface. Below the pavement the borings generally encountered lean to fat clay and/or silty sand to their termination depths.

B.2.a. Pavement

Most of the borings encountered 8 inches of concrete over 8 inches of aggregate base. Boring ST-05, however, encountered 1-inch of bituminous at the surface.

B.2.b. Subgrade Soil

Below the pavements, the borings generally encountered lean clay, fat clay or silty sand. Some of these soils appeared to be filled. The filled soils were generally silty sand, some were mixed with clayey sands and clays. Borings ST-01 through ST-03 encountered fat clay lacustrine deposits below the fill. Borings ST-04 and ST-6A encountered lean clay below the fill. Borings ST-05 and ST-07 encountered native silty sand below the fill.

Penetration resistances in the unfrozen, fill and native silty sands ranged from 6 to 34 blows per foot (BPF), indicating they ranged from loose to medium dense. Penetration resistances in the lean and fat clays ranged from 8 to 25 BPF, indicating they were medium to very stiff.

B.2.c. Bedrock

Auger refusal was encountered in 7 of the 13 borings; auger refusal can be caused by cobbles, boulders, hardpan, debris or bedrock. Based on our experience in the area, and our offset borings, it is our opinion the refusal was caused by bedrock.

Table 1. Bedrock Refusal Depth and Elevation

Boring	Refusal Depth (ft)	Refusal Cause	Bedrock Elevation
ST-06	2.8	Bedrock	960.0
ST-06B	4.3	Bedrock	955.5
ST-07	4.1	Bedrock	980.6
ST-08	7.8	Bedrock	986.5
ST-09	1.8	Bedrock	1016.4
ST-10	1.8	Bedrock	1028.5
ST-11	2.3	Bedrock	1035.0

B.2.d. Groundwater

Groundwater was generally not observed in our borings as they were advanced. Based on the moisture contents of the geologic materials encountered, it appears that groundwater was below the depths explored. We would expect that groundwater would be encountered running on top of the bedrock during periods of wet weather and spring thaw.

Seasonal and annual fluctuations of groundwater, however, should be anticipated.

C. Basis for Recommendations

C.1. Proposed Construction

C.1.a. General

The City of Duluth is planning to reconstruct pavements and utilities along the Hawthorne Road – Vermilion Road – St. Marie Street alignments between East 4th Street and Wallace Avenue. The proposed project includes pipe bursting 6-inch water main to 8-inch HDPE water main; water service replacement and selective storm sewer replacement. Existing VCP sanitary sewer main will be lined as part of a separate city project. The sidewalks and pavements will be reconstructed. The pavements will have a 10-ton bituminous section with curb and gutter.

The project is denoted as City of Duluth project 01172 TR and is being designed to state aid standards.

We have assumed the roadways will be designed and constructed in general accordance with current Minnesota Department of Transportation (Mn/DOT) standards and specifications.

C.1.b. Utility Invert Depths

We understand the proposed water mains will be installed with a minimum of 8 feet of cover. Sanitary sewers will be lined as part of separate project. Sanitary services will be replaced. We understand blasting was required to install the utilities in 1983, the new water mains and sewers will be installed in the existing rock trenches.

C.1.c. Pavements

The roadways will be reconstructed with bituminous pavement. Mr. Scott indicated the 2011 Average Daily Traffic (ADT) was 4650. We have assumed less than 5 percent heavy traffic was being used for traffic loading calculations. We have assigned a 2033 design Average Daily Traffic (ADT) of 5,500. Based on these values and a discussion with Mr. Scott, we have used a design traffic loading of 454,000 Equivalent 18-kip Single Axle Loads (ESALs) over the 20 year pavement design life for our recommendations.

C.1.d. 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 Considerations

C.2.a. Utility Installations

The silty sand, fat clay and lean clay soils encountered in the borings appear suitable for support of the proposed utilities.

C.2.b. Pavement Subgrades

Silty sands, lean clays and fat clays were encountered at anticipated subgrade locations. It is our opinion the silty sand soils are marginal pavement subgrade soils. It is our opinion the lean clay and fat clay soils are poor subgrade soils. The lean clays (CL), fat clays (CH) and silty sands (SM) are frost-susceptible soils. Mn/DOT design standards require minimum thicknesses of frost-free materials (FFMs) over these subgrade soils.

C.2.c. Bedrock

Apparent bedrock was encountered above anticipated utility invert elevations. We understand rock trenches are already present and will be reused. If rock excavation is required, blasting is generally the preferred method of excavation, however, mechanical breaking methods, such as drilling relief holes and a use of a large breaker may be considered. Alternatively, insulation can be considered for frost protection. If insulation is pursued, we recommend the insulation manufacturer be consulted; they can provide typical sections and specifications for their products.

We would note that if insulation is installed at a depth of less than 2 feet, it can cause frost and ice build up on the pavement or sidewalk surface, known as differential icing.

D. Recommendations

D.1. Utility Installations

D.1.a. Utility Excavations and Subgrades

Based on the soils encountered in the borings and the anticipated utility invert elevations, the utility subgrades will consist of native glacial tills and lacustrine clays. These soils appear suitable for support of the utilities. The silty sand, lean and fat clay soils are corrosive soils; we recommend the pipes be bedded in imported sand or sand with gravel.

D.1.b. Excavation Dewatering

If groundwater is encountered in excavations, we recommend the excavation be dewatered. Dewatering can be accomplished with a sump and pump.

D.1.c. Excavation Backfill

Onsite soils from the trench excavations may be used as backfill material. We recommend placing backfill soils in 1-foot lifts, and compacting to a minimum of 95 percent of standard Proctor maximum dry density, in accordance with ASTM International Test Method D 698. The minimum compaction level should be increased to 100 percent of standard Proctor density within the upper 3 feet of the roadway subgrade.

D.2. Subgrade Preparation

D.2.a. General

Where the existing pavements are removed, we recommend the pavement subgrades be scarified to a depth of at least 6 inches, mixed, moisture-conditioned, then compacted to a minimum of 95 percent of their maximum dry densities determined in accordance with Mn/DOT Laboratory Procedure 1305 (standard Proctor). Fill placed above the scarified and recompacted material should also be compacted to a minimum of 95 percent. Material placed and/or compacted within 3 feet of the proposed subgrade elevations should be compacted to a minimum of 100 percent.

D.2.b. Treatment of Soft Subgrade Soils

If an area cannot be compacted, we recommend subcutting 2 to 3 feet, then backfilling with a granular material. The backfill should be compacted to a minimum of 95 percent of its maximum dry density. Material placed within 3 feet of the proposed subgrade elevations should be compacted to a minimum of 95 percent.

D.2.c. Treatment of Frost-Susceptible Soils

Silty and clayey subgrade soils should be considered potentially frost-susceptible. Mn/DOT design standards (Mn/DOT Technical Memorandum 04-06-MAT-01 dated March 1, 2004) recommend minimum thicknesses of frost-free materials (FFMs) over frost-susceptible subgrade soils. When the anticipated traffic is equal to or less than one million 18-kip equivalent single-axle loads (ESALs), a minimum of 6 inches of FFM (Class 5 or Select Granular Borrow) should be placed between a minimum of 3 inches of Class 5 aggregate base and the frost-susceptible subgrade soils.

D.2.d. Subsurface Drainage

Clayey and silty soils are relatively impermeable. Water that gets into the aggregate base and/or coarse granular subgrade backfill may collect in the base course and granular backfill and saturate them if drainage is not provided. Subgrade drainage systems should be considered at low points of the vertical alignments.

D.2.e. Proof-Roll

As a final check prior to placing the pavement section, including sand sub base. We recommend the completed subgrades be proof-rolled with a loaded tandem-axle truck prior to placing the aggregate base course. Unstable areas should be subcut at least 2 feet and replaced with suitable soils.

D.3. Pavement Design

D.3.a. Design Resistance (R) Values

R-values of the subgrade soils can be estimated using Table 5-3.2(a) of the current MnDOT *Geotechnical and Pavement Manual*. Estimated R-values for the pertinent soil types are presented in the following table.

Table 2. Estimated R-Values

ASTM (AASHTO) Soil Classification	Estimated R-Value
SM (A-4)	20
CL and CH (A-7)	12

D.3.b. Required Granular Equivalent

We understand a 10-ton pavement design section is required. The Mn/DOT *Geotechnical and Pavement Manual* indicates that either the MnPAVE computer program or R-Value/ESAL charts be used for pavement design. We understand the R-Value/ESAL charts are being used for this project.

We recommend a clay subgrade be assumed for this project. Based on a clay subgrade (R-value of 12) and 454,000 ESALs MnDOT Figure 5-3.6 "Bituminous Pavement Design Chart" indicates a minimum of 26.46 GE is required for a 10-ton pavement design.

D.3.c. Proposed Pavement Section

Based on discussion with Mr. Scott, we understand the City of Duluth is considering the following pavement section.

Material (MnDOT Specification)	Thickness (Inches)	Granular Equivalent
Bituminous (2360)	5	11.25
Aggregate Base (3138)	7	7
Select Granular (3149.2B2)	18	9
Total Granular Equivalent Proposed		27.25

D.3.d. Proposed Pavement Section Adequacy

The proposed section exceeds the requirements of MnDOT Technical Memo No. 09-12-MAT-03 "Pavement Selection Process" for a clay subgrade (R-value of 12).

The above pavement design and discussion are based upon a 20-year performance life. This is the amount of time before major reconstruction is anticipated. This performance life assumes maintenance, such as seal coating and crack sealing, is routinely performed. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

D.3.e. Materials and Compaction

We recommend specifying crushed aggregate base meeting the requirements of Minnesota Department of Transportation (Mn/DOT) Specification 3138 for Class 5 or Class 6. We recommend the sand subbase material meet the requirements of Mn/DOT Specification 3149.2B2, Select Granular Borrow. We recommend that the bituminous wear and base courses meet the requirements of Specifications 2360, Type SP. We recommend the aggregate gradations for the asphalt mixes meet Gradation B.

We recommend compacting the aggregate base and sand subbase to a minimum of 100 percent of their maximum standard Proctor dry density. We recommend that the bituminous pavement be compacted to at least 93 percent of maximum theoretical density on the base course and 92 percent on the wear courses.

D.4. Construction Quality Control

D.4.a. Excavation Observations

We recommend having a geotechnical engineer observe excavations related to subgrade preparation and utility installations. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations and at the roadway subgrade.

D.4.b. Materials Testing

We recommend density tests be taken in excavation backfill placed below pavements.

We recommend performing Gyratory gravity tests and other necessary tests in accordance with Specification 2360 to evaluate strength and air voids, and density tests to evaluate compaction.

D.4.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.

E. Procedures

E.1. Penetration Test Borings

The penetration test borings were drilled with a floatation tire, all terrain carrier-mounted core and auger drill equipped with hollow-stem auger. The borings were performed in general accordance with ASTM D 1586. Samples were occasionally collected off the auger flights from 1 to 4 feet (due to frozen conditions adversely impacting the effectiveness of sample collection through a split-spoon sampler). Penetration test samples were taken at 2 1/2- or 5-foot intervals at greater depths. 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.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.

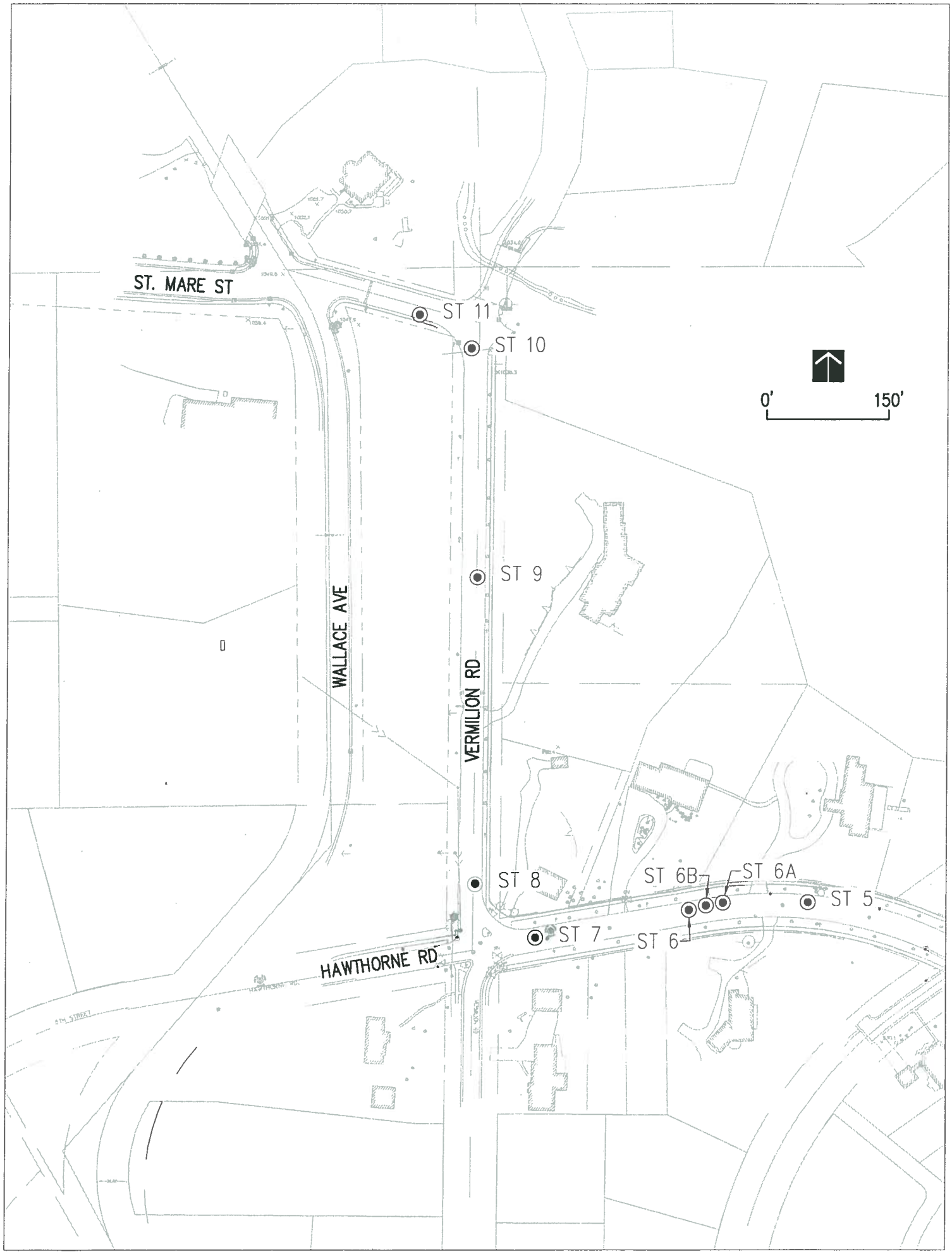
F.3. Use of Report

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


ST. MARE ST
ST 11
ST 10
0'
150'
WALLACE AVE
VERMILION RD
ST 9
ST 8
ST 6B
ST 6A
ST 5
ST 7
ST 6
HAWTHORNE RD


ST 9
VERMILION RD
ST 8
ST 6B
ST 6A
ST 5
ST 7
ST 6
ST 4
ST 3
HAWTHORNE RD
ST 2
ST 1
E 4TH ST
0'
150'

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LOG OF BORING

Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-01**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/31/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
890.5	0.0					Ground surface elevations at the boring locations were provided by LHB, Inc.
889.8	0.7	CONC	8 inches of Concrete.			
889.2	1.3	AGG	8 inches of Aggregate base.			
		CH	FAT CLAY, with traces of Sand and Gravel, reddish brown, frozen to moist, medium to stiff. (Lacustrine Deposit)	8		
				14		
				18		
				17		
879.5	11.0		END OF BORING.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-02**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/31/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
902.1	0.0					
901.4	0.7	CONC	8 inches of Concrete.			
900.8	1.3	AGG	8 inches of Aggregate base.			
		CH	FAT CLAY, reddish brown, frozen to moist, stiff to very stiff. (Lacustrine Deposit)	AS*		*Frozen
				15		
				19		
				17		
891.1	11.0		END OF BORING.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-03**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/31/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
914.1	0.0					
913.4	0.7	CONC	8 inches of Concrete.			
912.8	1.3	AGG	8 inches of Aggregate base.			
		FILL	FILL: Silty Sand, mixed with Fat Clay, dark brown, frozen to moist.	6		
				12		
907.1	7.0	CH	FAT CLAY, with traces of Sand and Gravel, reddish brown, moist, stiff to very stiff. (Lacustrine Deposit)	16		No recovery.
				18		
				20		
898.1	16.0			25		
			END OF BORING.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-04**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
924.5	0.0					
923.8	0.7	CONC	8 inches of Concrete.			
923.2	1.3	AGG	8 inches of Aggregate base.			
		FILL	FILL: Clayey Sand, mixed with Silty Sand, brown, frozen to moist.	AS*		*Frozen
920.5	4.0					
		CL	LEAN CLAY, with Gravel, brown, moist, very stiff. (Glacial Till)	22		
				18		
				25		
913.5	11.0					
			END OF BORING.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-05**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
948.8	0.0					
948.7	0.1	BIT	1 inch of Bituminous.			
948.1	0.7	CONC	8 inches of Concrete.			
947.4	1.4	AGG	8 inches of Aggregate base.			
		FILL	Silty Sand, fine- to medium-grained, with traces of Sand and Gravel, brown, frozen to moist.	AS*		*Frozen
942.8	6.0			13		
		SM	SILTY SAND, fine- to medium-grained, with Gravel, brown, moist, medium dense to dense. (Glacial Till)	22		
937.8	11.0			34		No recovery.
			END OF BORING.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-06**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
962.8	0.0					
962.1	0.7	CONC	8 inches of Concrete.			
961.5	1.3	AGG	8 inches of Aggregate base.			
		FILL	FILL: Silty Sand, mixed with Clayey Sand, brown, frozen.			
960.0	2.8		END OF BORING - Refusal to auger.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-06A**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/25/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
957.6	0.0					
956.9	0.7	CONC	8 inches of Concrete.			
956.3	1.3	AGG	8 inches of Aggregate base.			
		FILL	FILL: Silty Sand, fine- to medium-grained, with Gravel, brown, moist.	*		50/4", Frozen
952.6	5.0					
		CL	LEAN CLAY, reddish brown, moist, very stiff. (Glacial Till)	22		
				22		
				17		
946.6	11.0					
			END OF BORING.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-06B**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/25/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
959.8	0.0		Auger advanced without sampling.			
955.5	4.3		END OF BORING - Refusal to auger. Water not observed while drilling. Boring immediately backfilled and pavement patched.			

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-07**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
984.7	0.0					
984.0	0.7	CONC	8 inches of concrete.			
983.4	1.3	AGG	8 inches of Aggregate base.			
		FILL	FILL: Silty Sand, fine- to medium-grained, mixed with Clayey Sand, brown, moist.	AS*		*Frozen
981.2	3.5					
980.6	4.1	SM	SILTY SAND, fine- to medium-grained, brown, moist. (Glacial Till)			
			END OF BORING - Refusal to auger.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

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Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-08**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **1/31/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
994.3	0.0					
993.6	0.7	CONC	8 inches of Concrete.			
993.0	1.3	AGG	8 inches of Aggregate base.			
		FILL	FILL: Silty Sand, fine-grained, with a trace of Gravel, brown, moist.	AS*		*Frozen
				12		
986.5	7.8		END OF BORING - Refusal to auger.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-09**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1018.2	0.0					
1017.5	0.7	CONC	8 inches of Concrete.			
		AGG	13 inches of Aggregate base.			
1016.4	1.8		END OF BORING - Refusal to auger.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-10**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1030.3	0.0					
1029.6	0.7	CONC	8 inches of Concrete.			
		AGG	13 inches of Aggregate base.			
1028.5	1.8		END OF BORING - Refusal to auger.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project DU-12-06362
Geotechnical Evaluation
Proposed Roadway Reconstruction
Hawthorne Road - Vermillion Road - St. Marie Street
Duluth, Minnesota

BORING: **ST-11**

LOCATION: See attached sketch.

DRILLER: M. Heinzen | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1037.3	0.0					
1036.6	0.7	CONC	8 inches of Concrete.			
		AGG	19 inches of Aggregate base.			
1035.0	2.3		END OF BORING - Refusal to auger.			
			Water not observed while drilling.			
			Boring immediately backfilled and pavement patched.			

LOG OF BORING N:\GINT\PROJECTS\DULUTH\2012\06362.GPJ BRAUN_V8_CURRENT.GDT 3/19/13 15:56

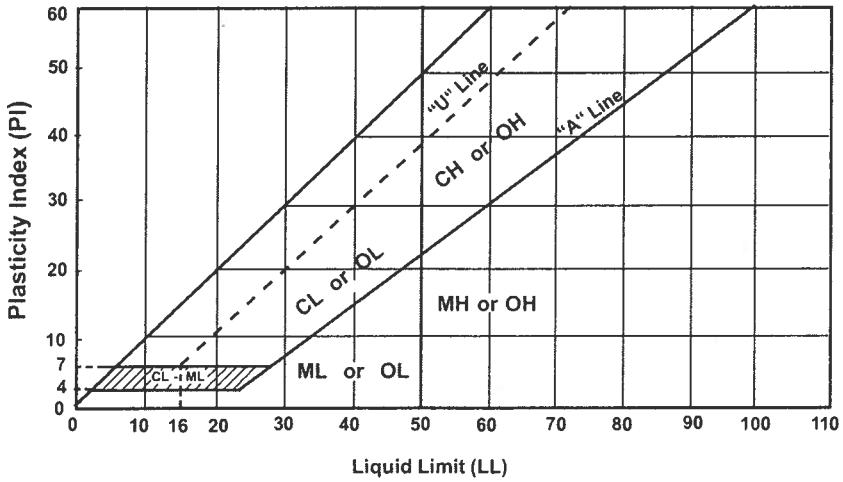
BRAUN
INTERTEC

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	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	Liquid limit - oven dried / 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	Liquid limit - oven dried / 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.