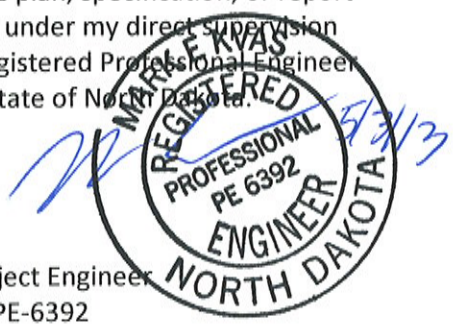
Geotechnical Evaluation Report

North Washington Street Reconstruction
Calgary to 57th Avenue
Bismarck, North Dakota

Prepared for

KLJ

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 Registered Professional Engineer under the laws of the State of North Dakota.



5/3/13

Mark E. Kvas, PE
Associate Principal/Project Engineer
Registration Number: PE-6392
May 3, 2013

Project BM-13-00626

Braun Intertec Corporation

BRAUN INTERTEC

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May 3, 2013

Project BM-13-00626

Mr. Troy Ripplinger
KLJ
128 Soo Line Drive
Bismarck, ND 58502

Re: Geotechnical Evaluation
North Washington Street Reconstruction
Calgary to 57th Avenue
Bismarck, North Dakota

Dear Mr. Ripplinger:

We are pleased to present this Geotechnical Evaluation Report for the North Washington Street reconstruction in Bismarck, North Dakota. 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

Fourteen standard penetration test borings were performed to a depth of 10 feet and two (2) standard penetration test borings were performed to a depth of 20 feet. At the surface, the borings encountered approximately 5 to 8 1/2 inches of bituminous surfacing over approximately 2 to 7 1/2 inches of aggregate base material. Beneath bituminous surfacing and aggregate base, several of the borings encountered approximately 1 to 10 feet of fill material consistent with lean clay or a mix of fat clay and lean clay. Under the existing fill material, the borings encountered glacial till deposits (generally consisting of lean clay) and decomposed claystone material (texturally classified as fat clay) likely associated with the Cannonball Formation to the termination depth of the borings. Two of the borings were terminated in existing fill material.

Groundwater was not observed during drilling or immediately after drilling. Based on the moisture contents of the geologic materials encountered, it appears that groundwater was below the depths explored. Seasonal and annual fluctuations of groundwater, however, should be anticipated.

Summary of Recommendations

Utilities

It appears from the borings that fat clays and lean clays will be encountered at the utility invert elevations. It is our opinion these soils will be suitable for support of the proposed utilities. Dewatering of the utility trenches will not likely be necessary along the alignment.

Pavement

We recommend the existing pavements be completely removed. We recommend the upper one (1) foot of the proposed subgrade be scarified, thoroughly mixed, moistened to a moisture content near optimum, and compacted to a minimum of 90 percent of its modified Proctor maximum dry density. On-site or imported backfills and fills should then be placed and compacted to desired grades.

Based on the soils observed in the borings and the results of our laboratory tests, we recommend the pavements be designed for a subgrade with a California Bearing Ratio (CBR) of 3.7.

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 call Mark Kvas at 701.255.7180.

Sincerely,

BRAUN INTERTEC CORPORATION

Michelle Stadel, EIT
Staff Engineer

Mark E. Kvas, PE
Associate Principal/Project Engineer

Table of Contents

Description **Page**

Table of Contents (continued)

Description **Page**

Appendix

A. Introduction

A.1. Project Description

The project will consist of the reconstruction of North Washington Street between Calgary Avenue and 57th Avenue in Bismarck, North Dakota. The scope of the project is illustrated in the Boring Location Sketch in the Appendix.

New storm sewers will be installed along the alignment. It is estimated that a 10-foot deep cut will be necessary along the intersection of Ash Coulee Drive and North Washington Street. New traffic control signals will also be installed at this intersection.

A.2. Purpose

The purpose of our geotechnical evaluation will be to characterize subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and reconstruction of the streets.

A.3. Background Information and Reference Documents

To facilitate our evaluation, we were provided with or reviewed the following information or documents:

- An aerial map of the roadway showing the proposed bore locations.
- A geologic map of the area titled “Geology of the Bismarck-Mandan Area”; Geologic Investigation No. 3; prepared by the North Dakota Geological Survey, dated 2004.

A.4. Site Conditions

North Washington Street is currently a bituminous-surfaced, two-lane rural section. A bike trail runs parallel on the west side of the roadway.

The existing alignment crosses rolling hills with a generalized downward slope to the north. Ground surface elevations measured at the boring locations range from about 1921 feet near Calgary Avenue (Boring ST-1) to a peak of 1931 feet near Slate Drive (ST-8) and descend to its lowest elevation of 1867 feet near 57th Avenue (ST-15).

Along Ash Coulee Drive, the ground slopes downward from west to east with ground surface elevations ranging from 1928 feet east of North Washington Street (ST-5) to 1950 feet west of the intersection (ST-6).

A.5. Scope of Services

Our scope of services for this project was originally submitted as a Proposal to Mr. Troy Ripplinger of Kadrmas, Lee & Jackson, Inc. (KLJ) on February 5, 2013. We received authorization to proceed from Mr. Ripplinger on February 20 with a Standard Form of Agreement between Engineer and Consultant for Professional Services. Tasks performed in accordance with our authorized scope of services included:

- Staking and clearing exploration locations of underground utilities.
- Performing 16 standard penetration test borings to depths ranging from 10 to 20 feet.
- Performing 30 moisture content tests, 5 Atterberg limits tests, and 5 No. 200 washes on selected penetration test samples.
- Performing 3 proctor tests and 3 California bearing ratio tests on selected bulk samples.
- Preparing this report containing a CAD sketch, exploration logs, a summary of the geologic materials encountered, results of laboratory tests, and recommendations for the roadway construction.

We staked the exploration locations by estimating their positions from the provided aerial photograph. After our field work was completed, KL&J surveyed the boring locations and provided us with their ground surface elevations.

Our scope of services was performed under the terms of the Standard Form of Agreement between Engineer and Consultant for Professional Services.

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, 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, (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

B.2.a. Geologic Materials

At the surface, the borings encountered approximately 5 to 8 1/2 inches of bituminous surfacing over approximately 2 to 7 1/2 inches of aggregate base material. Beneath bituminous surfacing and aggregate base, several of the borings encountered approximately 1 to 10 feet of fill material consistent with lean clay or a mix of fat clay and lean clay. Under the existing fill material, the borings encountered glacial till deposits (generally consisting of lean clay) and decomposed claystone material (texturally classified as fat clay) likely associated with the Cannonball Formation to the termination depth of the borings. Two of the borings were terminated in existing fill material.

The following table summarizes the pavement and subgrade conditions encountered within 5 feet of existing grades at the boring locations.

Table 1. Summary of Pavement and Subgrade Conditions

Boring	Bituminous Thickness (inches)	Aggregate Base Thickness (inches)	Subgrade Summary Down to a Depth of 5 feet*
ST-1	6	3	3' lt brn CL Fill over brn CLwS
ST-2	6	3	dk brn CL Fill
ST-3	6	4	dk brn & brn CL Fill
ST-4	5 1/2	6	1' brn mixed CL & CH Fill over brn & gry CLST
ST-5	7	3	2 3/4' lt brn CL over brn CLST
ST-6	6	2	brn CL
ST-7	5	4 1/2	brn & gry CL Fill
ST-8	7	4	brn & gry CL
ST-9	8	4	brn & gry CLST
ST-10	7	7 1/2	lt brn & dk brn CL Fill
ST-11	6	4 1/2	3' gry mixed CL & CH Fill over gry CLST
ST-12	6	4	3' lt gry & brn CLwS Fill over brn CL
ST-13	6	4	3' gry & brn CLwS Fill over brn CL
ST-14	8	4	gry & brn CLwS
ST-15	8	4	1' brn CL Fill over dk brn CL
ST-16	8 1/2	4 1/2	1' brn CL Fill over brn CL

* CH = Fat Clay, CL = Lean Clay, CLST = Claystone, brn = brown, dk = dark, lt = light, gry = gray.

B.2.b. Penetration Resistance

Penetration resistance values recorded in the fill clay materials ranged from 3 to 21 blows per foot (BPF), indicating they were variably compacted. Penetration resistance values recorded in the lean clay glacial tills ranged from5 to 21 BPF, indicating the soils were medium to very stiff. Blow counts in the weathered bedrock materials ranged from 11 to 21 BPF. We wish to note that it appears that the material associated with the Cannonball Formation can be excavated with typical construction equipment.

B.2.c. Groundwater

Groundwater was not observed during drilling or immediately after drilling. Based on the moisture contents of the geologic materials encountered, it appears that groundwater was below the depths explored. Seasonal and annual fluctuations of groundwater, however, should be anticipated.

B.3. Laboratory Test Results

B.3.a. Moisture Content Tests

Moisture content (MC) tests (per ASTM D2216) were conducted on selected samples to aid in our classifications and estimations of the soils' engineering properties. The moisture content of the clay soils varied from approximately 14 to 31 percent, indicating that the material was near to over its probable optimum moisture content. The results of the moisture content tests are listed in the "MC" column of the Log of Boring sheets in the Appendix.

B.3.b. Atterberg Limits Tests

Five Atterberg limits tests (per ASTM D4318) were performed on selected samples for classification, evaluation of the range of soil plasticity, and an estimation of engineering parameters related to consolidation to aid in settlement calculations. Liquid limits determined for the clay soils ranged from 34 to 67; plastic limits ranged from 16 to 21. These results indicate that the clay is moderately to highly plastic. The results of the Atterberg limits tests are listed in the "Tests or Notes" column on the attached Log of Boring sheets.

B.3.c. Percent Passing the #200 Sieve Tests

Percent passing the #200 sieve analysis tests (P200) (per ASTM D1140) were performed to estimate the engineering properties of the granular materials. The results of the P200 tests indicated the soils encountered had P200's ranging from 61 to 97 percent, indicating the soils are classified as sandy lean clay to fat clay. The results of the P200 tests are listed in the "Tests or Notes" column on the attached Log of Boring sheets.

B.3.d. Moisture-Density Relationship (Proctor Test)

Modified Proctor tests (per ASTM D1557) were performed on bulk samples to aid in estimating the CBR value of the soils. The results of the Proctor tests are provided in the table below and in graphical representation attached in the Appendix.

B.3.e. California Bearing Ratio (CBR) Tests

California Bearing Ratio (CBR) tests (per ASTM D1883) were performed on bulk samples collected from Borings ST-05, ST-10, and ST-14 ranging in depths from 1 to 5 feet. The CBR tests were performed on remolded samples that were compacted to 90 percent of the material's modified Proctor maximum dry density. The results of the CBR tests were used to establish pavement recommendations and are summarized in the following table and provided in the Appendix.

Table 1: Summary of Proctor and CBR value Test Results

Boring / Depth	Soil Type	Maximum Dry Density (pcf)	Optimum Moisture (%)	CBR value (@ 90% Mod. Proctor and @ optimum moisture)
ST-05 (1' to 5')	Sandy Lean Clay (CL)	119.7	12.2	3.7
ST-10 (1' to 5')	Sandy Lean Clay (CL)	121.9	12.2	10.5
ST-14 (1' to 5')	Sandy Lean Clay (CL)	122.6	11.2	4.9

C. Basis for Recommendations

C.1. Proposed Construction

The existing roadway consists of a two-lane bituminous-surfaced rural section. The roadway will be widened and an urban section added with curb and gutter. It is our understanding that as of the date of this report it is unknown whether concrete or bituminous paving will be used in the reconstruction.

Grade changes have not been determined as of the date of this report, however we anticipate that grades along the alignment will generally remain the same. It is estimated that a 10-foot deep cut will be necessary along the intersection of Ash Coulee Drive and North Washington Street. We should be notified if more than 3 feet of fill will be placed along the alignment. Additional analysis may be required to evaluate the soils for settlements. Additional bedding recommendations may be required based on the size of the pipe.

New storm sewer and watermain utilities will be installed/replaced along the alignment. We have assumed the storm sewer will have invert depths ranging from approximately 4 to 10 feet and the watermain will have a minimum of 8 feet of cover over their tops.

C.2. Existing Subgrade Conditions

The anticipated subgrade materials below the existing pavements will consist of lean clay, lean clay with sand, sandy lean clay, and fat clay. Based on the materials encountered in the borings, it appears the majority of the fill materials will be suitable for reuse as subgrade materials.

C.2.a. 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.3. Design and Construction Considerations

C.3.a. Utilities

It appears from the borings that fat clays and lean clays will be encountered at the utility invert elevations. It is our opinion these soils will be suitable for support of the proposed utilities. Dewatering of the utility trenches will not likely be necessary along the alignment.

C.3.b. Pavement

We recommend the existing pavements be completely removed. We recommend the upper one (1) foot of the proposed subgrades be scarified, thoroughly mixed, moistened to a moisture content near optimum, and compacted to a minimum of 90 percent of its modified Proctor maximum dry density. On-site or imported backfills and fills should then be placed and compacted to desired grades.

Based on the soils observed in the borings and the results of our laboratory tests, we recommend the pavements be designed for a subgrade with a California Bearing Ratio (CBR) of 3.7.

D. Recommendations

D.1. Utilities

D.1.a. Excavation

We anticipate the excavations for the proposed utilities can be completed with a backhoe. A ripper tooth mounted on a backhoe may be necessary to loosen the Cannonball Formation material. The existing fill soils encountered in the borings are generally Type C soils under Department of Labor Occupational Safety and Health Administration (OSHA) guidelines. The natural lean clays and claystone will generally be Type B soils.

D.1.b. Dewatering

Groundwater was not observed during drilling or immediately after drilling. We do not anticipate dewatering of the utility trenches will be required along the alignment. However, following spring thaw or wet weather, the aggregate base and upper fills could hold water and cause perched groundwater conditions. We anticipate dewatering can be accomplished by pumping from shallow trenches or sumps.

D.1.c. Trench Subgrades

For utility invert depths of less than 10 feet, the borings indicate naturally deposited fat clay and lean clay will be encountered in the bottoms of the trenches. It is our opinion that the anticipated subgrade soils will be suitable for support of the proposed utilities.

D.1.d. Bedding

We recommend the pipes be bedded imported sands or sandy gravels (soils with less than 12 percent particles by weight passing the 200 sieve). Sands or sandy gravels meeting this requirement are generally noncorrosive. The bedding should be compacted firmly under and around the pipes.

D.1.e. Backfill and Fill

Soils excavated from the utility trenches may be reused as trench backfill. Soils containing organic materials should not be reused as backfill within 3 vertical feet of the proposed pavement subgrades.

D.1.f. Compaction

The trench backfill should be placed in thin lifts and compacted to a minimum of 90 percent of their maximum dry density determined in accordance with American Society for Testing and Materials (ASTM) Test Method D1557 (modified Proctor). Clay soils should be moisture-conditioned to within 0 to 4 percentage points above their optimum moisture contents, and sandy or silty soils should be moisture-conditioned to within plus or minus 3 percentage points of their optimum moisture contents. Care should be taken to place the utility trench backfill within the recommended moisture content ranges to prevent or reduce differential settlements over the trenches.

D.2. Pavements

D.2.a. Subgrade Preparation

We recommend the existing pavements be completely removed. All topsoils and organic soils within 3 vertical feet of the proposed subgrade elevation also be removed. The removals should extend at least 1 foot horizontally behind the curbs, then upward and outward at a maximum 1/2H:1V slope.

Where black or organic soils are more than 3 feet below the bottom of the proposed aggregate base such as Boring ST-15, it is our opinion they can be left in place if they are sufficiently stable to permit compaction of overlying material. Backfill and fill placed within 3 vertical feet of the pavement subgrades should consist of non-black on-site soils.

Backfills and fills placed below the pavements should be placed and compacted in loose lifts not to exceed 6 to 12 inches

After removing the unwanted soils, we recommend the upper one (1) foot of the resulting subgrade be scarified, thoroughly mixed, moistened to a moisture content near optimum, and compacted to a minimum of 90 percent of its modified Proctor maximum dry density. If there are areas that cannot be adequately compacted, we recommend the unstable materials be subexcavated to a depth of about 2 to 3 feet and be replaced by materials which can be compacted. We recommend compaction be done per the requirements listed in the following table.

Table 2. Summary of Compaction and Moisture Recommendations

Reference	Relative Compaction, percent (ASTM D 1557 – Modified Proctor)	Moisture Content Variance from Optimum, % points
Backfills below pavement subgrades	≥90	-1 to +4 for Clay Soils +/-3 for Granular Soils
Aggregate base	≥95	
Backfill Located In Landscape Areas	≥90	

D.2.b. Anticipated Subgrades

After preparation, we anticipate the subgrades will consist of compacted fat clays and lean clays. Laboratory tests to evaluate the California Bearing Ratio (CBR) of the subgrade materials were performed Borings ST-5, ST-10 and ST-14. The materials tested were sandy lean clay. The results of the tests are presented in Section B.3.e. above. We recommend the pavements be designed for a subgrade with a CBR of 3.7. This CBR values reflect the subgrade soil strength at 90 percent compaction.

D.2.c. Subgrade Proofroll

After the subgrade has been prepared and compacted, we recommend the pavement subgrades be proof-rolled along both travel lanes to check for the presence of localized weak zones. The proof-roll should be observed by a geotechnical engineer or qualified observer to assist in evaluating the suitability of the pavement subgrade. Failed areas should be repaired prior to placement of the aggregate base. A second proof-roll should be performed after the aggregate base material is in place, and prior to placing bituminous or concrete pavement.

The proof-roll should be performed with a fully loaded, tandem axle dump truck with a weight of approximately 25 tons, or an approved equal. The proof-roll should be performed at a vehicle speed of between 2 ½ and 5 miles per hour. The proof roll should be performed along the pavement subgrades such that unrolled areas between wheel paths are not wider than 1 foot.

D.2.d. Drainage Considerations

Where the pavements are underlain by non-granular soils (soils with more than 20 percent passing the #200 sieve), we recommend drainage be provided for the aggregate base. The fat clays and lean clays encountered in the borings are non-granular materials. Drainage will be necessary along the entire proposed alignment.

We recommend edge drains be constructed along the pavement edges in accordance with NDDOT Specifications 714.02E and 714.03E. If the edge drains were constructed continuously along the alignment, there will be a risk to developing excessive water pressures at the low portions of the alignment. Along the steep portions of the alignments (slopes of ≈ 10% or greater), we recommend capping the drains at intervals of 200 to 300 feet. Consideration may also be given to installing interceptor drains (drains constructed perpendicular to the roadway, extending across the width of the pavement) along the steep portions to reduce the potential for excessive water pressure within the aggregate base at the bottoms of the slopes.

Consideration should be given to placing a geotextile separation fabric over the fat clay and lean clay subgrades to provide better drainage of the pavements and maintain the thickness of the aggregate.

D.2.e. Materials and Compaction

We recommend the aggregate base meet the requirements of NDDOT Specification 816.03B for Class 5 Aggregate Base. We recommend the aggregate base be compacted to a minimum of 90 percent of the modified Proctor maximum dry density.

We recommend geotextile separation fabric meet the NDDOT Specification 858 for Type S1 or S2 Separation fabrics (non-woven).

D.3. Traffic Signal Foundations

D.3.a. Spread Footings

D.3.a.1. Embedment Depth

For frost protection, we recommend embedding the foundations a minimum of 6 feet below the lowest surface grade.

D.3.a.2. Net Allowable Bearing Pressure

It is our opinion the footings may be designed for a net allowable bearing pressure up to 2,000 psf. Prior to foundation construction, we recommend the allowable bearing pressure be verified with dynamic cone penetrometer tests performed by a geotechnical engineer or qualified engineering assistant. The above values include a safety factor of at least 3.0 with regard to bearing capacity failure. The net allowable bearing pressure can be increased by one-third its value for occasional transient loads (wind loads).

D.3.b. Drilled Pier Footings

D.3.b.1. Allowable Skin Friction and End Bearing

Axial compressive loads on drilled piers are supported by a combination of skin (side) friction and end-bearing capacity. Uplift loads are resisted by the weight of the concrete and skin friction/adhesion. Since the critical foundation loads will be transient loads, the parameters provided in the table below are for a transient (undrained) condition.

The following table summarizes our recommendations of the skin friction and end-bearing capacities that should be used for design of drilled concrete piers. The applied factors of safety for each of the parameters indicated in the following table are stated at the bottom of the table.

Table 3. Summary of Strength Parameters

Depth Interval (feet)	Soil Type[1]	Design Unit Weight (pcf)[2, 7]	Friction Angle[7]	Cohesion (psf)[7]	Allowable Passive Pressure (psf)[3,4]	Allowable Uplift Adhesion/ Friction (psf)[3,5]	Allowable Compressive Adhesion/ Friction (psf)[3,5]	Estimated Allowable End-Bearing Capacity (psf)[3,6]
0 – 6 1/2	CL	120	0	900	1800	250	250	--
6 1/2 – 8	CLST	55	0	1600	3200	440	440	3000
8 – 21	CLST	60	0	3350	6700	910	910	5000

Notes:

1. For materials abbreviations please refer to the Descriptive Terminology sheet in the Appendix.
2. Effective unit weights are given for soils below an assumed design groundwater level of 6 1/2 feet below the ground surface. If groundwater levels observed at the time of construction are above 6 1/2 feet, modification of these parameters will be necessary.
3. Dual values represent values at top and bottom of stratum, respectively.
4. The allowable passive pressure values contain a factor of safety of three.
5. Adhesion/friction values include a factor of safety of two.
6. End-bearing capacities include a factor of safety of three.
7. Factors of safety were not applied to the unit weight, friction angle or cohesion values.

D.3.b.2. Frost Heave and Embedment Depth

We recommend the pier be extended to a depth of at least 6 feet. To limit the amount of potential frost heave, we recommend the upper 6 feet of the pier be formed with a sonotube. If the pier is constructed with a sonotube, the upper 6 feet of soil parameters in the above table should not be used.

D.4. Construction Quality Control

D.4.a. Excavation Observations

We recommend having a geotechnical engineer observe all excavations related to the pavement construction. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations, and the adequacy of required excavation oversizing.

D.4.b. Materials Testing

We recommend density testing be performed in all backfill and fill placed beneath pavements. Trench backfill should be tested every 500 feet at vertical intervals not exceeding 2 feet. We also recommend density testing of the compacted pavement subgrades, gravel base courses, and bituminous surfaces. Samples of proposed backfill and fill materials should be submitted to a testing laboratory at least three days prior to placement for evaluation of their suitability and determination of their optimum moisture contents and maximum dry densities.

We recommend Marshall tests or Gyratory tests (if SP mix) 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.4.c. Pavement Subgrade Proof-Roll

We recommend that proof-rolling of the pavement subgrades be observed by a geotechnical engineer to determine if the results of the procedure meet project specifications, or delineate the extent of additional pavement subgrade preparation work.

D.4.d. 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

DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

300' 0 600'

SCALE: 1" = 600'

BRAUN INTERTEC

11001 Hampshire Avenue So.
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020

Base Dwg Provided By:
KLJ ENGINEERING

SOIL BORING LOCATION SKETCH

GEOTECHNICAL EVALUATION
NORTH WASHINGTON STREET
CALGARY AVENUE TO 57th AVENUE
BISMARCK, NORTH DAKOTA

Project No:	BM1300626
Drawing No:	BM1300626
Scale:	1" = 600'
Drawn By:	BJB
Date Drawn:	5/2/13
Checked By:	MK
Last Modified:	5/2/13
Sheet:	Fig:
of	

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BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-01**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1921.2	0.0							
1920.6	0.6	BIT	6" Bituminous surfacing.	24*				*Frozen.
1920.3	0.9	AGG	3" Aggregate base.					
		FILL	FILL: Lean Clay, with Silt and Sand lenses, light brown, moist. - trace Gravel below 2 feet.	8			14	Bag sample collected from 1 to 5 feet.
1917.2	4.0							
		CL	LEAN CLAY with SAND, trace Gravel, brown, moist, stiff to very stiff. (Glacial Till)	13		4 1/4	17	
			- with Sand lenses below 6 1/2 feet.	17	▽	4 1/4		
1910.2	11.0			21				Ground surface elevations at the borings were provided by KLJ.
			END OF BORING. Water not observed with 9 1/2 feet of hollow stem auger in the ground. Water not observed to cave-in depth of 7 1/2 feet immediately after withdrawal of auger. Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-02**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | 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	MC %	Tests or Notes
1917.9	0.0						
1917.4	0.5	BIT	6" Bituminous surfacing.	13*			* Frozen.
1917.0	0.9	AGG	3" Aggregate base.				
		FILL	FILL: Lean Clay, dark brown, moist.	15		21	
			- trace Sand and Gravel at 4 1/2 feet.	13		15	
				5*	▽		*No recovery.
1908.9	9.0	CL	LEAN CLAY, trace Gravel, brown, moist, rather stiff. (Glacial Till)	12			
1906.9	11.0		END OF BORING.				

Water not observed with 9 1/2 feet of hollow stem auger in the ground.

Water not observed to cave-in depth of 7 1/2 feet immediately after withdrawal of auger.

Boring then backfilled.

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-03**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1912.1	0.0						
1911.6	0.5	BIT	6" Bituminous surfacing.	15*			*Frozen.
1911.3	0.8	AGG	4" Aggregate base.				
		FILL	FILL: Lean Clay with Sand, trace Gravel, dark brown-gray, moist.	21		22	Bag sample collected from 1 to 5 feet. P200=84% LL=38, PL=20, PI=18
				11		18	
			- dark brown and brown below 6 feet. - with Sand lenses below 6 feet.	9			
				3			
1901.1	11.0		END OF BORING.				
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-04**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1922.1	0.0							
1921.6	0.5	BIT	5 1/2" Bituminous surfacing.	12*				*Frozen.
1921.1	1.0	AGG	6" Aggregate base.					
1920.1	2.0	FILL	FILL: Mix of Fat Clay and Lean Clay, brown, moist.					
		CLST	CANNONBALL FORMATION, CLAYSTONE, with Silt lenses, brown, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	11			30	
			- gray below 4 feet.	13		3 1/2	31	
				16		4 1/4		
			- dark gray below 9 feet.					
				14		4 1/4		
1911.1	11.0		END OF BORING.					
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-05**

LOCATION: Moved 50' E of stake. See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1928.3	0.0							
1927.7	0.6	BIT	7" Bituminous surfacing.	17*				*Frozen.
1927.5	0.8	AGG	3" Aggregate base.					
		CL	LEAN CLAY, trace Gravel, light brown, moist, rather stiff. (Glacial Till)	12			22	Bag sample collected from 1 to 5 feet. P200=65% LL=45, PL=16, PI=29
1924.8	3.5	CLST	CANNONBALL FORMATION, CLAYSTONE, brown, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	14			31	
			- with Iron staining at 7 1/2 feet.	15				
				14		4.5+		
				20				
				21		4.5+		
			- gray below 18 feet.					
1907.3	21.0			21		4.5+		
			END OF BORING. Water not observed with 19 1/2 feet of hollow stem auger in the ground. Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-06**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1949.8	0.0							
1949.3	0.5	BIT	6" Bituminous surfacing.	13*				*Frozen.
1949.1	0.7	AGG	2" Aggregate base.					
		CL	LEAN CLAY, trace Gravel, brown, moist, medium. (Glacial Till)	6			26	
				8			27	
1943.3	6.5	CLST	CANNONBALL FORMATION, CLAYSTONE, brown, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	9		2 1/2		
			- brown and gray below 9 feet.	15				
				18		3 1/2		
			- with Sand lenses below 14 feet.	21		4 1/4		
1928.8	21.0			21		4 1/4		
			END OF BORING. Water not observed with 19 1/2 feet of hollow stem auger in the ground. Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

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LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-07**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1917.7	0.0						
1917.3	0.4	BIT	5" Bituminous surfacing.	25*			*Frozen.
1916.9	0.8	AGG	4 1/2" Aggregate base.				
		FILL	FILL: Lean Clay with Sand, trace Gravel, brown, moist.				
			- gray below 2 feet.	14		18	
				7			
				11			
1908.7	9.0						
		CL	LEAN CLAY, with Silt lenses, dark gray, moist, medium.				
			(Glacial Till)	6			
1906.7	11.0						
			END OF BORING.				
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-08**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1931.1	0.0							
1930.5	0.6	BIT	7" Bituminous surfacing.	19*				*Frozen.
1930.2	0.9	AGG	4" Aggregate base.					
		CL	SANDY LEAN CLAY, trace Gravel, brown, moist, rather soft to rather stiff. (Glacial Till) - brown and gray below 2 feet.	11			22	Bag sample collected from 1 to 5 feet.
				5		2 1/2	20	
				7		1		
1922.1	9.0	CLST	CANNONBALL FORMATION, CLAYSTONE, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	11		4 1/4		
1920.1	11.0		END OF BORING. Water not observed with 9 1/2 feet of hollow stem auger in the ground. Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-09**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1921.8	0.0							
1921.1	0.7	BIT	8" Bituminous surfacing.	28*				*Frozen.
1920.8	1.0	AGG	4" Aggregate base.					
		CLST	CANNONBALL FORMATION, CLAYSTONE, brown, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	12			30	P200=97% LL=67, PL=21, PI=46
			- Iron staining below 4 feet.	13			29	
			- brown and gray below 6 1/2 feet.	17		3 3/4		
			- gray below 9 feet.	18		4 1/4		
1910.8	11.0		END OF BORING.					
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-10**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1899.6	0.0						
1899.0	0.6	BIT	7" Bituminous surfacing.	19*			*Frozen.
1898.4	1.2	AGG	7 1/2" Aggregate base.				
		FILL	FILL: Lean Clay, trace Gravel, light gray to dark brown, moist.	12		22	Bag sample collected from 1 to 5 feet. P200=64% LL=43, PL=19, PI=24
			- with Sand lenses and Gravel below 4 feet.	7			
			- dark gray to dark brown below 6 1/2 feet.	9			
				6			
1888.6	11.0		END OF BORING.				
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-11**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1897.3	0.0							
1896.8	0.5	BIT	6" Bituminous surfacing.	18*				*Frozen.
1896.4	0.9	AGG	4 1/2" Aggregate base.					
		FILL	FILL: Mix of Fat Clay and Lean Clay, gray, moist.	14			31	
1893.3	4.0	CLST	CANNONBALL FORMATION, CLAYSTONE, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	11		3	31	
				14		4 1/4		
				18		4 1/4		
1886.3	11.0		END OF BORING.					
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-12**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1896.3	0.0							
1895.8	0.5	BIT	6" Bituminous surfacing.	22*				*Frozen.
1895.5	0.8	AGG	4" Aggregate base.					
		FILL	FILL: Lean Clay with Sand, light gray and brown, moist.	15			25	Bag sample collected from 1 to 5 feet.
1892.3	4.0							
		CL	SANDY LEAN CLAY, trace Gravel, brown, moist, medium to rather stiff. (Glacial Till)	10		3 3/4	20	
				8		2 1/2		
				7		2 1/4		
1885.3	11.0							
			END OF BORING.					
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-13**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1891.5	0.0							
1891.0	0.5	BIT	6" Bituminous surfacing.	18*				*Frozen.
1890.7	0.8	AGG	4" Aggregate base.					
		FILL	FILL: Lean Clay with Sand, trace Gravel, brown and gray, moist.	21			23	
			- brown and dark brown below 2 feet.					
1887.5	4.0							
		CL	SANDY LEAN CLAY, trace Gravel, brown, moist, rather stiff.	10		2 1/2	19	
			(Glacial Till)	9		3		
1880.5	11.0			10		2 1/2		
			END OF BORING.					
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-14**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1870.7	0.0							
1870.0	0.7	BIT	8" Bituminous surfacing.	15*				*Frozen.
1869.7	1.0	AGG	4" Aggregate base.					
		FILL	FILL: Lean Clay with Sand, trace Gravel, gray, moist.					
			- dark brown below 2 feet.	14			18	Bag sample collected from 1 to 5 feet. P200=61% LL=34, PL=17, PI=17
			- brown and gray below 4 feet.	10			17	
1864.2	6.5	CLST	CANNONBALL FORMATION, CLAYSTONE, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	11				
1859.7	11.0			17		4.5+		
			END OF BORING.					
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-15**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
1867.3	0.0							
1866.6	0.7	BIT	8" Bituminous surfacing.	16*				*Frozen.
1866.3	1.0	AGG	4" Aggregate base.					
1865.3	2.0	FILL	FILL: Lean Clay, with Silt lenses, brown, moist.					
		CL	LEAN CLAY, trace roots, dark brown, moist. (Buried Topsoil)	12			25	
				5			22	
1860.8	6.5							
		CL	LEAN CLAY, with Sand lenses, trace Gravel, brown, moist, rather stiff. (Glacial Till)	9				
1858.3	9.0							
		CLST	CANNONBALL FORMATION, CLAYSTONE, gray, moist, decomposed, very soft, hand deformed sample classified as "Fat Clay (CH)".	11		3 1/2		
1856.3	11.0							
			END OF BORING.					
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.					
			Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

BRAUN INTERTEC

LOG OF BORING

Braun Project BM-13-00626
Geotechnical Evaluation
North Washington Street
Calgary to 57th Avenue
Bismarck, North Dakota

BORING: **ST-16**

LOCATION: See sketch.

DRILLER: L. Smillie | METHOD: 3 1/4" HSA, Autohammer | DATE: **4/3/13** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1882.7	0.0						
1882.0	0.7	BIT	8 1/2" Bituminous surfacing.	14*			*Frozen.
1881.6	1.1	AGG	4 1/2" Aggregate base.				
1880.7	2.0	FILL	FILL: Lean Clay with Sand, brown, moist.				
		CL	LEAN CLAY, brown, moist, medium to rather stiff. (Glacial Till)	9		26	Bag sample collected from 1 to 5 feet.
				6		28	
			- with Sand lenses at 8 feet.	11			
			- trace Gravel below 9 feet.				
1871.7	11.0			9			
			END OF BORING.				
			Water not observed with 9 1/2 feet of hollow stem auger in the ground.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\BISMARCK\2013\00626.GPJ BRAUN_V8_CURRENT.GDT 5/3/13 16:10

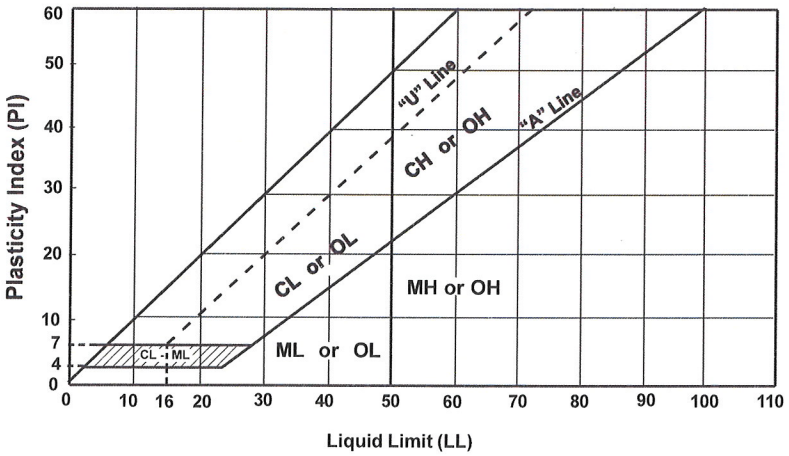
BRAUN INTERTEC

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.

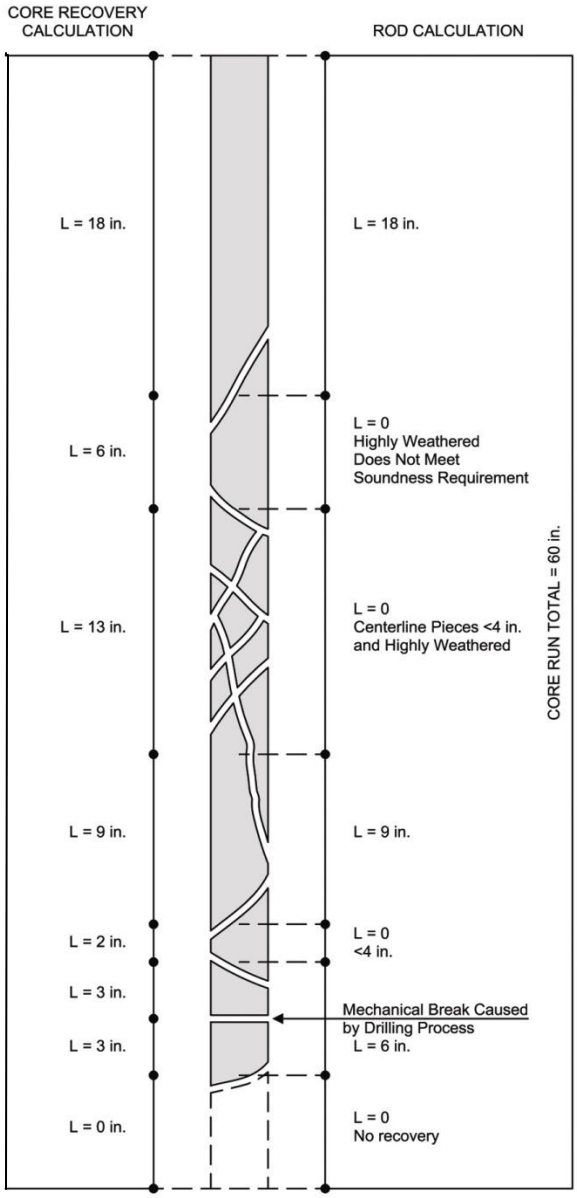
TW indicates thin-walled (undisturbed) tube sample.

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

BRAUN INTERTEC

Descriptive Terminology of Rock

Based on U.S. Army Corps of Engineers EM 1110-1-2908



Example Calculations

Core Recovery, CR = $\frac{\text{Total length of rock recovered}}{\text{Total core run length}}$

Example: CR = $\frac{(18 + 6 + 13 + 9 + 2 + 3 + 3)}{(60)}$

CR = 90%

RQD = $\frac{\text{Sum of sound pieces longer than 4 inches}}{\text{Total core run length}}$

RQD Percent	Rock Quality
<25	very poor
25 < 50	poor
50 < 75	fair
75 < 90	good
90 < 100	excellent

Example: RQD = $\frac{(18 + 9 + 4 + 6)}{(60)}$

RQD = 62%

Weathering

Unweathered: No evidence of chemical or mechanical alteration.

Slightly weathered: Slight discoloration on surface, slight alteration along discontinuities, less than 10% of rock volume altered.

Moderately Weathered: Discoloration evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering halos evident, 10% to 50% of the rock altered.

Highly Weathered: Entire mass discolored, alteration pervading nearly all of the rock, with some pockets of slightly weathered rock noticeable, some mineral leached away.

Decomposed: Rock reduced to a soil consistency with relict rock texture, generally molded and crumbled by hand.

Hardness

Very soft:	Can be deformed by hand
Soft:	Can be scratched with a fingernail
Moderately hard:	Can be scratched easily with a knife
Hard:	Can be scratched with difficulty with a knife
Very hard:	Cannot be scratched with a knife

Texture

Sedimentary Rocks:	Grain Size
Coarse grained	2 – 5 mm
Medium grained	0.4 – 2 mm
Fine grained	0.1 – 0.4 mm
Very fine grained	< 0.1 mm

Igneous and Metamorphic Rocks:	
Coarse grained	5 mm
Medium grained	1 – 5 mm
Fine grained	0.1 – 1 mm
Aphanitic	< 0.1 mm

Thickness of Bedding

Massive:	3 ft. thick or greater
Thick bedded:	1 to 3 ft. thick
Medium bedded:	4 in. to 1 ft. thick
Thin bedded:	4 in. thick or less

Degree of Fracturing (Jointing)

Unfractured:	Fracture spacing 6 ft. or more
Slightly fractured:	Fracture spacing 2 to 6 ft.
Moderately fractured:	Fracture spacing 8 in. to 2 ft.
Highly fractured:	Fracture spacing 2 in. to 8 in.
Intensely fractured:	Fracture spacing 2 in. or less

Braun Intertec Corporation
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Bismarck, ND 58504
Phone: 701.255.7180

Proctor Report

Report No: PTR:W13-000707-S1
Issue No: 1

Client: Troy Ripplinger
Kadrmas, Lee & Jackson, Inc.
128 Soo Line Drive
Bismarck, ND, 58502

Project: BM-13-00626
North Washington Street
Calgary to 57th Avenue
Bismarck, ND, 58501

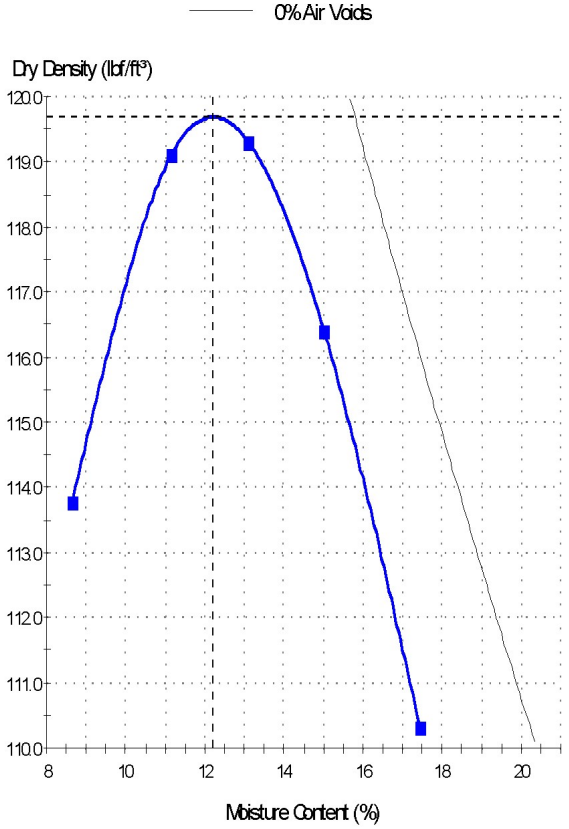
PM: Mark E. Kvas, mkvas@BraunIntertec.com

Brianne Nauman
EIT
Date of Issue: 4/17/2013

Sample Details

Sample ID:	W13-000707-S1	**Alternate Sample ID:**	ST-5
Date Sampled:	4/3/2013	**Date Submitted:**	4/3/2013
Sampled By:	Jamie Miller	**Sampling Method:**	Soil Boring Auger
Source:	Native		
Material:	On Site		
Specification:	General Soil		
Location:	ST-5		
Tested By:	Brianne Nauman	**Date Tested:**	4/17/2013

Dry Density - Moisture Content Relationship



Test Results

ASTM D 1557 - 07

Maximum Dry Density (lbf/ft³):	**119.7**
Corrected Maximum Dry Density (lbf/ft³):	**119.7**
Optimum Moisture Content (%):	**12.2**
Corrected Optimum Moisture Content (%):	**12.2**
Method:	A
Preparation Method:	Moist
Rammer Type:	Hand round
Specific Gravity (Fines):	2.75
Specific Gravity Method:	Assumed
Retained Sieve No 4 (4.75mm) (%):	3
Passing Sieve No 4 (4.75mm) (%):	97
Visual Description:	Sandy Lean Clay (CL)

Comments

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Phone: 701.255.7180

Proctor Report

Report No: PTR:W13-000707-S2
Issue No: 1

Client: Troy Ripplinger
Kadrmas, Lee & Jackson, Inc.
128 Soo Line Drive
Bismarck, ND, 58502

Project: BM-13-00626
North Washington Street
Calgary to 57th Avenue
Bismarck, ND, 58501

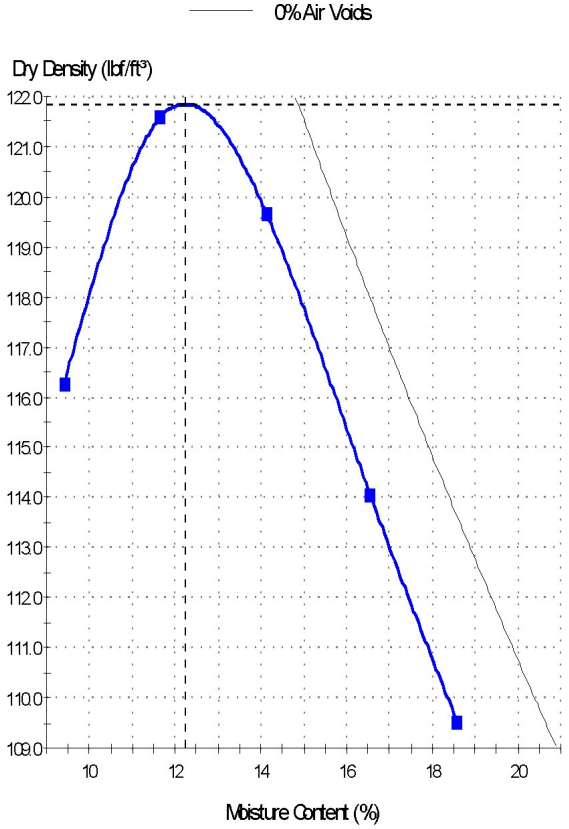
PM: Mark E. Kvas, mkvas@BraunIntertec.com

Brianne Nauman
EIT
Date of Issue: 4/17/2013

Sample Details

Sample ID:	W13-000707-S2	**Alternate Sample ID:**	ST-10
Date Sampled:	4/3/2013	**Date Submitted:**	4/3/2013
Sampled By:	Jamie Miller	**Sampling Method:**	Soil Boring Auger
Source:	Native		
Material:	On Site		
Specification:	General Soil		
Location:	ST-10		
Tested By:	Brianne Nauman	**Date Tested:**	4/17/2013

Dry Density - Moisture Content Relationship



Test Results

ASTM D 1557 - 07

Maximum Dry Density (lbf/ft³):	**121.9**
Corrected Maximum Dry Density (lbf/ft³):	**121.9**
Optimum Moisture Content (%):	**12.2**
Corrected Optimum Moisture Content (%):	**12.2**
Method:	C
Preparation Method:	Moist
Rammer Type:	Hand round
Specific Gravity (Fines):	2.75
Specific Gravity Method:	Assumed
Retained Sieve 3/8" (9.5mm) (%):	4
Retained Sieve 3/4" (19mm) (%):	1
Passing Sieve 3/8" (9.5mm) (%):	96
Passing Sieve 3/4" (19mm) (%):	99
Visual Description:	Sandy Lean Clay (CL)

Comments

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Proctor Report

Report No: PTR:W13-000707-S3
Issue No: 1

Client: Troy Ripplinger
Kadrmas, Lee & Jackson, Inc.
128 Soo Line Drive
Bismarck, ND, 58502

Project: BM-13-00626
North Washington Street
Calgary to 57th Avenue
Bismarck, ND, 58501

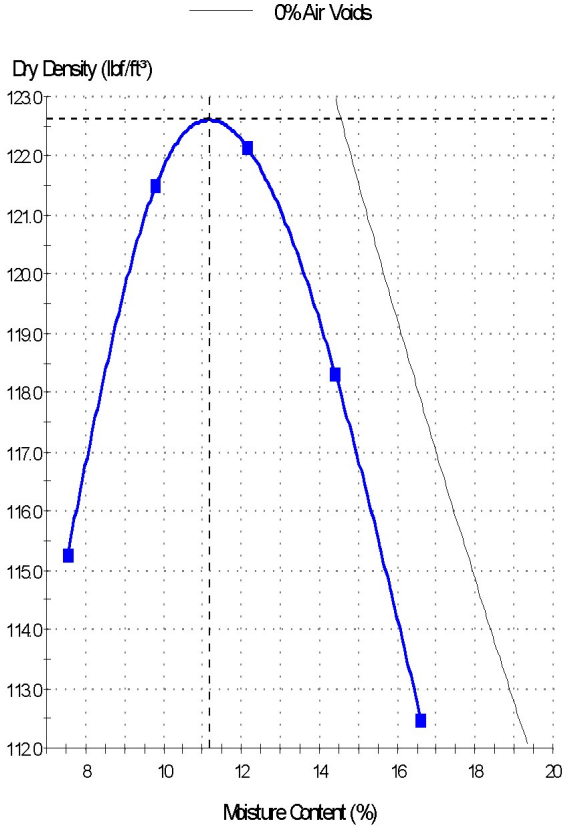
PM: Mark E. Kvas, mkvas@BraunIntertec.com

Brianne Nauman
EIT
Date of Issue: 4/17/2013

Sample Details

Sample ID:	W13-000707-S3	**Alternate Sample ID:**	ST-14
Date Sampled:	4/3/2013	**Date Submitted:**	4/3/2013
Sampled By:	Jamie Miller	**Sampling Method:**	Soil Boring Auger
Source:	Native		
Material:	On Site		
Specification:	General Soil		
Location:	ST-14		
Tested By:	Brianne Nauman	**Date Tested:**	4/17/2013

Dry Density - Moisture Content Relationship



Test Results

ASTM D 1557 - 07

Maximum Dry Density (lbf/ft³):	**122.6**
Corrected Maximum Dry Density (lbf/ft³):	**122.6**
Optimum Moisture Content (%):	**11.2**
Corrected Optimum Moisture Content (%):	**11.2**
Method:	A
Preparation Method:	Dry
Rammer Type:	Hand round
Specific Gravity (Fines):	2.75
Specific Gravity Method:	Assumed
Retained Sieve No 4 (4.75mm) (%):	4
Passing Sieve No 4 (4.75mm) (%):	96
Visual Description:	Sandy Lean Clay (CL)

Comments

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Braun Intertec Corporation
11001 Hampshire Avenue South
Minneapolis, MN 55438
Phone: 952.995.2000

California Bearing Ratio Test Report

Report No: CBR:W13-000733-S1
Issue No: 1

Client: Troy Ripplinger
Kadrmas, Lee & Jackson, Inc.
128 Soo Line Drive
Bismarck, ND, 58502

Project: BM-13-00626
North Washington Street
Calgary to 57th Avenue
Bismarck, ND, 58501

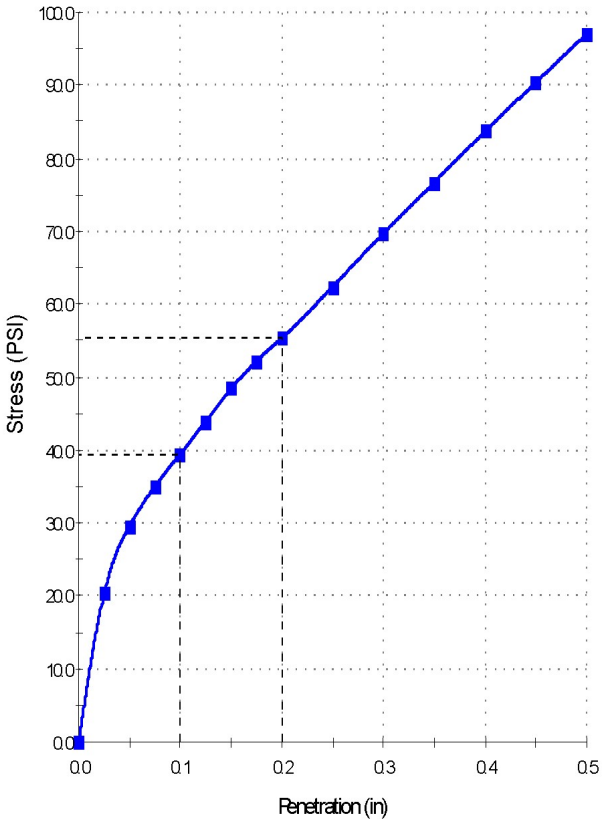
PM: Mark E. Kvas, mkvas@BraunIntertec.com

Dallas Miner
Laboratory Supervisor
Date of Issue: 4/26/2013

Sample Details

Sample ID:	W13-000733-S1	**Alternate Sample ID:**	ST-5
Sampled By:	Jamie Miller	**Date Sampled:**	4/3/2013
Sampling Method:	Soil Boring Auger	**Source:**	Native
Material:	Sandy Lean Clay	**Specification:**	
Sample Location:	ST-5 from 1'-5'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	3.9
CBR At 0.2in (%):	3.7
Compactive Effort:	ASTM D 1557
Number of Blows:	20
% of Maximum Dry Density:	95.0
Dry Density Before Soaking (lb/ft³):	113.7
MC Before Compaction (%):	12.6
MC After Compaction (%):	12.6
Moisture Content of Top 1in (%):	
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	119.7
Optimum Moisture Content (%):	12.2
Sample Condition:	soaked
Swell (%):	4.4
Surcharge Mass (lb):	10.00
Oversize Material (%):	
Date Tested:	4/26/2013

Comments

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11001 Hampshire Avenue South
Minneapolis, MN 55438
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California Bearing Ratio Test Report

Report No: CBR:W13-000733-S2
Issue No: 1

Client: Troy Ripplinger
Kadrmas, Lee & Jackson, Inc.
128 Soo Line Drive
Bismarck, ND, 58502

Project: BM-13-00626
North Washington Street
Calgary to 57th Avenue
Bismarck, ND, 58501

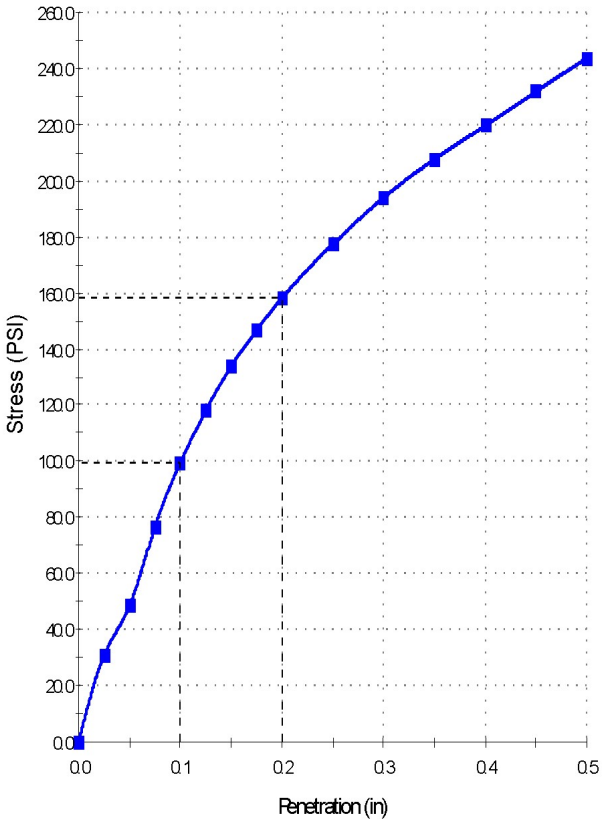
PM: Mark E. Kvas, mkvas@BraunIntertec.com

Dallas Miner
Laboratory Supervisor
Date of Issue: 4/26/2013

Sample Details

Sample ID:	W13-000733-S2	**Alternate Sample ID:**	ST-10
Sampled By:	Jamie Miller	**Date Sampled:**	4/4/2013
Sampling Method:	Soil Boring Auger	**Source:**	Native
Material:	Sandy Lean Clay	**Specification:**	
Sample Location:	ST-10 from 1'-5'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	9.9
CBR At 0.2in (%):	10.5
Compactive Effort:	ASTM D 1557
Number of Blows:	18
% of Maximum Dry Density:	95.2
Dry Density Before Soaking (lb/ft³):	116.1
MC Before Compaction (%):	12.4
MC After Compaction (%):	12.3
Moisture Content of Top 1in (%):	15.8
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	121.9
Optimum Moisture Content (%):	12.2
Sample Condition:	soaked
Swell (%):	2.7
Surcharge Mass (lb):	10.00
Oversize Material (%):	
Date Tested:	4/26/2013

Comments

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Braun Intertec Corporation
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California Bearing Ratio Test Report

Report No: CBR:W13-000733-S3
Issue No: 1

Client: Troy Ripplinger
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Project: BM-13-00626
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Calgary to 57th Avenue
Bismarck, ND, 58501

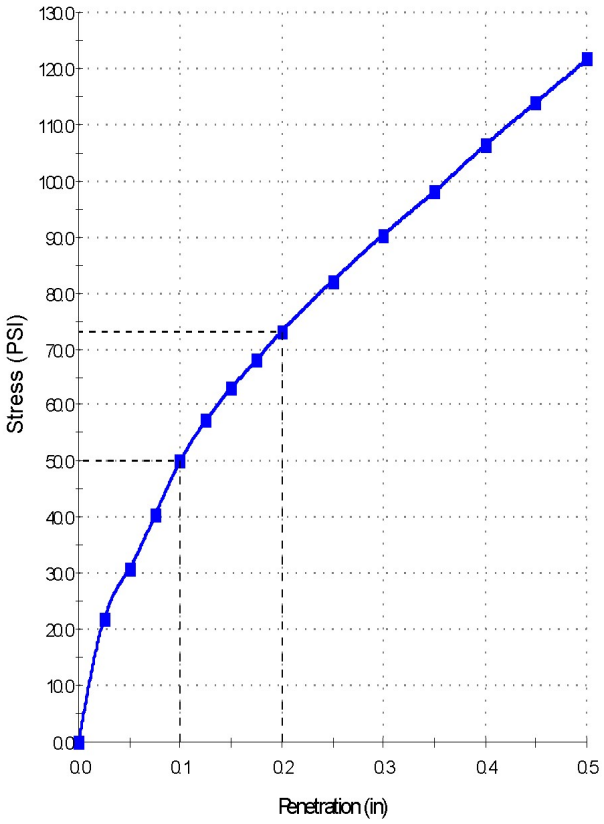
PM: Mark E. Kvas, mkvas@BraunIntertec.com

Dallas Miner
Laboratory Supervisor
Date of Issue: 4/26/2013

Sample Details

Sample ID:	W13-000733-S3	**Alternate Sample ID:**	ST-14
Sampled By:	Jamie Miller	**Date Sampled:**	4/4/2013
Sampling Method:	Soil Boring Auger	**Source:**	Native
Material:	Sandy Lean Clay	**Specification:**	
Sample Location:	ST-14 from 1'-5'		

Stress vs Penetration



Test Results

ASTM D 1883 - 07

CBR At 0.1in (%):	5.0
CBR At 0.2in (%):	4.9
Compactive Effort:	ASTM D 1557
Number of Blows:	20
% of Maximum Dry Density:	94.7
Dry Density Before Soaking (lb/ft³):	116.1
MC Before Compaction (%):	11.6
MC After Compaction (%):	11.4
Moisture Content of Top 1in (%):	18.6
Average Moisture Content (%):	
Maximum Dry Density (lb/ft³):	122.6
Optimum Moisture Content (%):	11.2
Sample Condition:	soaked
Swell (%):	4.3
Surcharge Mass (lb):	10.00
Oversize Material (%):	
Date Tested:	4/26/2013

Comments

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