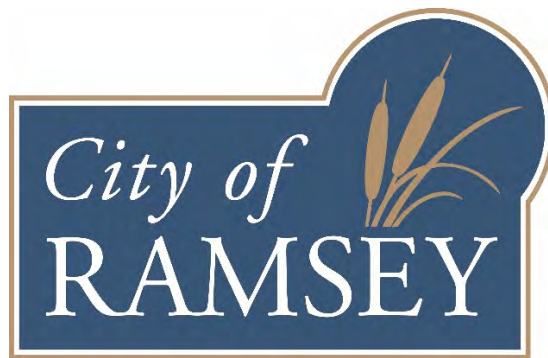


# FEASIBILITY REPORT

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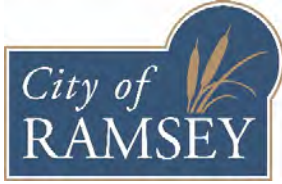
## VARIOLITE STREET RECONSTRUCTION CITY IMPROVEMENT PROJECT NO. 20-01



**April 9, 2020**

**Prepared By:**

**City of Ramsey  
Engineering Department  
7550 Sunwood Drive NW  
Ramsey, MN 55303  
763-433-9839  
763-433-9848 (Fax)**



April 9, 2020

Honorable Mayor and City Council  
City of Ramsey  
7550 Sunwood Drive NW  
Ramsey, MN 55303

Re: Feasibility Report – City of Ramsey Improvement Project #20-01  
Variolite Street Reconstruction

Dear Mayor and City Council Members:

Transmitted herewith is a Feasibility Report for the proposed reconstruction of Variolite Street between Alpine Drive and 173<sup>rd</sup> Avenue. The report examines the necessity, feasibility and cost-effectiveness of reconstructing the bituminous street section and completing other appurtenant improvements.

This Feasibility Report examines the scope of the proposed improvements, explores estimated costs and available funding sources, defines a preliminary project schedule, and explores alternate designs, as well as whether the improvements would best be completed separately or in conjunction with another project.

I would be happy to discuss this report with you at your convenience. Please feel free to contact me at 763-433-9825 or [bwestby@cityoframsey.com](mailto:bwestby@cityoframsey.com) with any questions.

Sincerely,  
*City of Ramsey*

Bruce Westby, PE  
City Engineer

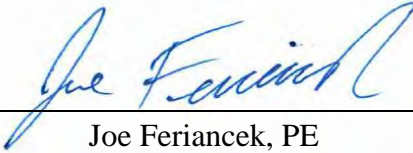
Enclosure

C: Kurt Ulrich, City Administrator  
Joe Feriancek, Civil Engineer II

## CERTIFICATION

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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.



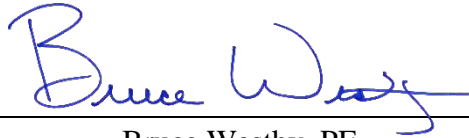
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Joe Feriancek, PE

Date: April 9, 2020

License No. 57095

I hereby certify that this plan, specification or report was reviewed for Quality Control and Quality Assurance purposes and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



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Bruce Westby, PE

Date: April 9, 2020

License No. 40116

**TITLE SHEET**

**LETTER OF TRANSMITTAL**

**CERTIFICATION SHEET**

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**Appendix A**

- Project Scope
- Typical Sections
- Project Site Pictures
- Proposed Variolite & 161<sup>st</sup> Pedestrian Improvements

**Appendix B**

- Opinion of Probable Costs

**Appendix C**

- Street Segment Summary
- Ground Penetrating Radar Summary

**Appendix D**

- Geotechnical Report (NTI)
- Drain Tile Design Recommendations
- WSB Forensics Report

## 1. EXECUTIVE SUMMARY

City Improvement Project 20-01 proposes to reconstruct Variolite Street between Alpine Drive and 173<sup>rd</sup> Avenue. The street totals approximately 12,000 linear feet (2.28 miles) in length. A figure showing the location and scope of the proposed improvements is included in *Appendix A*.

On December 10, 2019, the Ramsey City Council ordered this feasibility report which explores the necessity, feasibility and cost-effectiveness of the proposed improvements by examining the existing conditions, scope of the proposed improvements, design alternatives, estimated costs and available funding sources, and determining whether the improvements should be completed as proposed or in connection with other improvements. On September 10, 2019, the Ramsey City Council authorized Staff to execute proposals from Hakanson Anderson and Associates for the required topographic survey, and from Northern Technologies Inc. (NTI) for required geotechnical work. The NTI Geotechnical Report is included in *Appendix D*.

In 2017, Variolite Street was included in the Ground Penetrating Radar Pavement Evaluation performed by Braun Intertec. This data provides bituminous and aggregate base thickness information. The Ground Penetrating Radar (GPR) Summary, as well as the street segment summary, detailing the pavement history, are included in *Appendix C*.

Variolite Street is a Municipal State Aid (MSA) street, and as such must be reconstructed to current MSA design standards, which are regulated by the State Aid Division of the Minnesota Department of Transportation (MnDOT). Due to the MSA 9 ton road design requirements and the potential for heavy truck traffic on this route, Staff proposed improvements include a Stabilized Full Depth Reclamation (SFDR) with 4-inches of bituminous pavement placed over the top. Some areas of the road exhibit groundwater concerns, and will receive drain tile placed under the SFDR. The proposed typical section is included in *Appendix A*.

Trunk utility improvements are proposed with this project including the replacement of existing 10-inch force main trunk sanitary sewer with 21-inch gravity trunk sewer, and the extension of 12-inch trunk watermain to 173<sup>rd</sup> Avenue. This work is consistent with the 2040 City of Ramsey Comprehensive Plan, and is proposed to occur with this project to prevent unnecessary road reconstruction in the future to install these utilities. The utility improvements will support future expansion of City sewer and water to the northern parts of the City. Stormwater is generally conveyed through ditches, with culverts at abutting side streets and low points. Several of these culverts will be replaced with this project.

The engineer's opinion of probable project costs for completing the proposed improvements outlined in this report is \$4,335,000. Estimated costs include 10-percent contingency costs, as well as 23-percent indirect costs for administrative, engineering, finance and legal costs. A summary of the engineer's opinion of probable costs is included in *Appendix B*.

The street improvements proposed with this project are identified in the City’s current 10-year Capital Improvement Program (CIP), and can be funded using a combination of Municipal State Aid Funds and Stormwater Funds. Sanitary Sewer and Watermain improvements were not listed in the CIP but are required to support future needs, and are feasible and cost-effective.

This project would best be constructed as a stand-alone project and is necessary, feasible, and cost-effective from an engineering standpoint, and can be constructed as proposed herein.

## 2. INTRODUCTION

### 2.1 Authorization

Preparation of this feasibility report was authorized by the Ramsey City Council on December 10, 2019.

### 2.2 Program Overview

This project is designated as Variolite Street Reconstruction, Improvement Project No. 20-01.

This feasibility report explores proposed reconstruction of Variolite Street by the Stabilized Full-Depth Reclamation (SFDR) method, which includes reclamation of the existing bituminous pavement and underlying aggregate base and mixing asphalt emulsion into the reclaimed material to give additional strength, then placing 4-inches of new bituminous pavement on top.

The Public Works Committee directed Staff to explore pedestrian crossing improvements at 161<sup>st</sup> Avenue and traffic calming options along the corridor. The proposed pedestrian crosswalk improvements at the intersection of Variolite Street and 161<sup>st</sup> Avenue are included in *Appendix A*. To address traffic calming, Staff proposes narrowing the pavement and reducing the speed limit to 40 mph south of 163<sup>rd</sup> Avenue. The proposed typical section is included in *Appendix A*.

Per the 2040 Comprehensive Plan, trunk sanitary sewer and watermain improvements are needed to serve portions of the City north of Trott Brook. Therefore, the existing trunk sanitary sewer force main is proposed to be replaced with gravity sewer, and trunk watermain will be extended north to 173<sup>rd</sup> Avenue.

A figure showing the location and scope of the proposed improvements is included in *Appendix A*.

### 2.3 Scope

City Improvement project 20-01 proposes to reconstruct the existing bituminous pavement, narrow the pavement width south of 163<sup>rd</sup> Lane, improve the pedestrian crosswalk at 161<sup>st</sup> Avenue, tie-in to existing ditches, replacing force main trunk sanitary sewer with gravity sewer, extent trunk watermain, and complete other appurtenant work to Variolite Street between Alpine Drive and 173<sup>rd</sup> Avenue, which totals approximately 12,000 linear feet (2.28 miles) in length.

### 3. EXISTING CONDITIONS

#### 3.1 Existing Streets

Variolite Street between Alpine Drive and 173<sup>rd</sup> Avenue was constructed between 1981 and 1983 with bituminous pavement, class 5 aggregate base, and ditches. The street functions as a north-south collector. The west side of the street cuts across 6 plats and 3 un-platted sections, while the east side cuts across 7 plats and 2 un-platted sections. The existing right-of-ways vary from approximately 80-feet to approximately 100-feet. The street is generally straight, yet meanders within the right-of-way. The pavement width is generally 40-feet. Northbound right turn lanes exist for access to the Woodlands and Sweet Bay Ridge neighborhoods.

Pavement maintenance operations have included crack seal and seal coat improvements in 1988, an overlay in 1998, and crack seal and seal coat improvements in 2008. Spot patching has been performed on an as-needed basis, and has been a yearly treatment recently. In 2018, Staff assigned a Pavement and Surface Evaluation Rating (PASER) of 4 to this segment of Variolite Street. PASER ratings were not completed for this street in 2019. PASER ratings are a numerical index between 1 and 10 indicating the condition of a pavement based on various pavement distresses present during visual observations. A PASER value of 10 represents a new pavement section, while a PASER rating of 1 represents a failed pavement section requiring reconstruction. A street segment summary is included in *Appendix C*.

In June of 2019, Staff took 3 traffic counts on Variolite Street as part of the 2019 MnDOT State Aid traffic count schedule.

- Variolite Street south of 173<sup>rd</sup> Avenue: 685 ADT
- Variolite Street north of 161<sup>st</sup> Avenue: 1,420 ADT
- Variolite Street north of Alpine Drive: 1,584 ADT

The speed limit of Variolite Street is 50 mph, with the exception of a section north of Trott Brook which has a reduced speed limit of 45 mph due to severe localized vertical displacement of the pavement.

In 2017, Braun Intertec was employed to complete a ground penetrating radar (GPR) analysis for numerous City streets, including this segment of Variolite Street. The GPR data determined an average bituminous pavement thickness of 6.8 inches, and an average aggregate base thickness of 5.6 inches. The average pavement plus base section thickness was 12.4 inches, with a minimum section of 8.5 inches located 150 feet south of 171<sup>st</sup> Avenue. It should be noted that the GPR was not able to determine aggregate base depth for an 800 foot section of the road near 166<sup>th</sup> Avenue. A summary table and charts of the GPR Analysis are included in *Appendix C*.

#### 3.2 Subsurface Conditions

##### 3.2. a Geotechnical Report

Northern Technologies Inc. (NTI) was employed to complete a Geotechnical Exploration Review for this project, which included a total of sixty one (61) soil borings. The soil borings were spaced

500-feet for the majority of the project, and at 100-feet for areas of higher concern, including areas with known groundwater issues and in areas with adjacent wetlands. The borings terminated at depths ranging from approximately 10.5 to 18.5 feet below the top of pavement. The locations of the borings are shown in the Soil Boring Location Map in NTI's report, included in *Appendix D*.

The soil borings generally indicate the existing bituminous pavement thickness ranges from approximately 1.5 to 8.0 inches at the boring locations. Apparent aggregate base thickness ranges from approximately 3.0 to 24.0 inches.

Apparent previously placed fill soils generally consisting of poorly graded sand, poorly graded sand with silt, silty sand, and sandy lean clay were encountered to depths ranging from approximately 2.0 to 7.0 feet below the top of pavement. Organic materials and bituminous pieces were occasionally encountered within the fill materials. The apparent previously placed fill was not observed at Boring SB-38 and Boring SB-5 terminated in fill materials at a depth of approximately 10.5 feet below the top of pavement.

Native glacial deposit soils consisting of poorly graded sand to poorly graded sand with gravel, poorly graded sand with silt to poorly graded sand with silt with gravel, silt sand, and clayey sand were observed extending to the boring termination depths.

Swamp deposit soils were observed at Borings SB-23, SB-24, SB-35, SB-37, SB-39 through SB-44 and SB-46 through SB-49 consist of silty sand, poorly graded sand, poorly graded sand with silt, sandy silt, and peat. Organic contents of selected samples ranged from 2.1 to 53.7 percent with moisture contents ranging from 26 to 236 percent.

Groundwater was observed in 35 of the 57 boreholes at the time of drilling. The groundwater depths, which can fluctuate seasonally, ranged from approximately 2.5 to 11.5 feet below the top of pavement. The lack of observed groundwater in the remaining borings is likely due to the short duration for which the borehole remained open combined with the varying site elevations. Additionally the on-site silt laden soils have the potential to be impervious and conducive to the development of zones of perched water at varying elevations and locations across the project area.

### 3.2. b R-Value

NTI estimated that a properly prepared subgrade would have an average stabilometer R-value based on soil types as referenced below:

- Poorly graded sand (SP) – R-value of 50
- Poorly graded sand with silt (SP-SM) – R-value of 40
- Silty sand (SM) – R-value of 25

City Staff reviewed the boring logs within the Geotechnical Report, and calculated an average R-value of 36 for Variolite Street. This R-value directly affects the support of the pavement section,

and only the top 3 feet of subsoil was considered when calculating the average R-value. MSA projects require the use of MnPAVE, a pavement design software, which uses the R-value to determine the required section necessary to meet the MSA design standards.

### 3.3 Utilities

#### 3.3.a Watermain

Sixteen-inch trunk watermain exists under Variolite Street between 157<sup>th</sup> Avenue and 159<sup>th</sup> Avenue, the south access to the Woodlands neighborhood. Eight-inch watermain crosses at 161<sup>st</sup> Avenue for future extension to the west. Sixteen-inch trunk watermain exists along Variolite Street in the east ditch between 163<sup>rd</sup> Avenue, the north access to the Sweet Bay Ridge neighborhood, and 166<sup>th</sup> Avenue where the line turns east and connects to the Brookfield neighborhood.

#### 3.3.b Sanitary Sewer

Sanitary sewer crossings exist at 159<sup>th</sup> Avenue and 161<sup>st</sup> Avenue, for potential future expansion to the west of Variolite Street. A 24-inch sanitary sewer trunk gravity line crosses Variolite Street at 163<sup>rd</sup> Lane and runs southeast through the Sweet Bay Ridge neighborhood. From 163<sup>rd</sup> Lane, a 10-inch force main sanitary sewer line runs in the west ditch of Variolite Street to 166<sup>th</sup> Avenue. This force main conveys effluent from a lift station in the Brookfield neighborhood.

#### 3.3.c Storm Sewer/Drainage

Stormwater runoff is conveyed within ditches along both sides of Variolite Street. Crossing culverts exist at the low points, taking water from the west side of the road to the east side, and eventually into storm ponds or wetlands. A 72-inch concrete culvert conveys water under Variolite Street from west to east at Trott Brook. Ten of the fourteen side streets have culverts within the Variolite Street right of way. These culverts are corrugated metal pipes varying in size between 15-inch and 18-inch. One set of concrete pipes and low profile catch basins exist at 163<sup>rd</sup> Avenue.

#### 3.3.d Private Utilities

Staff has performed a Gopher One State Call to obtain as-built utility information for all private utility companies having service within the Variolite Street right of way. Additionally the Hakanson Anderson topographic survey included a design utility locate, and the locate markings were surveyed in the field and will be shown in the plans. Staff has not yet met with the telephone, gas, power and cable utilities regarding the project, but from as-builts it has been confirmed all are within the project area. During preparation of plans and specifications, Staff will meet with the private utility companies to discuss the proposed improvements as noted in the project schedule within this report. The alignment and footprint of the street will be considered to minimize impacts to private utilities. No impacts to power poles or street lights are anticipated with this project.

Should any utility company indicate they wish to upgrade, replace and/or otherwise modify their services during this project, any such upgrades, replacements and/or modifications will be at the sole discretion and cost of the utility company.

## 4. CONSIDERED IMPROVEMENTS

### 4.1 Project Area Selection

The City's 10-year Capital Improvement Program (CIP) calls for the reconstruction of Variolite Street between Alpine Drive and 173<sup>rd</sup> Avenue in 2020. The CIP does not include watermain or sanitary sewer improvements. However, the City's 2040 Comprehensive Plan calls for sanitary sewer and watermain improvements north of the existing utilities along Variolite Street. The scope of the proposed improvements is included in *Appendix A*.

### 4.2 Street Improvements

Variolite Street is proposed to be reconstructed by matching existing widths and elevations between 163<sup>rd</sup> Lane and 173<sup>rd</sup> Avenue, with bituminous pavement and ditch sections to carry storm water runoff. Between Alpine Drive and 163<sup>rd</sup> Lane, Variolite Street is generally proposed to be reconstructed 6-feet narrower than existing, but generally matching existing elevations with bituminous pavement and ditch sections.

#### 4.2. a Stabilized Full Depth Reclamation

To meet the required MSA design standards, several pavement sections were considered. Stabilized Full Depth Reclamation (SFDR) was determined to be the most cost-effective method of reconstruction. This process involves reclamation (grinding in-place) of the existing bituminous pavement plus a portion of the underlying aggregate base. Excess reclaimed material is then removed as needed so the new pavement will match into existing shoulders, driveways, and cross streets. Staff is proposing to stabilize the base 1 foot beyond the edges of drive lanes by adding liquid asphalt emulsion into the reclaim material, which is then mixed in, rolled and compacted. Once compacted, the SFDR can be opened up to traffic, and gains strength with the further compaction of vehicle traffic. This project proposes 6-inches of SFDR, with 4-inches of new bituminous pavement placed on top.

The City recently completed an SFDR project on Sunwood Drive between Ramsey Boulevard and Bunker Lake Boulevard. A concern with this process is that the moisture content of the stabilized base must meet a specific range before paving is allowed, therefore rain delays are a possibility. However, similar to the Sunwood Drive project, stabilizing the reclamation allows for a thinner overall pavement section, avoiding the need to excavate below the existing aggregate base to make costly subgrade corrections. Considering that Sunwood Drive was reconstructed in 2017 and is still exhibiting very little cracking, Staff is confident that the SFDR process will provide as long of a life for the new pavement section as a full reconstruction with subgrade corrections would, but at a significantly lower cost.

To maximize the existing reclamation volume re-used on site, the cross slope of the road is proposed to be increased from 2-percent to 3-percent, allowing the center profile of the street to be raised approximately 2-inches yet sill tie into existing shoulders, driveways and cross streets.

#### 4.2. b Alternative Reconstruction Method

To meet the required 9-ton design strength, the SFDR method requires a 10-inch section including 4-inches of new bituminous over 6-inches of SFDR. Alternatively, this design strength can be achieved using a 14-inch section including 4-inches of new bituminous over 10-inches of class 5 aggregate base. However, the downsides of using the 14-inch section are that project costs are estimated to be 13-percent higher than the SFDR method since 6-inches of subgrade excavation would be required, and material would need to be hauled off-site. All of the reclaim material would also have to be stockpiled, and it is estimated an additional 5,800 CY of class 5 aggregate base would be required. Additionally, excavating below existing subgrade would result in more impacts to the existing ditches. For these reasons, Staff is recommending the SFDR method.

#### 4.2. c Safety Improvements

##### 4.2. c.1 Variolite Street and 161<sup>st</sup> Avenue Pedestrian Crossing

The City has received several requests in recent years to improve pedestrian safety at the intersection of Variolite Street and 161<sup>st</sup> Avenue, resulting in a review of pedestrian safety concerns at this intersection by the Public Works Committee on May 16, 2017. At that time, based on the geometrics of the site and the minimal amount of pedestrians crossing Variolite Street, improvements were not justified. It was recommended to take another look at this location when Variolite Street came up for reconstruction, and to consider possible roadway improvements to alleviate the geometric concerns of the site.

As part of this feasibility study, Staff conducted a pedestrian crossing study at the aforementioned intersection. This study was completed following both MnDOT and FHWA safety guidelines as well as the Highway Capacity Manual Level of Service Analysis at Uncontrolled Crossing Locations. As in 2017, the recommendations of all these sources is to not improve the site with marked crossing or signage alone, but to perform traffic calming of the road corridor. Staff has determined the most effective method of traffic calming is to reduce vehicle speeds to 40 mph by constraining lane and shoulder widths to meet MSA standards for a 40 mph rural road, in addition to adding a concrete pedestrian refuge island at 161<sup>st</sup> Avenue. A figure of the proposed pedestrian crosswalk improvements is included in **Appendix A**.

Staff therefore proposes to reduce drive lane widths to 11-feet, and shoulder widths to 6-feet, south of 163<sup>rd</sup> Lane to meet MSA design standards for a 40 mph rural road. The installation of a concrete pedestrian refuge island on the north leg of Variolite Street at 161<sup>st</sup> Avenue will allow pedestrians to focus on one lane of traffic, safely cross that lane, then wait within the raised median island until an acceptable gap is available to safely finish crossing the next lane of traffic. An additional benefit is the shortened crossing times. ADA compliant pedestrian landings are proposed for all crosswalks at this intersection. Staff met with MnDOT State Aid Staff to discuss the City's proposed design. State Aid Staff agreed that a raised concrete pedestrian refuge island likely provided the greatest safety benefit, but suggested considering mini-roundabouts instead. Staff explored the mini-roundabout option, but due to right-of-way constraints, this option is not considered feasible at this time.

Regarding crosswalk signing, State Aid Staff recommended not installing Rapid Rectangular Flashing Beacons (RRFB's) if the speed limit remains at 50 mph as they have not had positive results on roads posted with high speeds, which is considered 45 mph or greater. If the speed limit is reduced to 40 mph, RRFB's would be considered acceptable, as long as advance warning signs are included. Standard pedestrian crossing signs (no lights), including advance warning signs, would also be considered an allowable option by State Aid. Interactive speed limit display signs, similar to the Sunwood Drive signs near City Hall, were discussed as a potential use to help deter speeding through the intersection of Variolite Street and 161<sup>st</sup> Avenue.

#### 4.2. c.2 Traffic Calming

To make the pedestrian crossing most effective, and to address general concerns over existing travel speeds along Variolite Street, Staff looked at options for traffic calming. Options looked at, but not found feasible, were center medians including raised concrete, raised and landscaped, lowered with a center ditch, and stripped. Industry consensus is vertical elements and tighter “feeling” streets are effective at reducing speeds. Staff is therefore proposing to reduce the width of the drive lanes and parking lanes to meet the minimum requirements of State Aid for a 40 mph rural road south of 163<sup>rd</sup> Lane. The drive lanes will be reduced from 12-feet to 11-feet, and shoulders will be reduced from 8-feet to 6-feet. If off-street paths are available, the shoulder could include 2-feet of pavement next to the drive lane, and aggregate for the remaining 4-feet, to make the street feel even tighter. However, due to right of way constraints and costs this was not found feasible. The shoulder must therefore continue to serve as a bike lane.

Ramsey Police Department Staff approve of reducing the speed limit south of 163<sup>rd</sup> Lane to 40 mph. However, to effectively enforce speeds along the corridor they requested that bump-outs be provided mid-block on both sides of Variolite Street, one set on either side of 161<sup>st</sup> Avenue, to allow police vehicles to safely park outside the shoulder and turn around as needed.

#### 4.2. d Trails & Sidewalks

Off-road bituminous trail exists from 159<sup>th</sup> Avenue to one-half block past 163<sup>rd</sup> Avenue where it terminates. This project proposes to remove the one-half block section of terminated trail, as there is no future route or plan in place for this trail to continue north. Due to the proposed pedestrian refuge island at 161<sup>st</sup> Avenue, the intersection at 161<sup>st</sup> will be widened, and a section of trail will need to be replaced. All trail street crossings are proposed to be upgraded with ADA compliant concrete pedestrian landings.

#### 4.2. e Other Considerations

Driveways: Existing driveway aprons may need to be reconstructed to varying degrees. The limits of construction will vary with each driveway apron based on the elevation of the street abutting the driveway and the driveway pavement type. During design, Staff will evaluate the construction limits for each driveway and will incorporate this into the plans, but as with all street reconstruction projects, the exact limits of construction will be determined in the field during

construction. Right-of-entry forms will be obtained from private property owners if work is required outside City right-of-ways and easements.

**Irrigation Systems:** Developed properties along the project corridor may have private irrigation systems. Staff will notify property owners of pending construction as far in advance as practical to allow them time to move their irrigation systems out of harm's way before work begins.

**Parking Restrictions:** Parking is currently provided along both sides of the streets and is not currently restricted except for overnight parking per City code. During this project, parking will be restricted during allowable working hours.

**Protected Turn Lanes:** Protected turn lanes were considered at 161<sup>st</sup> Avenue and at Alpine Drive. At 161<sup>st</sup> Avenue, the pavement is proposed to be widened to accommodate a pedestrian refuge island. This reduces available right of way for a southbound right turn lane. Furthermore, adding a southbound right turn lane would increase the crossing distance for pedestrians, reducing the benefits of the pedestrian crosswalk improvements. Since the majority of traffic traveling to Central Park, located west of Variolite Street on 161<sup>st</sup> Avenue, comes from the south, a northbound left turn lane may be warranted and will be explored during final design. Staff feels a northbound left turn lane at 161<sup>st</sup> Avenue would improve safety, especially for pedestrians, by removing the chance for drivers to use the shoulder to pass vehicles waiting to turn left from the through lane. At Alpine Drive, turn lanes are not proposed to be explored during final design considering the stop condition for Alpine Drive and the low traffic volumes on Alpine Drive and Variolite Street. There is simply not enough vehicle queuing to justify southbound right and/or left turn lanes.

#### 4.3 Stormwater

No stormwater retention and/or treatment improvements will be required as a result of this project. This project proposes to replace side street culverts on 8 of the 10 streets which currently have culverts due to the age and conditions of the existing culverts. The 72-inch Trott Brook culvert is full of water and cannot be inspected but is in good condition and is not proposed to be replaced.

#### 4.4 Watermain Improvements

This project proposes to extend 12-inch watermain from the end of the existing 16-inch watermain at 166<sup>th</sup> Avenue north to 173<sup>rd</sup> Avenue as identified in the 2040 Comprehensive Plan. This will allow looping of trunk watermain, and will support future development north of Trott Brook.

#### 4.5 Sanitary Sewer Improvements

This project proposes to replace the existing force main sanitary sewer from 163<sup>rd</sup> Avenue to 166<sup>th</sup> Avenue with 21-inch gravity sanitary sewer as identified in the 2040 Comprehensive Plan. This will provide greater flexibility for future development to the north and west, and will reduce head loss due to friction in the pipe thereby increasing the capacity of the sewer system downstream of the sanitary sewer lift station currently serving the Brookfield development and the new elementary school. Other areas to the north and east could potentially be served by this lift station

*Feasibility Report*

*Variolite Street Reconstruction*

*City of Ramsey Project No. 20-01*

in the future, but this would require an analysis of the reserve capacity of the lift station needed to accommodate the additional flows.

#### 4.6 Right-of-Way/Easements

Staff has anticipated additional easement will be required at the NW corner of Variolite Street and 161<sup>st</sup> Avenue to accommodate the pedestrian crossing improvements. Staff has reached out and is working with that property owner. It is anticipated that all other improvements will occur within existing City right-of-ways and/or easement, with the exception of tying into private driveways. Therefore, potential costs for any right-of-ways or easements are not included in the probable project costs.

Rights of entries from individual property owners may need to be obtained prior to construction commencing for grading, driveway removals and paving, utility construction, and restoration activities.

#### 4.7 Permits

Permits that are anticipated to be required as part of the proposed improvements include:

- MPCA General Stormwater Permit (NPDES)                      Grading and Stormwater
- MPCA / Met Council                                                      Sanitary Sewer Extension
- MDH                                                                              Watermain Extension
- MN DNR                                                                         Dewatering

#### 4.8 Minnesota State Aid Submittals

Variolite Street is a Municipal State Aid (MSA) street so the City receives MSA funds for the reconstruction and maintenance of this street. Variolite Street must therefore be designed and constructed to State Aid standards, which requires various submittals throughout the project process, including:

- Request for State Aid Project Number
- Plan Submittal for MSAS Review, including;
  - Plan Review Checklist – State Aid Only – No Bridge
  - Engineer’s Estimate
  - Special Provisions
  - ESAL Calculator (Equivalent Single Axle Loads)
  - Pavement Design (MnPAVE Flexible Design Guidance)
  - Drainage Design
- Lab Testing and Inspection Services Request
- Payment Request Form
  - Release of state aid funds – 95 percent of the accepted bid price upon approval of payment request and required documentation
- Final inspection/acceptance of completed work
  - Site visit by state aid official.

## 5. FINANCING

### 5.1 Opinion of Probable Costs

A detailed opinion of probable costs for the proposed improvements can be found in *Appendix B*. The opinion of probable costs incorporates anticipated 2020 construction costs for the proposed improvements with 10-percent contingency costs, plus 23-percent indirect costs for administrative, engineering, financing and legal costs.

#### 5.1. a Estimated Project Costs

|                             |                     |
|-----------------------------|---------------------|
| Street Improvements         | \$ 2,820,000        |
| Storm Sewer Improvements    | \$ 65,000           |
| Sanitary Sewer Improvements | \$ 650,000          |
| Watermain Improvements      | \$ 800,000          |
| <b>Total Project Cost</b>   | <b>\$ 4,335,000</b> |

#### 5.1. b Incurred Engineering Costs

City Staff prepared the Feasibility Report in-house as part of Staff's normal duties.

Northern Technologies Inc. prepared the Geotechnical Exploration and Engineering Review, included in *Appendix D*, at a cost of \$29,750.00.

Hakanson Anderson prepared the topographic survey and roadway easement exhibit, at a cost of \$13,650.00.

WSB performed the pavement forensic report, included in *Appendix D*, at a cost of \$1,283.00.

Braun Intertec performed the drain tile design report, included in *Appendix D*, at a cost of \$2,140.00.

## 5.2 Funding

### 5.2. a Assessments

At the September 17, 2019 Public Works Committee meeting, it was approved to move forward with this project without the use of special assessments. Variolite Street has only 13 direct accesses, and assessments on 13 properties would not recover the costs associated with the assessment process. The September 17, 2019 Public Works Committee meeting report was accepted at the October 8, 2019 City Council meeting.

### 5.2. b City Contribution

The City contribution to the project will include the full project amount. No funds were budgeted for this project.

The City's contribution for project costs related to surface (street) improvements is using Municipal State Aid Funds. Water, Sewer and Stormwater Funds would be utilized strictly for these improvements. Proposed funding amounts are provided below:

|                           |                     |
|---------------------------|---------------------|
| Municipal State Aid Funds | \$ 2,820,000        |
| Stormwater Fund           | \$ 65,000           |
| Sewer Fund                | \$ 650,000          |
| Water Fund                | \$ 800,000          |
| <b>Total City Funding</b> | <b>\$ 4,335,000</b> |

## 6. SCHEDULE

The proposed project schedule is as follows:

|                                                                        |                   |
|------------------------------------------------------------------------|-------------------|
| Council Orders Feasibility Report                                      | December 10, 2019 |
| Council Accepts Feasibility Report/Authorizes Plans and Specifications | April 14, 2020    |
| Staff Conducts Private Utility Coordination Meeting                    | May 2020          |
| Council Approves Plans and Specifications/Authorizes Ad for Bids       | May 12, 2020      |
| Staff Receives Bids                                                    | June 5, 2020      |
| Council Awards Contract                                                | June 9, 2020      |
| Contractor Begins Construction                                         | June 22, 2020     |
| Contractor Substantially Completes Construction                        | November 2020     |
| Contractor Completes Construction                                      | July 2021         |

## 7. CONCLUSIONS AND RECOMMENDATIONS

City of Ramsey Improvement Project No. 20-01 proposes to reconstruct the bituminous pavement section using the Stabilized Full Depth Reclamation method, replace trunk sanitary sewer, extend trunk watermain, and complete miscellaneous appurtenant work on Variolite Street between Alpine Drive and 173<sup>rd</sup> Avenue.

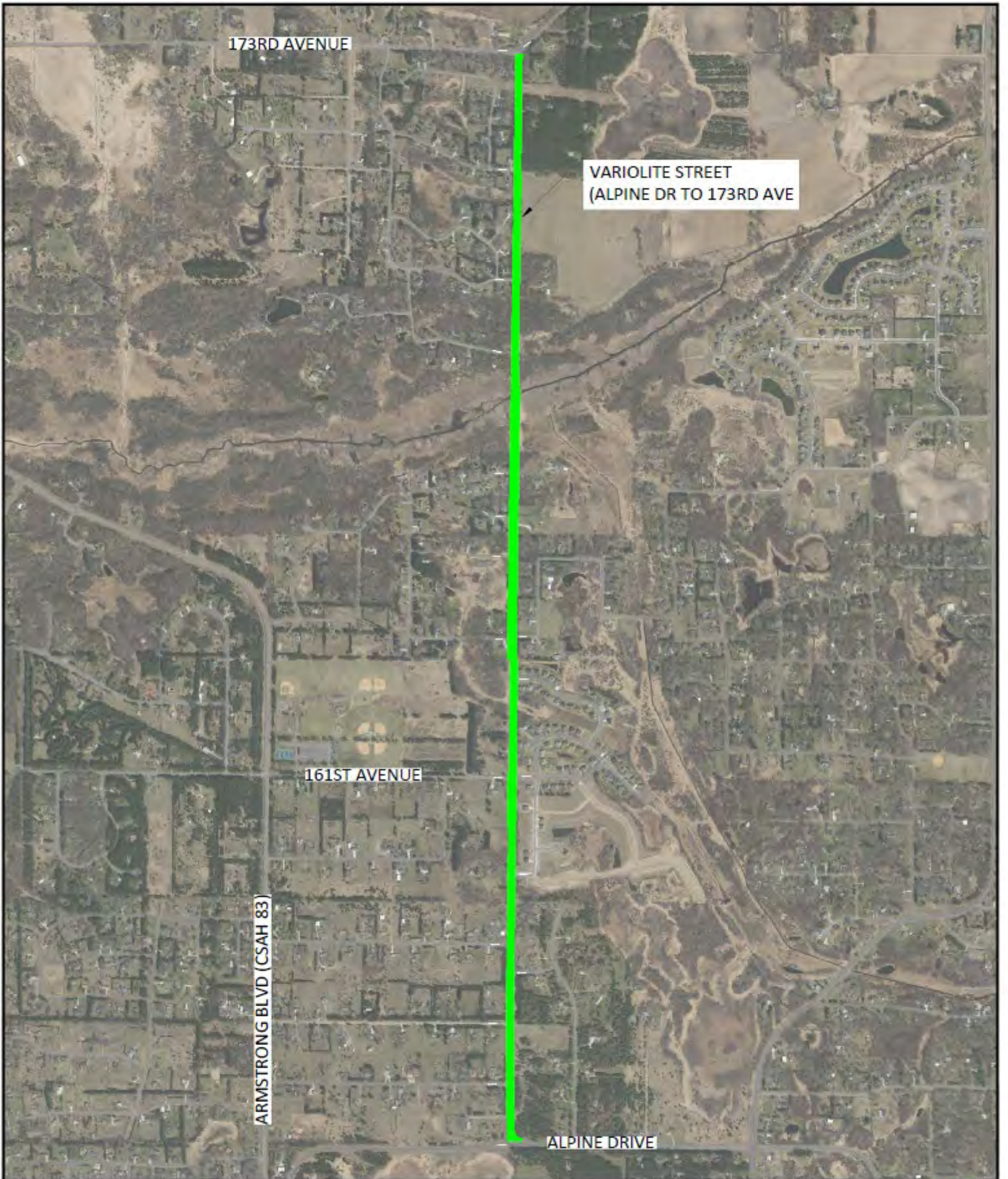
It is the recommendation of City Staff that City Project No. 20-01 is feasible, necessary, and cost-effective from an engineering standpoint, and this project would best be constructed as a stand-alone project as proposed herein.

The following Staff recommendations related to the proposed project are presented for Council consideration and concurrence:

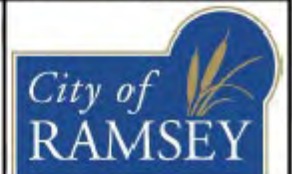
- Staff recommends reconstructing the bituminous pavement section using the Stabilized Full Depth Reclamation method in compliance with MSA design guidelines including 6-inches stabilized full depth reclamation, 2-inches new bituminous base course, and 2-inches new bituminous wear course.
- Staff recommends installing a concrete pedestrian refuge island at the intersection of Variolite Street and 161<sup>st</sup> Avenue, with advanced pedestrian crossing signs, and ADA compliant pedestrian landings.
- Staff recommends reducing the width of Variolite Street from 40-feet (existing) to 34-feet and posting a 40 mph speed limit between Alpine Drive and 163<sup>rd</sup> Avenue to promote traffic calming in conjunction with the 161<sup>st</sup> Avenue pedestrian crosswalk improvements.
- Staff recommends replacing the existing force main trunk sanitary sewer with gravity trunk sanitary sewer between 163<sup>rd</sup> Avenue and 166<sup>th</sup> Avenue, and extending trunk watermain from 166<sup>th</sup> Avenue to 173<sup>rd</sup> Avenue as recommended in the 2040 Comprehensive Plan.

**APPENDIX A**

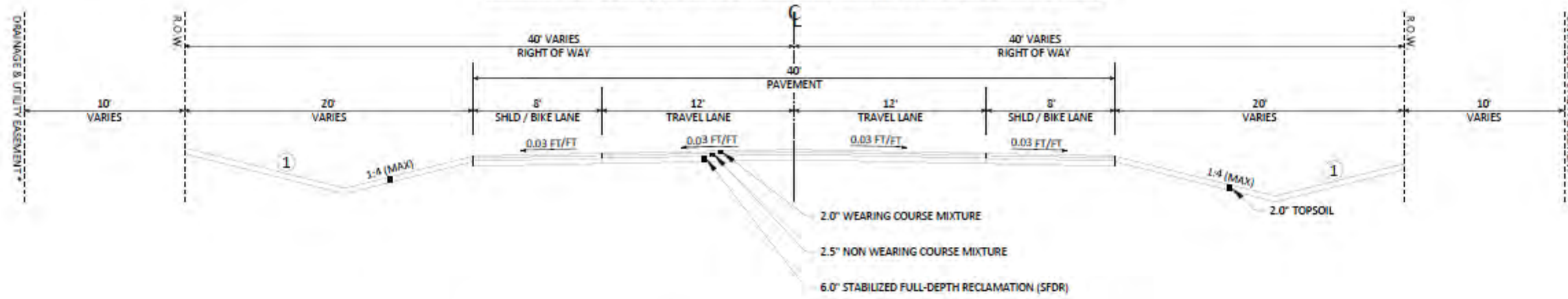
**Project Scope  
Typical Sections  
Project Site Pictures  
161<sup>st</sup> Avenue Pedestrian Crosswalk Improvements**



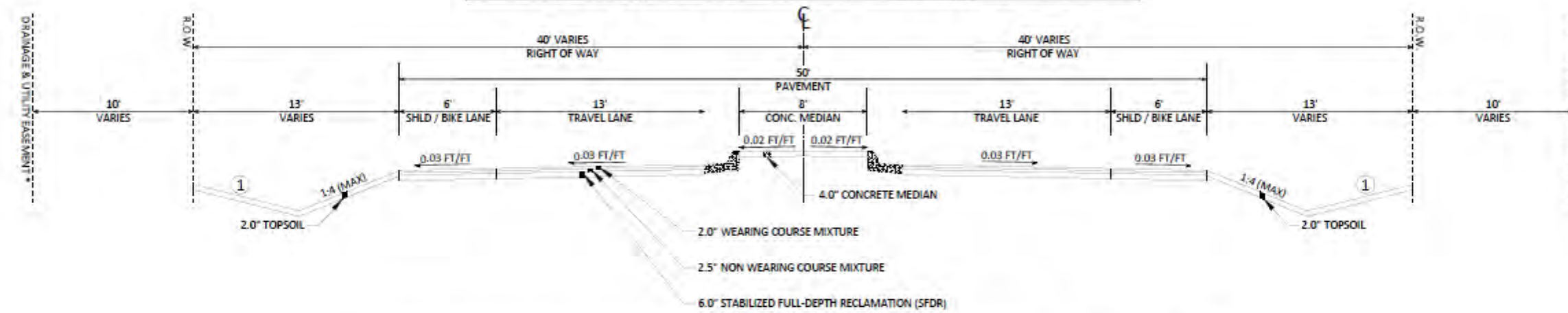
**20-01 VARIOLITE STREET  
RECONSTRUCTION  
PROJECT SCOPE**



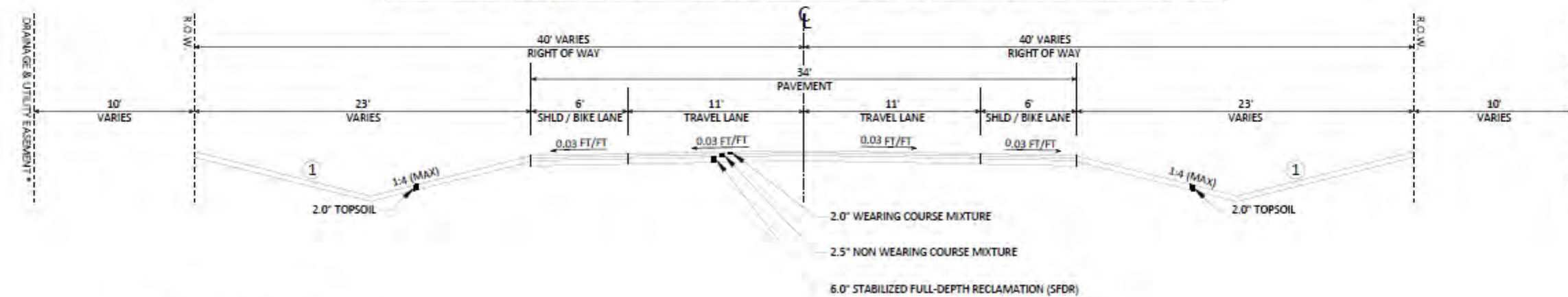
Variolite Street Typical Section Full Width: Sta. 54+60 to 118+74



Variolite Street Typical Section Concrete Median: Sta. 40+17 to 40+44



Variolite Street Typical Section Narrow Width: Sta. 0+16 to 40+17; Sta. 40+44 to 54+60



REFERENCE NOTES:

- ① GRADE TO MATCH EXISTING GROUND. ESTABLISH TURF USING A MINIMUM OF 2" TOPSOIL AND HYDROSEED WITH MNDOT SEED MIXTURE 25-151.
- \* SEVERAL STRETCHES OF VARIOLITE STREET HAVE UN-PLATTED LOTS ADJACENT TO THE ROADWAY, WHICH DO NOT INCLUDE DRAINAGE & UTILITY EASEMENTS. RIGHT-OF-WAY DISTANCE FROM THE GENERAL CENTERLINE OF VARIOLITE STREET VARIES BY SUBDIVISION, THERE ARE 13 SUBDIVISIONS & 5 UN-PLATTED SEGMENTS ALONG VARIOLITE STREET.

| DATE | REVISION |
|------|----------|
|      |          |
|      |          |
|      |          |
|      |          |

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.

JOE PERIANCER  
Date: XX/XX/XX Lic. No. 57095

DESIGNED BY: JIF  
DRAWN BY: JIF  
CHECKED BY: BRW

DATE: XX/XX/XX  
FILE: 20-01



CITY OF RAMSEY  
7550 SUNWOOD DRIVE  
RAMSEY, MN 55303  
(763) 427-1410 FAX (763) 433-9898

TYPICAL SECTIONS  
S.A.P. 199-101-012

VARIOLITE STREET RECONSTRUCTION  
CITY PROJECT NO. 20-01  
CITY OF RAMSEY, MINNESOTA

|        |    |
|--------|----|
| SHEET  | 01 |
| OF     |    |
| SHEETS |    |

**Project Site Pictures**  
Taken November, 2019



P1: Variolite north of Alpine Dr. – facing north



P2: Variolite south of 159<sup>th</sup> Ave – facing north



P3: Variolite south of 161<sup>st</sup> Ave – facing south



P4: Variolite north of 161<sup>st</sup> Ave – facing north



P5: Variolite south of 163<sup>rd</sup> Ave – facing north



P6: Variolite north of 166<sup>th</sup> Ave – facing south



P7: Variolite south of Trott Brook – facing north



P8: Trott Brook Culvert End



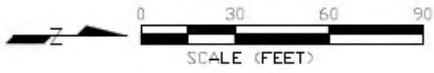
P9: Variolite north of 168<sup>th</sup> (Patch area) – facing north



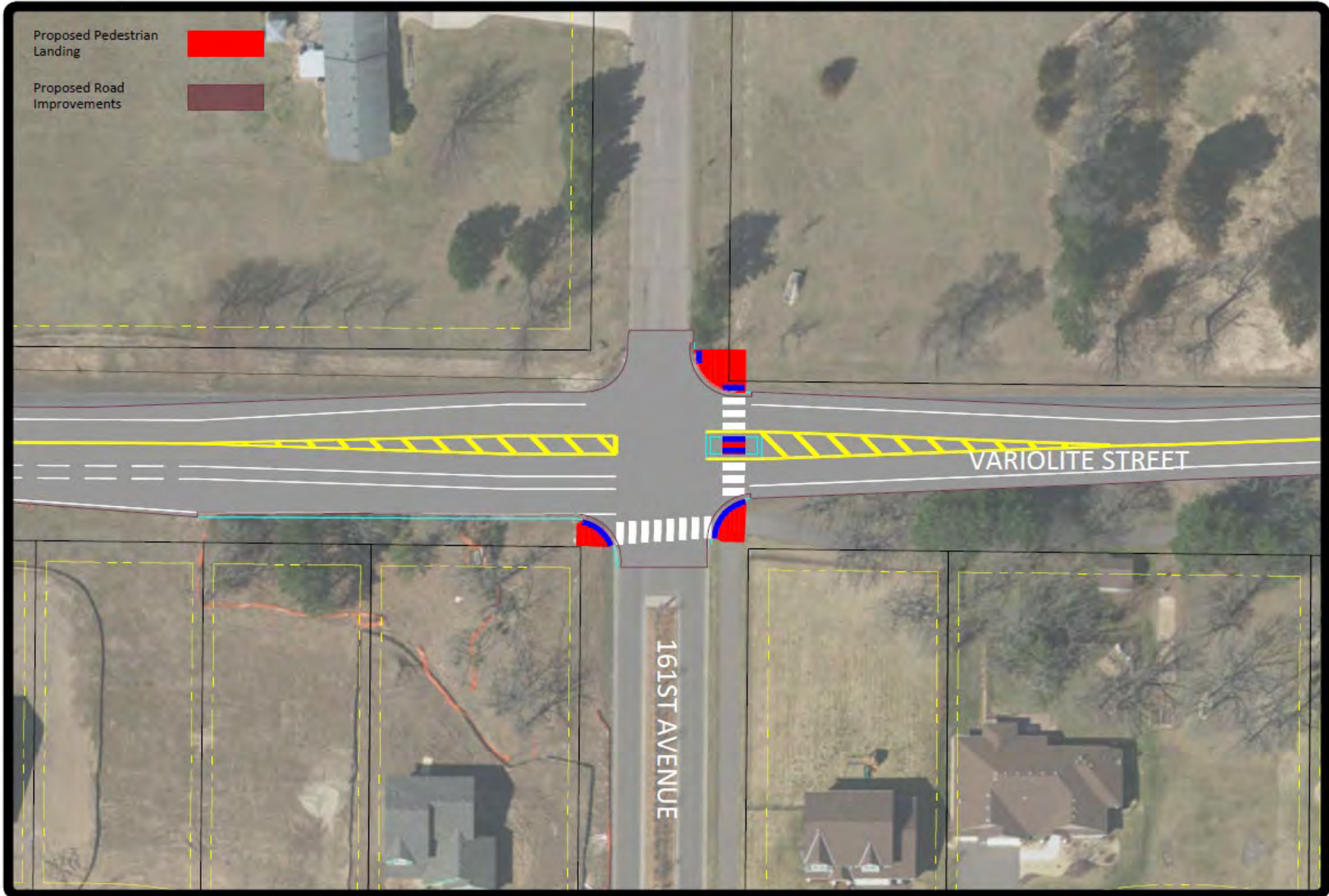
P10: Variolite south of 173<sup>rd</sup> Ave – facing north



P11: Variolite south of 173<sup>rd</sup> Ave – facing south



# VARIOLITE STREET & 161ST AVENUE PEDESTRIAN CROSSING UPDATES



## **APPENDIX B**

### **Opinion of Probable Costs**

20-01 Variolite Street Reconstruction: Preliminary Engineer's Estimate

**Street Improvements**

| Item No.                                            | MnDOT No. | Item Description                                                              | Unit | Quantity | Price        | Extension       |
|-----------------------------------------------------|-----------|-------------------------------------------------------------------------------|------|----------|--------------|-----------------|
| 1                                                   | 2021.501  | Mobilization (5%)                                                             | LS   | 1        | \$ 99,000.00 | \$ 99,000.00    |
| 2                                                   | 2101.502  | Clearing Tree                                                                 | TREE | 4        | \$ 500.00    | \$ 2,000.00     |
| 3                                                   | 2101.507  | Grubbing Tree                                                                 | TREE | 4        | \$ 500.00    | \$ 2,000.00     |
| 4                                                   | 2104.501  | Remove Pipe Culverts                                                          | LF   | 470      | \$ 15.00     | \$ 7,050.00     |
| 5                                                   | 2104.502  | Remove Manhole (Sanitary)                                                     | EA   | 2        | \$ 2,000.00  | \$ 4,000.00     |
| 6                                                   | 2104.503  | Remove Concrete Pavement – Driveway                                           | SF   | 250      | \$ 1.25      | \$ 312.50       |
| 7                                                   | 2104.503  | Remove Pipe (Sanitary)                                                        | LF   | 33       | \$ 20.00     | \$ 660.00       |
| 8                                                   | 2104.505  | Remove Bituminous Pavement – Driveway                                         | SY   | 110      | \$ 5.00      | \$ 550.00       |
| 9                                                   | 2104.505  | Remove Bituminous Pavement – Bituminous Trail                                 | SY   | 600      | \$ 5.00      | \$ 3,000.00     |
| 10                                                  | 2104.505  | Remove Gravel Pavement – Driveway                                             | SY   | 210      | \$ 4.50      | \$ 945.00       |
| 12                                                  | 2104.511  | Sawing Concrete Pavement – Full Depth                                         | LF   | 40       | \$ 5.00      | \$ 200.00       |
| 13                                                  | 2104.513  | Sawing Bituminous Pavement – Full Depth                                       | LF   | 800      | \$ 3.00      | \$ 2,400.00     |
| 14                                                  | 2104.523  | Salvage Mail Box Support                                                      | EA   | 12       | \$ 150.00    | \$ 1,800.00     |
| 15                                                  | 2104.523  | Temporary Mail Box Cluster                                                    | EA   | 4        | \$ 400.00    | \$ 1,600.00     |
| 16                                                  | 2105.501  | Common Excavation (EV)                                                        | CY   | 1,650    | \$ 15.00     | \$ 24,750.00    |
| 19                                                  | 2112.501  | Subgrade Preparation                                                          | RDST | 119      | \$ 300.00    | \$ 35,700.00    |
| 20                                                  | 2118.502  | Aggregate Surfacing, Class V Modified (LV) – Driveways                        | CY   | 30       | \$ 50.00     | \$ 1,500.00     |
| 21                                                  | 2130.501  | Water                                                                         | MGAL | 400      | \$ 50.00     | \$ 20,000.00    |
| 22                                                  | 2211.503  | Aggregate Base Class V Modified (CV)<br>(Recycled FDR Acceptable)             | CY   | 3,120    | \$ 20.00     | \$ 62,400.00    |
| 23                                                  | 2215.501  | Stabilized Full Depth Reclamation                                             | SY   | 38,352   | \$ 2.75      | \$ 105,468.00   |
| 24                                                  | 2215.501  | Bituminous Pavement Reclamation – Full Depth                                  | SY   | 18,846   | \$ 1.25      | \$ 23,557.50    |
| 25                                                  | 2232.501  | Mill Bituminous Pavement                                                      | SY   | 160      | \$ 10.00     | \$ 1,600.00     |
| 26                                                  | 2331.607  | Haul Bit Pavement Reclamation (LV)                                            | CY   | 1,600    | \$ 12.00     | \$ 19,200.00    |
| 27                                                  | 2331.609  | Bituminous Material for Mixture (Assume 4%)                                   | TON  | 500      | \$ 600.00    | \$ 300,000.00   |
| 28                                                  | 2357.502  | Bituminous Material for Tack Coat                                             | GAL  | 3,733    | \$ 3.75      | \$ 13,998.75    |
| 29                                                  | 2360.501  | Type SP 9.5 Wearing Course Mixture (SPWEA340C) (2.0")                         | TON  | 6,160    | \$ 90.00     | \$ 554,400.00   |
| 30                                                  | 2360.501  | Type SP 9.5 Wearing Course Mixture (SPWEA340C) (2.0")<br>Driveways            | TON  | 15       | \$ 150.00    | \$ 2,250.00     |
| 31                                                  | 2360.501  | Type SP 9.5 Wearing Course Mixture (SPWEA340C) (2.5")<br>10' Bituminous Trail | TON  | 45       | \$ 120.00    | \$ 5,400.00     |
| 32                                                  | 2360.502  | Type 12.5 Non Wearing Course Mixture (SPNWB330C) (2.0")                       | TON  | 6,450    | \$ 85.00     | \$ 548,250.00   |
| 33                                                  | 2411.604  | Modular Block Retaining Wall                                                  | SY   | 30       | \$ 150.00    | \$ 4,500.00     |
| 57                                                  | 2521.501  | 6" Concrete Walk                                                              | SF   | 1,331    | \$ 16.00     | \$ 21,296.00    |
| 58                                                  | 2531.501  | Concrete Curb & Gutter Design B418                                            | LF   | 550      | \$ 30.00     | \$ 16,500.00    |
| 59                                                  | 2531.507  | 6" Concrete Driveway Pavement                                                 | SF   | 250      | \$ 13.50     | \$ 3,375.00     |
| 60                                                  | 2531.607  | Concrete Bullnose                                                             | SF   | 37       | \$ 10.00     | \$ 370.00       |
| 62                                                  | 2531.618  | Truncated Domes                                                               | SF   | 208      | \$ 50.00     | \$ 10,400.00    |
| 63                                                  | 2540.601  | Landscape Restoration                                                         | LS   | 1        | \$ 10,000.00 | \$ 10,000.00    |
| 64                                                  | 2540.602  | Install Mail Box Support                                                      | EA   | 12       | \$ 75.00     | \$ 900.00       |
| 65                                                  | 2563.601  | Traffic Control                                                               | LS   | 1        | \$ 20,000.00 | \$ 20,000.00    |
| 66                                                  | 2573.502  | Silt Fence, Type MS                                                           | LF   | 13,000   | \$ 2.50      | \$ 32,500.00    |
| 67                                                  | 2573.530  | Storm Drain Inlet Protection                                                  | EA   | 5        | \$ 200.00    | \$ 1,000.00     |
| 68                                                  | 2573.533  | Sediment Control Log Type Straw                                               | LF   | 2,600    | \$ 3.00      | \$ 7,800.00     |
| 69                                                  | 2574.508  | Fertilizer Type 3                                                             | LBS  | 500      | \$ 1.25      | \$ 625.00       |
| 70                                                  | 2574.525  | Topsoil (LV)                                                                  | CY   | 1,650    | \$ 30.00     | \$ 49,500.00    |
| 71                                                  | 2575.501  | Hydroseeding                                                                  | ACRE | 4.88     | \$ 5,000.00  | \$ 24,400.00    |
| 72                                                  | 2575.502  | Seed Mixture 25-151                                                           | LBS  | 600      | \$ 3.50      | \$ 2,100.00     |
| 73                                                  | 2575.505  | Sodding Type Lawn                                                             | SY   | 100      | \$ 7.00      | \$ 700.00       |
| 74                                                  | 2575.562  | Hydraulic Matrix Type Mulch                                                   | LBS  | 10,000   | \$ 1.00      | \$ 10,000.00    |
| 75                                                  | 2582.502  | 24" Solid Line Yellow – Epoxy                                                 | LF   | 200      | \$ 10.00     | \$ 2,000.00     |
| 76                                                  | 2582.502  | 4" Double Solid Line Yellow – Epoxy                                           | LF   | 4,170    | \$ 0.75      | \$ 3,127.50     |
| 77                                                  | 2582.502  | 4" Solid Line White – Epoxy                                                   | LF   | 24,025   | \$ 0.50      | \$ 12,012.50    |
| 78                                                  | 2582.502  | 4" Broken Line Yellow – Epoxy                                                 | LF   | 1,600    | \$ 0.50      | \$ 800.00       |
| 79                                                  | 2582.502  | 4" Broken Line White – Epoxy                                                  | LF   | 300      | \$ 0.50      | \$ 150.00       |
| 80                                                  | 2582.503  | Crosswalk Markings – Epoxy                                                    | SF   | 534      | \$ 8.00      | \$ 4,272.00     |
| 81                                                  | 2582.602  | PAVT MSSG (RT Arrow) – Epoxy                                                  | EA   | 6        | \$ 150.00    | \$ 900.00       |
| 82                                                  | 2582.602  | PAVT Marking (Handicap Symbol) – Epoxy                                        | EA   | 1        | \$ 200.00    | \$ 200.00       |
| <i>20-01 Street Improvements Construction Costs</i> |           |                                                                               |      |          |              | \$ 2,083,419.75 |
| <i>10% Contingency Costs</i>                        |           |                                                                               |      |          |              | \$ 208,341.98   |
| <i>23% Indirect Costs</i>                           |           |                                                                               |      |          |              | \$ 527,105.20   |
| <i>20-01 Street Improvements Project Costs</i>      |           |                                                                               |      |          |              | \$ 2,818,866.92 |

## Storm Sewer Improvements

| Item No.                                    | MnDOT No. | Item Description             | Unit | Quantity | Price       | Extension    |
|---------------------------------------------|-----------|------------------------------|------|----------|-------------|--------------|
| 1                                           | 2021.501  | Mobilization (5%)            | LS   | 1        | \$ 2,000.00 | \$ 2,000.00  |
| 34                                          | 2501.511  | 18" CS Pipe Culvert          | LF   | 458      | \$ 50.00    | \$ 22,900.00 |
| 35                                          | 2501.515  | 18" CS Pipe Apron            | EA   | 18       | \$ 650.00   | \$ 11,700.00 |
| 36                                          | 2502.502  | 4" Precast Concrete Headwall | EA   | 4        | \$ 250.00   | \$ 1,000.00  |
| 37                                          | 2502.541  | 4" Perf. Pipe Drain          | LF   | 440      | \$ 15.00    | \$ 6,600.00  |
| 56                                          | 2506.602  | Reset Catch Basin Casting    | EA   | 3        | \$ 1,000.00 | \$ 3,000.00  |
| 61                                          | 2531.604  | Concrete Spillway            | SF   | 33       | \$ 10.00    | \$ 330.00    |
| <i>20-01 Storm Sewer Construction Costs</i> |           |                              |      |          |             | \$ 47,530.00 |
| <i>10% Contingency Costs</i>                |           |                              |      |          |             | \$ 4,753.00  |
| <i>23% Indirect Costs</i>                   |           |                              |      |          |             | \$ 12,025.09 |
| <i>20-01 Storm Sewer Project Costs</i>      |           |                              |      |          |             | \$ 64,308.09 |

## Shared Watermain & Sanitary Sewer Utility Installation

| Item No.                                                                                   | MnDOT No. | Item Description                                     | Unit | Quantity | Price         | Extension     |
|--------------------------------------------------------------------------------------------|-----------|------------------------------------------------------|------|----------|---------------|---------------|
| 1                                                                                          | 2021.501  | Mobilization (5%)                                    | LS   | 1        | \$ 17,000.00  | \$ 17,000.00  |
| 11                                                                                         | 2104.507  | Subgrade Excavation, Remove Unsuitable Material (EV) | CY   | 7,800    | \$ 12.00      | \$ 93,600.00  |
| 17                                                                                         | 2105.522  | Select Granular Borrow (CV)                          | CY   | 9,125    | \$ 15.00      | \$ 136,875.00 |
| 18                                                                                         | 2105.601  | Dewatering                                           | LS   | 1        | \$ 100,000.00 | \$ 100,000.00 |
| <i>20-01 Shared Watermain &amp; Sanitary Sewer Utility Installation Construction Costs</i> |           |                                                      |      |          |               | \$ 347,475.00 |
| <i>10% Contingency Costs</i>                                                               |           |                                                      |      |          |               | \$ 34,747.50  |
| <i>23% Indirect Costs</i>                                                                  |           |                                                      |      |          |               | \$ 87,911.18  |
| <i>20-01 Shared Watermain &amp; Sanitary Sewer Utility Installation Project Costs</i>      |           |                                                      |      |          |               | \$ 470,133.68 |

## Sanitary Sewer

| Item No.                                       | MnDOT No. | Item Description                                       | Unit | Quantity | Price        | Extension     |
|------------------------------------------------|-----------|--------------------------------------------------------|------|----------|--------------|---------------|
| 1                                              | 2021.501  | Mobilization (5%)                                      | LS   | 1        | \$ 15,000.00 | \$ 15,000.00  |
| 38                                             | 2503.511  | 21" PVC Pipe Sewer (SDR 26)                            | LF   | 2,270    | \$ 75.00     | \$ 170,250.00 |
| 39                                             | 2503.602  | Connect to Existing Sanitary Sewer                     | EA   | 2        | \$ 2,500.00  | \$ 5,000.00   |
| 40                                             | 2503.603  | Clean and Video Tape Pipe Sewer (Sanitary)             | LF   | 2,270    | \$ 1.50      | \$ 3,405.00   |
| 41                                             | 2503.603  | Plug Fill and Abandon Pipe Sewer (Sanitary Force Main) | LF   | 2,275    | \$ 35.00     | \$ 79,625.00  |
| 53                                             | 2506.501  | Construct Sanitary Structure Design 48-4007            | LF   | 122.2    | \$ 200.00    | \$ 24,440.00  |
| 54                                             | 2506.516  | Furnish & Install Casting Assembly (Sanitary)          | EA   | 7        | \$ 750.00    | \$ 5,250.00   |
| 55                                             | 2506.521  | Adjust Frame and Ring Casting                          | EA   | 9        | \$ 250.00    | \$ 2,250.00   |
| <i>20-01 Sanitary Sewer Construction Costs</i> |           |                                                        |      |          |              | \$ 305,220.00 |
| <i>10% Contingency Costs</i>                   |           |                                                        |      |          |              | \$ 30,522.00  |
| <i>23% Indirect Costs</i>                      |           |                                                        |      |          |              | \$ 77,220.66  |
| <i>20-01 Sanitary Sewer Project Costs</i>      |           |                                                        |      |          |              | \$ 412,962.66 |

## Watermain

| Item No.                                  | MnDOT No. | Item Description                     | Unit | Quantity | Price        | Extension     |
|-------------------------------------------|-----------|--------------------------------------|------|----------|--------------|---------------|
| 1                                         | 2021.501  | Mobilization (5%)                    | LS   | 1        | \$ 20,000.00 | \$ 20,000.00  |
| 42                                        | 2504.602  | Adjust Valve Box                     | EA   | 24       | \$ 250.00    | \$ 6,000.00   |
| 43                                        | 2504.602  | Furnish & Install Hydrant            | EA   | 6        | \$ 4,000.00  | \$ 24,000.00  |
| 44                                        | 2504.602  | 6" Gate Valve & Box                  | EA   | 5        | \$ 2,000.00  | \$ 10,000.00  |
| 45                                        | 2504.602  | 8" Gate Valve & Box                  | EA   | 1        | \$ 4,000.00  | \$ 4,000.00   |
| 46                                        | 2504.602  | 12" Gate Valve & Box                 | EA   | 8        | \$ 5,000.00  | \$ 40,000.00  |
| 47                                        | 2504.602  | Connect to Existing Watermain        | EA   | 1        | \$ 2,000.00  | \$ 2,000.00   |
| 48                                        | 2504.603  | 6" Watermain Ductile Iron Class 53   | LF   | 100      | \$ 50.00     | \$ 5,000.00   |
| 49                                        | 2504.603  | 8" Watermain Ductile Iron Class 52   | LF   | 20       | \$ 55.00     | \$ 1,100.00   |
| 50                                        | 2504.603  | 12" Watermain Ductile Iron Class 52  | LF   | 4,577    | \$ 60.00     | \$ 274,620.00 |
| 51                                        | 2504.603  | 20" Steel Casing (Directional Drill) | LF   | 100      | \$ 200.00    | \$ 20,000.00  |
| 52                                        | 2504.608  | Ductile Iron Fittings                | LBS  | 1,280    | \$ 10.00     | \$ 12,800.00  |
| <i>20-01 Watermain Construction Costs</i> |           |                                      |      |          |              | \$ 419,520.00 |
| <i>10% Contingency Costs</i>              |           |                                      |      |          |              | \$ 41,952.00  |
| <i>23% Indirect Costs</i>                 |           |                                      |      |          |              | \$ 106,138.56 |
| <i>20-01 Watermain Project Costs</i>      |           |                                      |      |          |              | \$ 567,610.56 |

## 20-01 Variolite Street Preliminary Estimate Summary

|                             |                           |                        |
|-----------------------------|---------------------------|------------------------|
| Street Improvements         | <i>Construction Costs</i> | \$ 2,083,419.75        |
|                             | <i>Project Costs</i>      | \$ 2,818,866.92        |
| Storm Sewer Improvements    | <i>Construction Costs</i> | \$ 47,530.00           |
|                             | <i>Project Costs</i>      | \$ 64,308.09           |
| Sanitary Sewer Improvements | <i>Construction Costs</i> | \$ 478,957.50          |
|                             | <i>Project Costs</i>      | \$ 648,029.50          |
| Watermain Improvements      | <i>Construction Costs</i> | \$ 593,257.50          |
|                             | <i>Project Costs</i>      | \$ 802,677.40          |
| <hr/>                       |                           |                        |
| <b>Project Total</b>        | <b>Construction Costs</b> | <b>\$ 3,203,167.75</b> |
|                             | <b>Project Costs</b>      | <b>\$ 4,333,881.91</b> |

**APPENDIX C**

**Street Segment Summary  
Ground Penetrating Radar Summary**

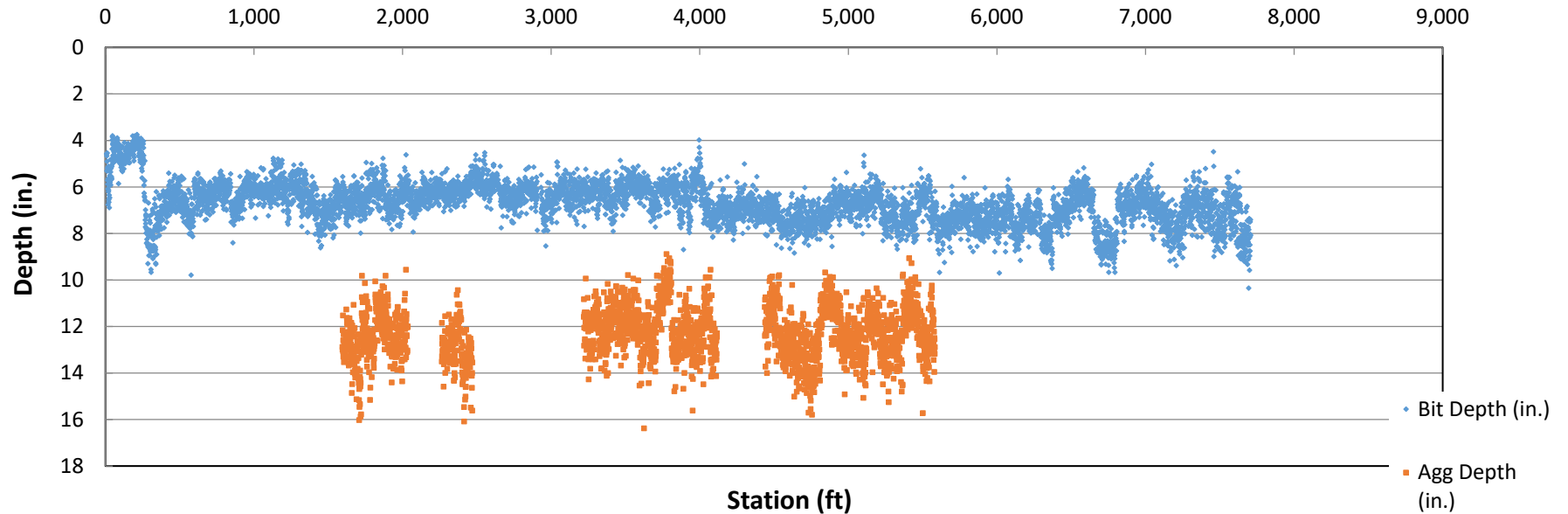
20-01 Variolite Street (Alpine Drive to 173<sup>rd</sup> Avenue)  
Street Segment Summary

| <b>Street</b>               | <b>Segment Description</b>                                                            | <b>Length<br/>(miles)</b> | <b>Width</b>      | <b>Curb</b> | <b>2018<br/>PASER<br/>Rating</b> | <b>Year<br/>Built</b> | <b>Maint.<br/>1</b> | <b>Maint.<br/>2</b> | <b>Maint.<br/>3</b> |
|-----------------------------|---------------------------------------------------------------------------------------|---------------------------|-------------------|-------------|----------------------------------|-----------------------|---------------------|---------------------|---------------------|
| Variolite Street            | Alpine Drive to 161 <sup>st</sup> Avenue                                              | 3,993                     | 40                | n/a         | 4                                | 1983                  | SC 1<br>1988        | OL<br>1998          | SC 2<br>2008        |
| Variolite Street            | 161st Ave to 458 feet South of<br>166 <sup>th</sup> Ave                               | 2,969                     | 40                | n/a         | 4                                | 1981                  | SC 1<br>1988        | OL<br>1998          | SC 2<br>2008        |
| Variolite Street            | 458 feet South of 166 <sup>th</sup> Ave to<br>302 feet North of 166 <sup>th</sup> Ave | 760                       | 40                | n/a         | 4                                | 1981                  | SC 1<br>1988        | OL<br>1998          | SC 2<br>2008        |
| Variolite Street            | 302 feet North of 166 <sup>th</sup> Ave to<br>173 <sup>rd</sup> Ave                   | 4,312                     | 40                | n/a         | 4                                | 1981                  | SC 1<br>1988        | OL<br>1998          | SC 2<br>2008        |
| <i>Total Project Length</i> |                                                                                       | <i>12,034</i>             | <i>2.28 miles</i> |             |                                  |                       |                     |                     |                     |

20-01 Variolite Street (Alpine Drive to 173<sup>rd</sup> Avenue)  
Ground Penetrating Radar (GPR) Summary

|                                             |                                                                                    | Pavement<br>(inches) |             |            | Aggregate<br>(inches) |            |            | Section<br>(inches) |            |                                           |
|---------------------------------------------|------------------------------------------------------------------------------------|----------------------|-------------|------------|-----------------------|------------|------------|---------------------|------------|-------------------------------------------|
| Street                                      | Segment Description                                                                | Min                  | Max         | Average    | Min                   | Max        | Average    | Average             | Min        | Location                                  |
| Variolite Street                            | Alpine Drive to 161 <sup>st</sup> Avenue                                           | 3.8                  | 9.8         | 6.3        | 3.1                   | 9.6        | 6.0        | 12.3                | 8.9        |                                           |
| Variolite Street                            | 161 <sup>st</sup> Ave to 458 feet South of 166 <sup>th</sup> Ave                   | 4.0                  | 9.7         | 7.1        | 2.6                   | 9.1        | 5.4        | 12.5                | 9.1        |                                           |
| Variolite Street                            | 458 feet South of 166 <sup>th</sup> Ave to 302 feet North of 166 <sup>th</sup> Ave | 4.5                  | 9.7         | 7.2        | *                     | *          | *          | *                   | *          | *                                         |
| Variolite Street                            | 302 feet North of 166 <sup>th</sup> Ave to 173 <sup>rd</sup> Ave                   | 4.3                  | 12.9        | 7.1        | 2.3                   | 9.3        | 5.4        | 12.5                | 8.5        | 150 ft. S. of 171 <sup>st</sup> Ave       |
| * GPR Data for aggregate base not available |                                                                                    |                      |             |            |                       |            |            |                     |            |                                           |
| <b>Project Summary</b>                      |                                                                                    | <b>3.8</b>           | <b>12.9</b> | <b>6.8</b> | <b>2.3</b>            | <b>9.6</b> | <b>5.6</b> | <b>12.4</b>         | <b>8.5</b> | <b>150 ft. S. of 171<sup>st</sup> Ave</b> |

**GPR Results: Variolite Street (Alpine Drive to 173rd Avenue)**



**APPENDIX D**

**Geotechnical Report (NTI)  
Drain Tile Design Recommendations (Braun)  
Forensics Report (WSB)**



**NTI**<sup>™</sup>  
NORTHERN  
TECHNOLOGIES, LLC

6160 Carmen Avenue East  
Inver Grove Heights, MN 55076  
P: 651.389.4191 F: 651.389.4190

www.NTIgeo.com

Unearthing confidence<sup>™</sup>

October 11, 2019

City of Ramsey  
Attention: Mr. Joe Feriancek  
7550 Sunwood Drive Northwest  
Ramsey, Minnesota 55303

Subject: Geotechnical Exploration and Engineering Review  
**20-01 Variolite Street Reconstruction**  
Ramsey, Minnesota  
NTI Project No. 19.MSP09109.000

Northern Technologies, LLC (NTI) has completed a total of sixty-one (61) soil borings for the project area located in the city of Ramsey, Minnesota. The project includes the reconstruction of approximately 2.25 miles of roadway along Variolite Street Northwest and 161<sup>st</sup> Avenue Northwest. Our services were performed in accordance with our proposal dated August 19, 2019.

Soil samples obtained at the site will be held for 60 days at which time they will be discarded. Please advise us in writing if you wish to have us retain them for a longer period. You will be assessed an additional fee if soil samples are retained beyond 60 days.

We appreciate the opportunity to have been of service on this project. If there are any questions regarding the soils explored or our review and recommendations, please contact us at your convenience at (651) 389-4191.

**Northern Technologies, LLC**

Debra A. Schroeder, P.E.  
Senior Engineer

Richard S. Jett, E.I.T.  
Staff Engineer

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.

Debra A. Schroeder

Date: 10/11/2019 Reg. No. 52743

DAS/rsj

Precision · Expertise · Geotechnical · Materials

FARGO

BISMARCK

GRAND FORKS

INVER GROVE HEIGHTS

RAMSEY

RAPID CITY



## SCOPE OF SERVICES

Sixty-one (61) borings were performed for the project. The scope of services included determining existing bituminous and aggregate base thicknesses, groundwater levels, subsurface conditions, and providing recommendations for site preparation, excavations, engineered fill and compaction, depths of unsuitable soils to be removed, groundwater management, potential difficulties during construction, utility construction, and estimated soil support parameters (R-values) for pavement design.

## PROJECT AND SITE DESCRIPTION

The street improvements include reconstruction of existing bituminous streets and the installation of public utilities. The project area includes approximately 2.25 miles of roadway along Variolite Street Northwest and 161st Avenue Northwest in Ramsey, Minnesota.

NTI was not aware of invert elevations or other design details of the proposed utilities at the time this report was prepared.

## SUBSURFACE EXPLORATION SUMMARY

NTI performed the subsurface exploration program during the period of September 23 through 26, 2019 with two-person crews using a truck-mounted CME-55 drill rig and an ATV-mounted CME-750 drill rig. Samples were generally collected in accordance with ASTM D 1586 "Standard Test Method for Standard Penetration Testing (SPT) and Split-Barrel Sampling of Soils." Pavement cores were obtained at each boring location.

The boring locations and depths were determined by a representative of the City of Ramsey and were marked in the field by NTI. The borings terminated at depths ranging from approximately 10.5 to 18.5 feet below the top of pavement. Due to soft / very loose soil conditions at the termination depth of Borings SB-9, SB-15, and SB-39, these borings were extended to depths ranging from approximately 13.0 to 18.5 feet below the top of pavement.

NTI located the borings relative to existing site features and subsequent to drilling operations determined the approximate elevation, latitude and longitude of the borings using a handheld Trimble GeoXH 6000 GPS unit (Anoka County datum). Boring elevations, latitude, and longitude should be considered to be approximate.

Please refer to the Boring Location Diagrams and the Boring Logs in Appendix C, and the Pavement Core Photographs in Appendix D.



### Variolite Street Northwest – Borings SB-1 through SB-57

Bituminous pavement thickness within this area ranged from approximately 1.5 to 8.0 inches at the boring locations. Apparent aggregate base thickness ranged from approximately 3.0 to 24.0 inches. As an exception, apparent aggregate base was not observed at the Boring SB-17 location. Apparent previously-placed fill soils generally consisting of poorly graded sand (SP), poorly graded sand with silt (SP-SM), silty sand (SM), and sandy lean clay (CL) were encountered to depths ranging from approximately 2.0 to 7.0 feet below the top of pavement. As exceptions, apparent previously placed fill was not observed at Boring SB-38 and Boring SB-5 terminated in fill materials at a depth of approximately 10.5 feet below the top of pavement. Organic materials and bituminous pieces were occasionally encountered within the fill materials.

Native glacial deposit soils consisting of poorly graded sand to poorly graded sand with gravel (SP), poorly graded sand with silt to poorly graded sand with silt with gravel (SP-SM), silty sand (SM), and clayey sand (SC) were observed extending to the boring termination depths.

Swamp deposit soils were observed at Borings SB-23, SB-24, SB-35, SB-37, SB-39 through SB-44, and SB-46 through SB-49 consisting of silty sand (SM), poorly graded sand (SP), poorly graded sand with silt (SP-SM), sandy silt (ML), and peat (Pt). Organic contents of selected samples ranged from 2.1 to 53.7 percent with moisture contents ranging from 26 to 236 percent.

Groundwater was observed in thirty-five of the fifty-seven (57) boreholes at the time of drilling. The groundwater depths ranged from approximately 2.5 to 11.5 feet below the top of pavement. The lack of observed groundwater in the remaining boring is likely due to the short duration for which the borehole remained open combined with the varying site elevations. In addition, the on-site silt laden soils have the potential to be somewhat impervious and conducive to the development of zones of perched water at varying elevations and locations across the project area. Please refer to the boring log included in the appendices.

Tables 1A and 1B summarizes the encountered subsurface conditions for Variolite Street Northwest.



**Table 1A: Pavement and Subgrade Summary<sup>1</sup>**  
**Variolite Street Northwest**

| Boring No.         | Bituminous Pavement Thickness <sup>2</sup> (inches) | Apparent Aggregate Base Thickness <sup>3</sup> (inches) | Fill Subgrade Material <sup>4</sup> | Native Subgrade Material |
|--------------------|-----------------------------------------------------|---------------------------------------------------------|-------------------------------------|--------------------------|
| SB-1               | 4.5                                                 | 5.0                                                     | SP-SM, SM                           | SP                       |
| SB-2               | 6.0                                                 | 5.0                                                     | SP-SM                               | SP-SM                    |
| SB-3               | 6.0                                                 | 4.0                                                     | SM                                  | SP                       |
| SB-4               | 6.0                                                 | 5.0                                                     | SP-SM                               | SP                       |
| SB-5               | 5.5                                                 | 5.0                                                     | SP-SM, SM                           | None Observed            |
| SB-6               | 5.5                                                 | 4.0                                                     | SP-SM                               | SP                       |
| SB-7               | 7.0                                                 | 3.0                                                     | SP, SM                              | SP                       |
| SB-8               | 5.5                                                 | 4.5                                                     | SP-SM                               | SP                       |
| SB-9 <sup>5</sup>  | 6.0                                                 | 3.5                                                     | SP-SM, SP                           | SP                       |
| SB-10              | 5.5                                                 | 5.0                                                     | SP-SM, SP                           | SP-SM                    |
| SB-11              | 6.5                                                 | 4.5                                                     | SP-SM                               | SP                       |
| SB-12              | 7.0                                                 | 18.0                                                    | SP-SM                               | SP                       |
| SB-13              | 7.0                                                 | 6.0                                                     | SP-SM, SM                           | SP                       |
| SB-14 <sup>5</sup> | 2.0                                                 | 6.0                                                     | SP, SM                              | SP, SC                   |
| SB-15              | 6.0                                                 | 5.0                                                     | SP-SM                               | SP-SM, SP                |
| SB-16              | 6.5                                                 | 4.0                                                     | SP-SM                               | SP-SM, SP                |
| SB-17              | 7.0                                                 | None Observed                                           | SP-SM                               | SM SP-SM, SP             |
| SB-18              | 7.5                                                 | 3.0                                                     | SP-SM, SM                           | SP, SM                   |
| SB-19 <sup>5</sup> | 5.0                                                 | 4.0                                                     | SP-SM, SM                           | SP                       |
| SB-20              | 7.0                                                 | 10.0                                                    | SM                                  | SP-SM, SP                |
| SB-21              | 6.0                                                 | 4.0                                                     | SP-SM, SM                           | SP                       |
| SB-22              | 7.0                                                 | 4.0                                                     | SP-SM                               | SM, SP                   |
| SB-23              | 6.0                                                 | 5.0                                                     | SP, SM                              | SP-SM, SP                |
| SB-24              | 6.5                                                 | 10.0                                                    | SP                                  | SM, SP                   |
| SB-25              | 7.0                                                 | 5.0                                                     | SP-SM, SM                           | SP-SM                    |
| SB-26              | 7.5                                                 | 4.0                                                     | SP-SM, SM                           | SP                       |
| SB-27 <sup>5</sup> | 4.0                                                 | 3.5                                                     | SP-SM, SM                           | SM, SP-SM                |
| SB-28              | 7.0                                                 | 16.0                                                    | SM                                  | SP-SM, SP                |
| SB-29              | 7.0                                                 | 4.0                                                     | SP-SM, SP                           | SP, SM                   |
| SB-30              | 4.0                                                 | 4.0                                                     | SM, SP                              | SP                       |
| SB-31 <sup>5</sup> | 6.0                                                 | 5.0                                                     | SP-SM                               | SM, SP                   |
| SB-32              | 8.0                                                 | 24.0                                                    | SP                                  | SP, SM                   |
| SB-33              | 5.5                                                 | 6.0                                                     | SM, SP                              | CL, SM                   |

1. Table summary is a generalization of subsurface conditions at the individual soil boring locations only. They may not reflect variations in subsurface strata occurring on site between boring locations. The general geologic origin of retained soil samples is listed on the boring logs.
2. Measured thickness of the pavement core.
3. Apparent aggregate base thickness, at time of our fieldwork, by visual inspection only. The classification is not meant to confer conformance with DOT specifications.
4. Undocumented fill soils.
5. Pavement core thickness may not be representative due to crumbling during coring process.



**Table 1B: Pavement and Subgrade Summary<sup>1</sup>**  
**Variolite Street Northwest**

| Boring No.         | Bituminous Pavement Thickness <sup>2</sup> (inches) | Apparent Aggregate Base Thickness <sup>3</sup> (inches) | Fill Subgrade Material <sup>4</sup> | Native Subgrade Material |
|--------------------|-----------------------------------------------------|---------------------------------------------------------|-------------------------------------|--------------------------|
| SB-34 <sup>5</sup> | 1.5                                                 | 20.0                                                    | SM                                  | SM                       |
| SB-35 <sup>5</sup> | 7.5                                                 | 5.0                                                     | SM, SP                              | SM                       |
| SB-36              | 4.5                                                 | 3.0                                                     | SP-SM                               | SP, SM                   |
| SB-37              | 4.0                                                 | 4.0                                                     | SP-SM                               | SP, SP-SM                |
| SB-38              | 4.0                                                 | 18.0                                                    | None Observed                       | SP, SM                   |
| SB-39 <sup>5</sup> | 5.5                                                 | 5.0                                                     | SM                                  | SP-SM, SM, ML, Pt        |
| SB-40 <sup>5</sup> | 4.0                                                 | 10.0                                                    | SP-SM, SM                           | SP-SM                    |
| SB-41              | 6.0                                                 | 5.0                                                     | SP-SM                               | SP, SM, SP-SM            |
| SB-42              | 3.5                                                 | 4.0                                                     | SM                                  | SP-SM, ML                |
| SB-43 <sup>5</sup> | 3.0                                                 | 6.5                                                     | SP-SM                               | SP-SM, ML                |
| SB-44 <sup>5</sup> | 6.5                                                 | 6.0                                                     | SM                                  | SM, Pt                   |
| SB-45              | 6.5                                                 | 6.5                                                     | SM                                  | SP                       |
| SB-46              | 6.5                                                 | 7.0                                                     | SM                                  | SP-SM, SP                |
| SB-47              | 5.0                                                 | 3.0                                                     | SM                                  | SM, SP                   |
| SB-48              | 7.5                                                 | 7.0                                                     | SM                                  | SP                       |
| SB-49              | 3.0                                                 | 4.0                                                     | SP-SM                               | SM, ML                   |
| SB-50 <sup>5</sup> | 6.0                                                 | 8.0                                                     | SM                                  | SP, SC                   |
| SB-51              | 6.0                                                 | 4.5                                                     | SP-SM, SM                           | SP                       |
| SB-52              | 5.5                                                 | 5.0                                                     | SP, SM, SP-SM, CL                   | SP, SP-SM                |
| SB-53              | 7.0                                                 | 7.0                                                     | SP-SM                               | SP                       |
| SB-54              | 6.5                                                 | 6.0                                                     | SP-SM                               | SP                       |
| SB-55              | 6.5                                                 | 8.0                                                     | SP-SM                               | SP                       |
| SB-56 <sup>5</sup> | 6.0                                                 | 8.0                                                     | SM                                  | SP, SM, SP-SM            |
| SB-57 <sup>5</sup> | 6.0                                                 | 7.0                                                     | SP-SM                               | SP                       |

1. Table summary is a generalization of subsurface conditions at the individual soil boring locations only. They may not reflect variations in subsurface strata occurring on site between boring locations. The general geologic origin of retained soil samples is listed on the boring logs.
2. Measured thickness of the pavement core.
3. Apparent aggregate base thickness, at time of our fieldwork, by visual inspection only. The classification is not meant to confer conformance with DOT specifications.
4. Undocumented fill soils.
5. Pavement core thickness may not be representative due to crumbling during coring process.

### 161<sup>ST</sup> Avenue Northwest – Borings SB-58 through SB-61

Bituminous pavement thickness in this area ranged from approximately 3.0 to 3.5 inches at the boring locations. Apparent aggregate base thickness ranged from approximately 8.0 to 18.0 inches. Apparent previously placed fill soils generally consisting of poorly graded sand with silt (SP-SM) and silty sand (SM) were encountered to depths ranging from approximately 1.5 to 4.0 feet below the top of pavement. Varying amounts of gravel, bituminous pieces, and organic materials were occasionally encountered within the fill materials.



Native glacial deposit soils consisting of poorly graded sand (SP), poorly graded sand with silt (SP-SM), and silty sand (SM) were commonly observed extending to the boring termination depths.

Groundwater was not observed in the boreholes at the time of drilling. Table 2 summarizes the encountered subsurface conditions for 161<sup>st</sup> Avenue Northwest.

**Table 2: Pavement and Subgrade Summary<sup>1</sup>  
 161<sup>st</sup> Avenue Northwest**

| Boring No. | Bituminous Pavement Thickness <sup>2</sup> (inches) | Apparent Aggregate Base Thickness <sup>3</sup> (inches) | Fill Subgrade Material <sup>4</sup> | Native Subgrade Material |
|------------|-----------------------------------------------------|---------------------------------------------------------|-------------------------------------|--------------------------|
| SB-58      | 3.0                                                 | 12.0                                                    | SM                                  | SP                       |
| SB-59      | 3.0                                                 | 8.0                                                     | SM                                  | SP, SM                   |
| SB-60      | 3.5                                                 | 8.0                                                     | SM                                  | SP-SM, SP                |
| SB-61      | 3.5                                                 | 18.0                                                    | SP-SM                               | SP                       |

1. Table summary is a generalization of subsurface conditions at the individual soil boring locations only. They may not reflect variations in subsurface strata occurring on site between boring locations. The general geologic origin of retained soil samples is listed on the boring logs.
2. Measured thickness of the pavement core.
3. Apparent aggregate base thickness, at time of our fieldwork, by visual inspection only. The classification is not meant to confer conformance with DOT specifications.
4. Undocumented fill soils.

## GROUNDWATER AND GROUNDWATER CONTROL

Groundwater was observed in all of the project areas at the time of drilling.

**Variolite Street Northwest:** Groundwater was observed in thirty-five of the fifty-seven (57) boreholes at the time of drilling. The groundwater depths ranged from approximately 2.5 to 11.5 feet below the top of pavement.

**161<sup>st</sup> Avenue Northwest:** Groundwater was not observed in the boreholes at the time of drilling.

In addition, the on-site silt based soils have the potential to be somewhat impervious and conducive to the development of zones of perched water at varying elevations and locations across the project area.

Depending upon elevations of underground utilities, groundwater may be an issue during construction. If excavations are proposed below the groundwater level, the granular nature of the on-site soils will likely result in significant volumes of water entering the excavations unless proper dewatering measures are implemented. If dewatering is needed during construction, we recommend that the groundwater be maintained a minimum of 2 feet below the bottom of the excavation.

## LABORATORY TEST PROGRAM

Our analysis and recommendations of this report are based upon our interpretation of the standard penetration test resistance determined while sampling soils, laboratory test results, and experience with similar soils from other sites near the project. The results of such tests are summarized on the boring logs or attached laboratory test reports.



## UTILITIES

The fill and native glacial deposit soils observed at the soil boring locations were generally suitable for utility support. Replacement backfill required in utility trenches should consist of non-organic material similar to the surrounding soil. All import fill should be approved by NTI or the City's representative.

Due to the observed groundwater levels and depending on the installation depth of the utilities, temporary dewatering would likely be required during some of the utility trench excavations. In addition, the granular nature of the on-site soils will likely result in significant volumes of water entering the excavations unless proper dewatering measures are implemented. If dewatering is needed during construction, we recommend that the groundwater be maintained a minimum of 2 feet below the bottom of the excavation.

Stabilization of the trench subgrade may also be required in order to provide a stable platform for construction. Stabilization could consist of a one half to one foot layer of crushed rock or sand with a maximum 5 percent material passing the No. 200 sieve and 50 percent passing the No. 40 sieve.

As noted previously, swamp deposit soils were observed at Borings SB-23, SB-24, SB-35, SB-37, SB-39 through SB-44, and SB-46 through SB-49. The peat (Pt) soils are generally not suitable for utility support and utility backfill. NTI does not recommend the founding of utilities in or above swamp deposited soils. However, if the design team elects to take the risk of doing so, appropriate measures should be taken. If the utilities are to be founded above or within the organic soils, the least risky options for support of utilities would be to perform a soil correction below the utilities down to competent, non-organic native soils, or to support the utilities on a deep foundation system with bents for support at the joints.

Another alternative would include the placement of additional bedding to provide a more stable platform to construct the utilities upon. However, the team should anticipate that utilities supported in this manner will likely undergo significant differential movement and/or sagging over time. This will be particularly evident at the connections to any proposed structures. At a minimum, flexible connections should be utilized within the pipe alignment where possible and at all connections to structures.

The Geotechnical Engineer of Record or their designated representative should observe the project excavations to determine that unsuitable materials have been properly removed and adequate bearing support is provided by the exposed soils. The exposed soil at the base should be compacted to 95 percent standard Proctor dry density (ASTM D698). Such observations and testing should be performed prior to backfilling.

It is especially important that trench backfill for utility construction within paved areas be thoroughly compacted to minimize future pavement damage. We recommend that such soils be compacted in accordance with the recommendations noted in the "Placement and Compaction of Engineered Fill" section in Appendix B of this report.

The stability of embankments along utility excavations is dependent on soil strength, site geometry, moisture content, and any surcharge load for excavated soils and equipment. We present cautionary remarks concerning stability of excavation sideslopes in the "Excavation Stability" section of this report.

The Contractor is solely responsible for assessing the stability of and executing underground utility and project excavations using safe methods. The contractor is also responsible for naming the "competent individual" as per Subpart P of 29 CFR 1926.6 (Federal Register - OSHA).



## PAVEMENT RECOMMENDATIONS

The Contractor should be aware that the subgrade soils will be moisture-sensitive and protecting them from inclement weather will aid in maintaining stability. The stripping of the existing pavement and aggregate base course should occur immediately prior to subgrade preparation and base aggregate installation to minimize weather-induced instability. The subgrade and aggregate base should be compacted and sloped to drain to help prevent ponding in the roadway during construction.

Undocumented fill soils were encountered within the roadway corridor. The most conservative method of construction would be to remove and replace all the existing undocumented fill from beneath the proposed roadway areas. If the City were willing to accept some risk of future settlement and maintenance, the existing fill may remain in place provided that it can be sufficiently compacted to provide a stable platform for construction of the proposed pavements.

As noted previously, organic (peat, Pt) soils were encountered within the roadway. We recommend the removal of, at a minimum, soils with high organic content (3 percent or greater by dry weight) from beneath pavement areas. Slightly organic soils, those with an organic content less than 3 percent, can remain in place provided that they are at least 3 feet below the bottom of the pavement section and can be sufficiently compacted to provide a stable platform for construction of the proposed pavements.

It should be noted that pavements constructed over organic soils will not generally perform over the long-term the same as pavements constructed over inorganic soils, and some movement and long-term pavement maintenance should be anticipated. Backfill should consist of inorganic soil similar to the onsite soils.

Prior to installing the new pavement section, the existing subgrade should be scarified to a depth of at least 12 inches and re-compacted. A proof roll test should then be performed to determine soft or unstable subgrade areas.

The proof roll should be performed with a tandem axle dump truck loaded to gross capacity (at least 20 tons). Acceptance criteria of the proof roll shall be limited to rut formation no more than one inch depth (front or rear axles) and no pumping (rolling) observed during the visual inspection. Proof roll tests should be observed by an experienced technician or geotechnical engineer prior to placement of the aggregate base course to verify the subgrade will provide adequate pavement support.

If rutting or localized unstable subgrade areas are observed, those areas should be subcut, moisture-conditioned, and re-compacted or removed to a stable depth.

If imported fill is required in paved areas, it should consist of debris-free, non-organic, mineral soil similar in composition to the subgrade soils encountered in the surrounding areas. If sand is imported into areas that are underlain by relatively impervious fine grained soils, the sand layer must be drained with drain tile in order to prevent frost heave from water trapped within the imported sand layer during freezing temperatures. Individual lifts of engineered fill should be tempered for moisture content, placed, and compacted as noted in the "Placement and Compaction of Engineered Fill" section in Appendix B of this report.



Due to the compressibility of the localized underlying swamp deposited soils, positive changes in grade should be minimized to the extent practical. In addition, any proposed increases in grade should occur as early as possible in the construction process to allow for as much consolidation as practical to occur prior to the placement of aggregate base and pavement.

The performance of stabilometer or similar tests, were beyond the scope of this report; however, they may be performed, upon request, for an additional fee. We estimate that a properly prepared subgrade would have an average stabilometer R-value based on soil types as referenced below:

- Poorly graded sand (SP) – R-value of 50
- Poorly graded sand with silt (SP-SM) – R-value of 40
- Silty sand (SM) – R-value of 25

Pavement recommendations assume the subgrade soils and aggregate section below paved surfaces will drain to subsurface piping for eventual discharge into storm sewer, or above grade to ditching, or similar acceptable systems. Lack of surface and subsurface drainage will significantly reduce the capacity and longevity of the pavement systems indicated above.

Properly constructed pavements, even those constructed entirely over inorganic soil, will crack due to creep movements, changes in temperatures, frost action, and other factors. Due to the organic nature in some areas of the roadway subgrade, the pavements should be expected to move and crack more than a typical pavement section. Features that would help reduce this movement and cracking include:

- Installing finger drains about catch basins, low lying areas,
- Placing a reinforcement geotextile or geogrid under the aggregate base or within the aggregate base,
- Adding a 1 foot or thicker section of clean sand below the aggregate base to act as a drainage layer.

We recommend pavements receive annual maintenance, as a minimum, to correct damages to the pavement structure, clean and infill cracks which develop, and repair or resurface areas which exhibit reduced subgrade performance. The lack of maintenance can lead to moisture infiltration of the pavement structure and softening of the subgrade soils. This, in turn, can degrade the performance of the pavement system and result in poorly performing pavements with shortened life expectancy.

## **EXCAVATION STABILITY**

Excavation depth and sidewall inclination should not exceed those specified in local, state, or federal regulations. Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment. Contractors must comply with local, state, and federal safety regulations including current OSHA excavation and trench safety standards. Temporary shoring must be designed in accordance with applicable regulatory requirements.



## ENGINEERED FILL & WINTER CONSTRUCTION

The silt and clay-laden soils encountered at the project locations will be susceptible to freezing if not provided adequate drainage, insulation, or coverage. Frozen soil should not be used as backfill. When the ambient air temperature falls below freezing for an extended period of time, frost forms, and soil near the surface grade expands. Settlement of the fill may occur as the frozen soils thaw.

If frost penetrates the soil prior to paving, soils must be thawed, scarified, and re-compacted as recommended in this report. Subgrade soils should be inspected prior to paving to verify frozen conditions are not present.

## CLOSURE

As the widely spaced, small diameter borings provide only a limited amount of data regarding the existing fill, the existing fill may contain soft zones, debris or significantly greater amounts of unsuitable materials than could be reasonably inferred from the boring information. Unsuitable materials may not be discovered during construction and may remain buried within the fill below the pavement, resulting in greater than anticipated settlements of the pavement. These risks cannot be eliminated without completely removing the fill, but can be reduced by thorough exploration and testing during site preparation and construction.

Our conclusions and recommendations are predicated on observation and testing of the earthwork directed by Geotechnical Engineer of Record. Our opinions are based on data assumed representative of the project area. However, the area coverage of borings in relation to the entire project is very small. For this and other reasons, we do not warrant conditions below the depth of our borings, or that the strata logged from our borings are necessarily typical of the site. Deviations from our recommendations by plans, written specifications, or field applications shall relieve us of responsibility unless our written concurrence with such deviations has been established.

The scope of services for this project does not include either specifically or by implication any environmental or biological assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of the City of Ramsey and their agents for specific application to the proposed 20-01 Variolite Street Reconstruction project in Ramsey, Minnesota. Northern Technologies, LLC has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Northern Technologies, LLC makes no other warranty, express or implied.

## Attachments

- Appendix A - General Notes
- Appendix B - Groundwater Issues, Compaction and Placement of Fill
- Appendix C - Attachments: Boring Location Diagrams (6), Soil Boring Logs (61)
- Appendix D - Photographs (61 cores)



**APPENDIX A**

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## GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

We visually examined recovered soil samples to estimate distribution of grain sizes, plasticity, consistency, moisture condition, color, presence of lenses and seams, and apparent geologic origin. We then classified the soils according using the Unified Soil Classification System (ASTM D2488). A chart describing this classification system and general notes explaining soil sampling procedures are presented within appendices attachments.

The stratification depth lines between soil types on the logs are estimated based on the available data. In-situ, the transition between type(s) may be distinct or gradual in either the horizontal or vertical directions. The soil conditions have been established at our specific boring locations only. Variations in the soil stratigraphy may occur between and around the borings, with the nature and extent of such change not readily evident until exposed by excavation. These variations must be properly assessed when utilizing information presented on the boring logs.

We request that you, your design team or contractors contact NTI immediately if local conditions differ from those assumed by this report, as we would need to review how such changes impact our recommendations. Such contact would also allow us to revise our recommendations as necessary to account for the changed site conditions.

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## FIELD EXPLORATION PROCEDURES

### ***Soil Sampling – Standard Penetration Boring:***

Soil sampling was performed according to the procedures described by ASTM D-1586. Using this procedure, a 2 inch O.D. split barrel sampler is driven into the soil by a 140 pound weight falling 30 inches. After an initial set of six inches, the number of blows required to drive the sampler an additional 12 inches is recorded (known as the penetration resistance (i.e. “N-value”) of the soil at the point of sampling. The N-value is an index of the relative density of cohesionless soils and an approximation of the consistency of cohesive soils.

### ***Soil Sampling – Power Auger Boring:***

The boring(s) was/were advanced with a 6 inch nominal diameter continuous flight auger. As a result, samples recovered from the boring are disturbed, and our determination of the depth, extend of various stratum and layers, and relative density or consistency of the soils is approximate.

### ***Soil Classification:***

Soil samples were visually and manually classified in general conformance with ASTM D-2488 as they were removed from the sampler(s). Representative fractions of soil samples were then sealed within respective containers and returned to the laboratory for further examination and verification of the field classification. In addition, select samples were submitted for laboratory tests. Individual sample information, identification of sampling methods, method of advancement of the samples and other pertinent information concerning the soil samples are presented on boring logs and related report attachments.

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## GENERAL NOTES

| <i>DRILLING and SAMPLING SYMBOLS</i> |                             | <i>LABORATORY TEST SYMBOLS</i> |                                                                                          |
|--------------------------------------|-----------------------------|--------------------------------|------------------------------------------------------------------------------------------|
| <b>SYMBOL</b>                        | <b>DEFINITION</b>           | <b>SYMBOL</b>                  | <b>DEFINITION</b>                                                                        |
| C.S.                                 | Continuous Sampling         | W                              | Moisture content-percent of dry weight                                                   |
| P.D.                                 | 2-3/8" Pipe Drill           | D                              | Dry Density-pounds per cubic foot                                                        |
| C.O.                                 | Cleanout Tube               | LL, PL                         | Liquid and plastic limits determined in accordance with ASTM D 423 and D 424             |
| 3 HSA                                | 3 ¼" I.D. Hollow Stem Auger | Q <sub>u</sub>                 | Unconfined compressive strength-pounds per square foot in accordance with ASTM D 2166-66 |
| 4 FA                                 | 4" Diameter Flight Auger    |                                |                                                                                          |
| 6 FA                                 | 6" Diameter Flight Auger    |                                |                                                                                          |
| 2 ½ C                                | 2 ½" Casing                 |                                |                                                                                          |
| 4 C                                  | 4" Casing                   |                                |                                                                                          |
| D.M.                                 | Drilling Mud                | Pq                             | Penetrometer reading-tons/square foot                                                    |
| J.W.                                 | Jet Water                   | S                              | Torvane reading-tons/square foot                                                         |
| H.A.                                 | Hand Auger                  | G                              | Specific Gravity – ASTM D 854-58                                                         |
| NXC                                  | Size NX Casing              | SL                             | Shrinkage limit – ASTM 427-61                                                            |
| BXC                                  | Size BX Casing              | Ph                             | Hydrogen ion content-meter method                                                        |
| AXC                                  | Size AX casing              | O                              | Organic content-combustion method                                                        |
| SS                                   | 2" O.D. Split Spoon Sample  | M.A.                           | Grain size analysis                                                                      |
| 2T                                   | 2" Thin Wall Tube Sample    | C*                             | One dimensional consolidation                                                            |
| SH                                   | 3" Thin Wall Tube Sample    | Q <sub>c</sub>                 | Triaxial Compression                                                                     |

\* See attached data Sheet and/or graph

## WATER LEVEL SYMBOL

Water levels shown on the boring logs were determined at the time and under the conditions indicated. In sand, the indicated levels can be considered relatively reliable for most site conditions. In clay soils, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious water bearing soil are present; and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

## DESCRIPTIVE TERMINOLOGY

| <i>RELATIVE DENSITY</i> |                                         | <i>CONSISTENCY</i> |                                         |
|-------------------------|-----------------------------------------|--------------------|-----------------------------------------|
| <b>TERM</b>             | <b>N<sub>60</sub> Value (corrected)</b> | <b>TERM</b>        | <b>N<sub>60</sub> Value (corrected)</b> |
| Very Loose              | 0 – 4                                   | Soft               | 0-4                                     |
| Loose                   | 5 – 8                                   | Medium             | 5-8                                     |
| Medium Dense            | 9 – 16                                  | Rather Stiff       | 9 – 15                                  |
| Dense                   | 16 – 30                                 | Stiff              | 16 – 30                                 |
| Very Dense              | Over 30                                 | Very Stiff         | Over 30                                 |

## RELATIVE PROPORTIONS

| <b>TERMS</b> | <b>RANGE</b> |
|--------------|--------------|
| Trace        | 0 – 5%       |
| A little     | 5 – 15%      |
| Some         | 15 – 30%     |

## PARTICLE SIZES

| <b>MATERIAL</b> | <b>DESCRIPTION</b>            | <b>U.S. SIEVE SIZE</b> |
|-----------------|-------------------------------|------------------------|
| Boulders        |                               | Over 3"                |
| Gravel          | Coarse                        | 3" to ¾"               |
|                 | Medium                        | ¾" to #4               |
| Sand            | Coarse                        | #4 to #10              |
|                 | Medium                        | #10 to #40             |
|                 | Fine                          | #40 to #200            |
| Silt and Clay   | Determined by Hydrometer Test |                        |



**CLASSIFICATION of SOILS for ENGINEERING PURPOSES**

ASTM Designation D-2487 and D2488 (Unified Soil Classification System)

| Major Divisions                                                                             | Group Symbol                                                       | Typical Name                                                      | Classification Criteria                                                                |
|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <b>Course Grained Soils</b><br>More than 50% retained on No. 200 sieve *                    | Gravels<br>50% or more of coarse fraction retained on No. 4 sieve. | Clean Gravels                                                     | <b>GW</b><br>Well-graded gravels and gravel-sand mixtures, little or no fines.         |
|                                                                                             |                                                                    | Gravels with Fines                                                | <b>GP</b><br>Poorly graded gravels and gravel-sand mixtures, little or no fines.       |
|                                                                                             |                                                                    |                                                                   | <b>GM</b><br>Silty gravels, gravel-sand-silt mixtures.                                 |
|                                                                                             |                                                                    |                                                                   | <b>GC</b><br>Clayey gravels, gravel-sand-clay mixtures.                                |
|                                                                                             | Sands<br>More than 50% of coarse fraction passes No. 4 sieve.      | Clean Sands                                                       | <b>SW</b><br>Well-graded sands and gravelly sands, little or no fines.                 |
|                                                                                             |                                                                    | Sands with Fines                                                  | <b>SP</b><br>Poorly-graded sands and gravelly sands, little or no fines.               |
|                                                                                             |                                                                    |                                                                   | <b>SM</b><br>Silty sands, sand-silt mixtures.                                          |
|                                                                                             |                                                                    |                                                                   | <b>SC</b><br>Clayey sands, sand-clay mixtures.                                         |
|                                                                                             |                                                                    |                                                                   | <b>ML</b><br>Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. |
|                                                                                             |                                                                    | <b>Fine Grained Soils</b><br>More than 50% passes No. 200 sieve * | Silts and Clays<br>Liquid Limit of 50% or less                                         |
| <b>OL</b><br>Organic silts and organic silty clays of low plasticity.                       |                                                                    |                                                                   |                                                                                        |
| <b>MH</b><br>Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. |                                                                    |                                                                   |                                                                                        |
| Silts and Clays<br>Liquid Limit greater than 50%.                                           | <b>CH</b><br>Inorganic clays of high plasticity, fat clays.        |                                                                   |                                                                                        |
|                                                                                             | <b>OH</b><br>Organic clays of medium to high plasticity.           |                                                                   |                                                                                        |
|                                                                                             | <b>Pt</b><br>Peat, muck and other highly organic soils.            |                                                                   |                                                                                        |

**Classification on basis of percentage of fines.**  
 Less than 5% passing No. 200 Sieve: GW, GP, SW, SP  
 More than 12% passing No. 200 Sieve: GM, GC, SM, SC  
 From 5% to 12% passing No. 200 Sieve: Borderline Classification requiring use of dual symbols.

Cu = D60 / D10 greater than 4.  
 Cz = (D30)<sup>2</sup> / (D10 x D60) between 1 & 3.

Not meeting both criteria for GW materials.

Atterberg limits below "A" line, or P.I. less than 4.  
 Atterberg limits above "A" line with P.I. greater than 7.

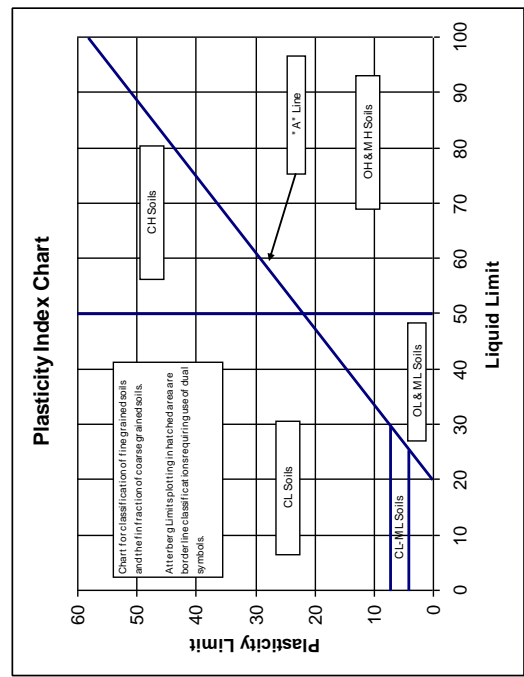
Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.

Cu = D60 / D10 greater than 6.  
 Cz = (D30)<sup>2</sup> / (D10 x D60) between 1 & 3.

Not meeting both criteria for SW materials.

Atterberg limits below "A" line, or P.I. less than 4.  
 Atterberg limits above "A" line with P.I. > 7.

Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.





**APPENDIX B**

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## GROUNDWATER ISSUES

***The following presents additional comment and soil specific issues related to measurement of ground water conditions at your project site.***

Note that our ground water measurements, or lack thereof, will vary depending on the time allowed for equilibrium to occur in the borings. Extended observation time was not available during the scope of the field exploration program and, therefore, ground water measurements as noted on the borings logs may or may not accurately reflect actual conditions at your site.

Seasonal and yearly fluctuations of the ground water level, if any, occur. Perched ground water may be present within sand and silt lenses bedded within cohesive soil formations.

If minor seepage into project excavations occurs, dewatering with sumps and pumps within excavations will be adequate within fine grained clay or silt based soils. Within the clean sand soils dewatering can likely be accomplished with the use of a well point system. When excavations penetrate more than 1 foot below the groundwater surface, we recommend that the dewatering wells or sand points be installed to maintain the groundwater surface at least 2 feet below the bottom of the excavation.

---



**PLACEMENT AND COMPACTION OF ENGINEERED FILL**

***Unless otherwise superseded within the body of the Geotechnical Exploration Report, the following criteria shall be utilized for placement of engineered fill on project. This includes, but is not limited to earthen fill placement to improve site grades, fill placed below structural footings, fill placed interior of structure, and fill placed as backfill of foundations.***

Engineered fill placed for construction, if necessary should consist of natural, non-organic, competent soils native to the project area. Such soils may include, but are not limited to gravel, sand, or clays with Unified Soil Classification System (ASTM D2488) classifications of GW, SP, SM, CL or CH. Use of silt or clayey silt as project fill will require additional review and approval of project Geotechnical Engineer of Record. Such soils have USCS classifications of ML, MH, ML-CL, MH-CH. Use of topsoil, marl, peat, other organic soils construction debris and/or other unsuitable materials as fill is not allowed. Such soils have USCS classifications of OL, OH, Pt.

Engineered fill, classified as clay, should be tempered such that the moisture content at the time of placement is equal to and no more than 3 percent above the optimum content for as defined by the appropriate proctor test. Likewise, engineered fill classified as gravel or sand should be tempered such that the moisture content at the time of placement is within 3 percent of the optimum content.

All engineered fill for construction should be placed in individual 8 inch maximum depth lifts. Each lift of fill should be compacted by large vibratory equipment until the in-place soil density is equal to or greater than the criteria established within the following tabulation.

| Type of Construction                                                                                           | Compaction Criteria                 |                |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------|
|                                                                                                                | (% respective Proctor) <sup>1</sup> |                |
|                                                                                                                | Clay                                | Sand or Gravel |
| Engineered Fill placed as Pavement Subgrade (more than 3 feet below bottom of final grade)                     | Min. 95                             | Min. 95        |
| Engineered Fill placed as Pavement Subgrade (less than 3 feet below bottom of final grade)                     | Min. 100                            | Min. 100       |
| Engineered Fill placed as Pavement Aggregate Base                                                              | NA                                  | Min. 100       |
| Note 1 Unless otherwise required, compaction criteria shall be based on the Standard Proctor Test (ASTM D698). |                                     |                |

Density tests should be taken during engineered fill placement to document earthwork has achieved necessary compaction of the material(s).



**APPENDIX C**

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Boring Location Diagram  
20-01 Variolite Street Reconstruction  
Ramsey, Minnesota  
NTI Project #: 19.MSP09109.000  
NOTE: Boring locations are approximate.

Completed Soil Borings: 



**NTI**<sup>™</sup>  
NORTHERN  
TECHNOLOGIES, LLC



Boring Location Diagram  
20-01 Variolite Street Reconstruction  
Ramsey, Minnesota  
NTI Project #: 19.MSP09109.000  
NOTE: Boring locations are approximate.

Completed Soil Borings: 



**NTI**<sup>™</sup>  
NORTHERN  
TECHNOLOGIES, LLC



Boring Location Diagram  
 20-01 Variolite Street Reconstruction  
 Ramsey, Minnesota  
 NTI Project #: 19.MSP09109.000  
 NOTE: Boring locations are approximate.

Completed Soil Borings: ●



**NTI**  
 NORTHERN  
 TECHNOLOGIES, LLC



Boring Location Diagram  
20-01 Variolite Street Reconstruction  
Ramsey, Minnesota  
NTI Project #: 19.MSP09109.000  
NOTE: Boring locations are approximate.

Completed Soil Borings: 



**NTI**<sup>™</sup>  
NORTHERN  
TECHNOLOGIES, LLC



- SB-52 ●
- SB-51 ●
- SB-50 ●
- SB-49 ●
- SB-48 ●
- SB-47 ●
- SB-46 ●
- SB-45 ●
- SB-44 ●
- SB-43 ●
- SB-42 ●
- SB-41 ●
- SB-40 ●
- SB-39 ●
- SB-38 ●
- SB-37 ●
- SB-36 ●
- SB-35 ●
- SB-34 ●
- SB-33 ●
- SB-32 ●
- SB-31 ●
- SB-30 ●

Variolite St. NW

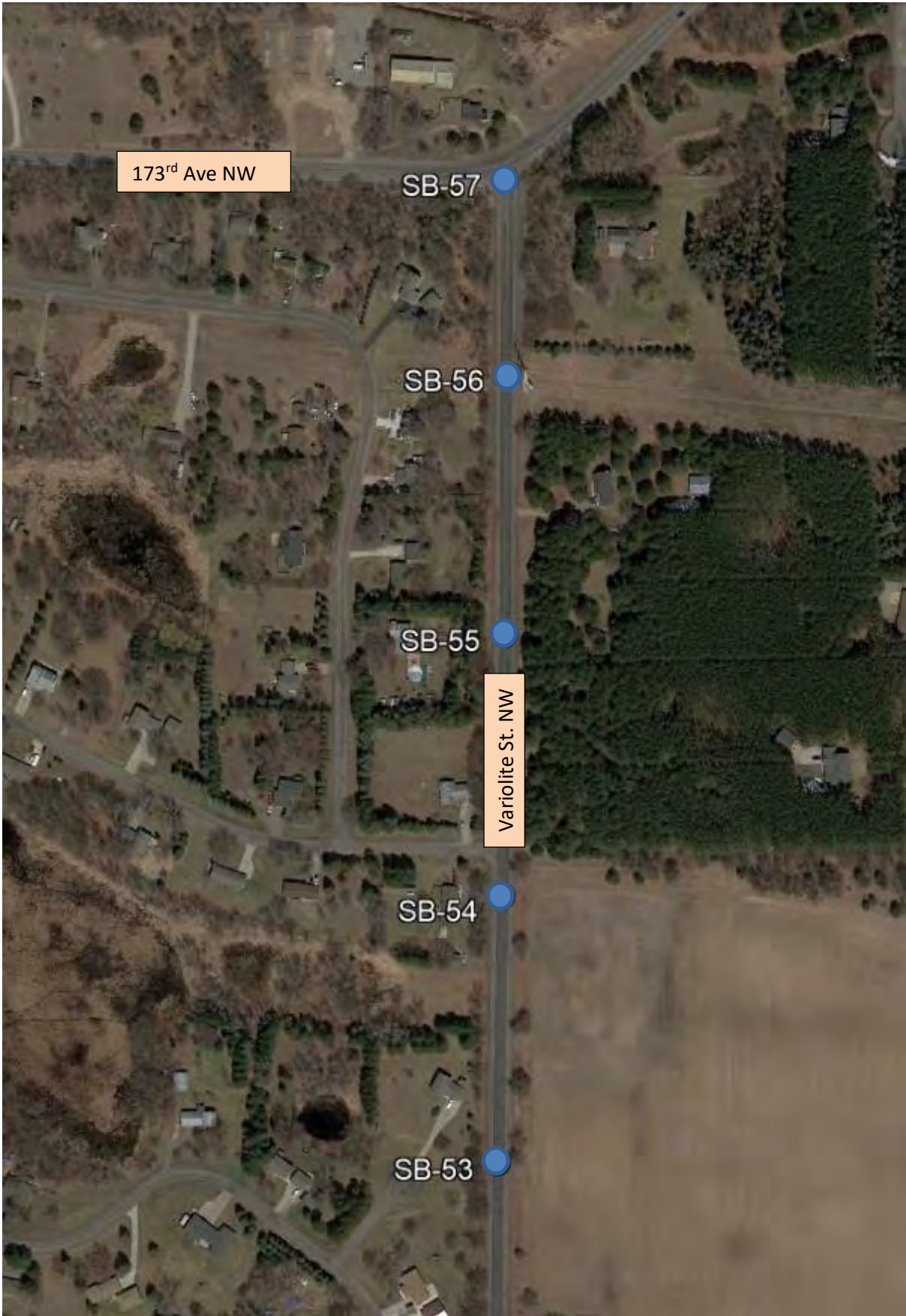


Boring Location Diagram  
 20-01 Variolite Street Reconstruction  
 Ramsey, Minnesota  
 NTI Project #: 19.MSP09109.000  
 NOTE: Boring locations are approximate.

Completed Soil Borings: ●



**NTI**<sup>™</sup>  
 NORTHERN  
 TECHNOLOGIES, LLC



Boring Location Diagram  
20-01 Variolite Street Reconstruction  
Ramsey, Minnesota  
NTI Project #: 19.MSP09109.000  
NOTE: Boring locations are approximate.

Completed Soil Borings: 



**NTI**<sup>™</sup>  
NORTHERN  
TECHNOLOGIES, LLC



**Inver Grove Heights**  
 6160 Carmen Avenue East  
 Inver Grove Heights, MN 55076  
 P: 651-389-4191  
 www.NTIgeo.com

**BORING NUMBER SB-1**

PAGE 1 OF 1  
 Long: -93° 27' 36.5421"  
 Lat: 45° 15' 7.5145"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 885 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                                | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                                     |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.4        |             | BITUMINOUS PAVEMENT (4.5 inches)                                                                                                                                    | 884.6              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.8        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                                | 884.2              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                              |                    | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | SILTY SAND, (SM) black, fine to medium grained, moist, trace gravel, slightly organic<br><b>(Undocumented Fill)</b><br>NOTE: Organic content in Sample No. 3 = 3.1% | 881.0              | SS 2             | 67                    | 7-6-6-5 (12)      |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                                     |                    | SS 3             | 89                    | 5-4-4 (8)         |                    | 13                   |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, loose, trace gravel<br>(Glacial Outwash)                                                             | 878.5              | SS 4             | 67                    | 5-3-3 (6)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose, trace gravel<br>(Glacial Outwash)                                                             | 876.0              | SS 5             | 78                    | 5-4-4 (8)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                                     | 874.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



**Inver Grove Heights**  
 6160 Carmen Avenue East  
 Inver Grove Heights, MN 55076  
 P: 651-389-4191  
 www.NTIgeo.com

# BORING NUMBER SB-2

PAGE 1 OF 1  
 Long: -93° 27' 36.4654"  
 Lat: 45° 15' 12.2587"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 892.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                                                          | CORE               | 892.0            |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                      |                    | 891.6            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown to brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>      | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                           | SS 2               | 67               | 11-8-9-7 (17)         |                   |                    | 7                    |                  |               |                  | 10    |
| 5.0        |             |                                                                                                                                           | SS 3               | 67               | 5-3-3 (6)             |                   |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                           |                    | 886.0            |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, very loose to loose, trace gravel<br><b>(Glacial Outwash)</b> | SS 4               | 78               | 4-2-2 (4)             |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                           | SS 5               | 78               | 2-3-2 (5)             |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                           |                    | 882.0            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\IGNITVARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-3**

PAGE 1 OF 1  
 Long: -93° 27' 36.1637"  
 Lat: 45° 15' 17.2091"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 901.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                         | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                              |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                              |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                             | 901.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.8        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                         | 900.7              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel, trace organics (Undocumented Fill) |                    | SS 1             | 100                   | 8-9-11 (20)       |                    | 9                    |                  |               |                  | 15    |
| 4.0        |             |                                                                                                              |                    | SS 2             | 75                    | 6-7-5-4 (12)      |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose, trace gravel (Glacial Outwash)         | 897.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                              |                    | SS 3             | 89                    | 2-3-2 (5)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                              |                    | SS 4             | 89                    | 5-4-4 (8)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                              |                    | SS 5             | 89                    | 3-3-2 (5)         |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VAROLITE BORING LOGS.GPJ



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# BORING NUMBER SB-4

PAGE 1 OF 1  
 Long: -93° 27' 36.5913"  
 Lat: 45° 15' 22.1688"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 897.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                     |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                                                                    | CORE               | 897.0            |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                |                    | 896.6            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b>         | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                     | SS 2               | 58               | 8-14-9-10 (23)        |                   |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                     | SS 3               | 67               | 5-4-2 (6)             |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, very loose to loose, trace gravel, occasional silt seams<br><b>(Glacial Outwash)</b> | SS 4               | 78               | 3-2-2 (4)             |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                     | SS 5               | 89               | 5-4-4 (8)             |                   |                    | 7                    |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                     |                    | 887.0            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\IGNITVARIOLITE BORING LOGS.GPJ



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# BORING NUMBER SB-5

PAGE 1 OF 1  
 Long: -93° 27' 36.1135"  
 Lat: 45° 15' 26.9551"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 897.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (5.5 inches)                                                                                                     |                    | 897.0            |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                 |                    | 896.6            |                       |                   |                    | 4                    |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b> | SS 1               | 100              | 10-11-16 (27)         |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b>               | SS 2               | 67               | 9-11-14-16 (25)       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                      | SS 3               | 89               | 6-4-4 (8)             |                   |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                      | SS 4               | 100              | 5-7-10 (17)           |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                      | SS 5               | 100              | 2-3-2 (5)             |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                      |                    | 887.0            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VAROLITE BORING LOGS.GPJ



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**BORING NUMBER SB-6**

PAGE 1 OF 1  
 Long: -93° 27' 36.444"  
 Lat: 45° 15' 32.0122"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 901.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (5.5 inches)                                                                                                                          | 901.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                      | 900.6              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> |                    | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose, trace gravel<br>(Glacial Outwash)                                                   | 897.5              | SS 2             | 58                    | 12-9-8-7 (17)     |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose, trace gravel<br>(Glacial Outwash)                                                   |                    | SS 3             | 78                    | 4-3-2 (5)         |                    | 5                    |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, loose, trace gravel, occasional silt seams<br>(Glacial Outwash)                      | 895.0              | SS 4             | 89                    | 3-3-4 (7)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, loose, trace gravel<br>(Glacial Outwash)                                                   | 892.5              | SS 5             | 78                    | 2-3-3 (6)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 891.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-7**

PAGE 1 OF 1  
 Long: -93° 27' 36.001"  
 Lat: 45° 15' 36.9175"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 900.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                         | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                              |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                                             | CORE               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             |                                                                                                                                              | 899.9              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.8        |             | APPARENT AGGREGATE BASE (3.0 inches)                                                                                                         | 899.7              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND, (SP) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 898.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) black to dark brown, fine to coarse grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b>              |                    |                  |                       |                   |                    | 9                    |                  |               |                  | 15    |
| 4.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, moist, loose to medium dense, trace gravel<br>(Glacial Outwash)                | 896.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                              |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                              |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                              |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                              | 890.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-8**

PAGE 1 OF 1  
 Long: -93° 27' 36.3463"  
 Lat: 45° 15' 41.8681"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 899.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                        | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                             |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                             |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (5.5 inches)                                                                                                                            |                    | 899.0            | CORE                  |                   |                    |                      |                  |               |                  |       |
| 0.8        |             | APPARENT AGGREGATE BASE (4.5 inches)                                                                                                                        |                    | 898.7            |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel, occasional bituminous pavement<br><b>(Undocumented Fill)</b> | AU 1               | 897.5            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense to loose, trace gravel<br>(Glacial Outwash)                               | SS 2               | 58               | 7-7-8-8 (15)          |                   |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                             | SS 3               | 78               | 4-4-4 (8)             |                   |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                             |                    | 893.0            |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, very loose, trace gravel<br>(Glacial Outwash)                                                | SS 4               | 89               | 3-2-2 (4)             |                   |                    |                      |                  |               |                  |       |
| 9.0        |             |                                                                                                                                                             |                    | 890.5            |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | POORLY GRADED SAND, (SP) light gray, fine to medium grained, moist, very loose, trace gravel<br>(Glacial Outwash)                                           | SS 5               | 78               | 3-2-2 (4)             |                   |                    | 6                    |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                             |                    | 889.0            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-9**

PAGE 1 OF 1  
 Long: -93° 27' 35.9904"  
 Lat: 45° 15' 44.8192"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 900.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             | BITUMINOUS PAVEMENT (6.0 inches)*                                                                                                                         | CORE               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             |                                                                                                                                                           |                    | 900.0            |                       |                   |                    |                      |                  |               |                  |       |
| 0.7        |             | APPARENT AGGREGATE BASE (3.5 inches)                                                                                                                      |                    | 899.8            |                       |                   |                    |                      |                  |               |                  |       |
|            |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             |                                                                                                                                                           |                    | 898.5            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                                 | SS 2               | 58               | 6-6-5-5 (11)          |                   |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                           | SS 3               | 89               | 4-2-2 (4)             |                   |                    | 5                    |                  |               |                  | 9     |
| 6.5        |             |                                                                                                                                                           |                    | 894.0            |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, loose to very loose, trace gravel (Glacial Outwash)                                        | SS 4               | 44               | 5-3-4 (7)             |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           | SS 5               | 78               | 3-2-1 (3)             |                   |                    | 4                    |                  |               |                  |       |
| 12.5       |             |                                                                                                                                                           | SS 6               | 89               | 3-2-3 (5)             |                   |                    |                      |                  |               |                  |       |
| 13.0       |             |                                                                                                                                                           |                    | 887.5            |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 13.0 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINTVARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-10**

PAGE 1 OF 1  
 Long: -93° 27' 36.3894"  
 Lat: 45° 15' 47.1101"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 901.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                     |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (5.5 inches)                                                                                                                    | 901.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                | 900.6              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                         | 899.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                           |                    | SS 2             | 67                    | 12-9-10-9 (19)    |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                     |                    | SS 3             | 78                    | 5-6-9 (15)        |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                     | 895.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist, loose to medium dense, trace gravel<br>(Glacial Outwash) |                    | SS 4             | 78                    | 6-5-2 (7)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                     |                    | SS 5             | 89                    | 6-5-5 (10)        |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                     | 891.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**Inver Grove Heights**  
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**BORING NUMBER SB-11**

PAGE 1 OF 1  
 Long: -93° 27' 36.0125"  
 Lat: 45° 15' 48.8181"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 901.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINTVARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf)   | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|---------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                     |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                     |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)                                                                                                                          | 901.0              | CORE             |                       |                     |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (4.5 inches)                                                                                                                      | 900.6              |                  |                       |                     |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 899.5              | AU 1             |                       |                     |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine grained, moist, very dense to medium dense, trace gravel<br>(Glacial Outwash)                                  |                    | SS 2             | 67                    | 11-17-15-14<br>(32) |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                           |                    | SS 3             | 78                    | 5-6-7<br>(13)       |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                           | 895.0              |                  |                       |                     |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, loose, trace gravel<br>(Glacial Outwash)                                                   |                    | SS 4             | 89                    | 4-4-3<br>(7)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    | SS 5             | 78                    | 3-2-3<br>(5)        |                    | 8                    |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 891.0              |                  |                       |                     |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-12**

PAGE 1 OF 1  
 Long: -93° 27' 36.3769"  
 Lat: 45° 15' 51.7781"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 891 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                              | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                   |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                   |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                  | CORE               | 890.4            |                       |                   |                    |                      |                  |               |                  |       |
|            |             | APPARENT AGGREGATE BASE (18.0 inches)                                                                             | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.1        |             |                                                                                                                   |                    | 888.9            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel (Undocumented Fill) | SS 2               |                  | 56                    | 9-11-12 (23)      |                    |                      |                  |               |                  |       |
| 4.0        |             |                                                                                                                   |                    | 887.0            |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, medium dense, trace gravel (Glacial Outwash)       | SS 3               |                  | 67                    | 4-6-8 (14)        |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                   |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             |                                                                                                                   |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 9.0        |             |                                                                                                                   |                    | 882.0            |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | POORLY GRADED SAND, (SP) light gray, fine to medium grained, moist, loose, trace gravel (Glacial Outwash)         | SS 5               |                  | 100                   | 3-3-4 (7)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                   |                    | 880.5            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-13**

PAGE 1 OF 1  
 Long: -93° 27' 35.9365"  
 Lat: 45° 15' 56.6447"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 875 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 5.50 ft / Elev 869.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft)                       | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                   | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|----------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|                                  |             |                                                                                                                                        |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0                              |             |                                                                                                                                        |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6                              |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                                       | 874.4              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.1                              |             | APPARENT AGGREGATE BASE (6.0 inches)                                                                                                   | 873.9              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0                              |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>   | 873.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5                              |             | SILTY SAND, (SM) dark brown, fine to medium grained, moist to saturated, trace gravel, trace organics<br><b>(Undocumented Fill)</b>    |                    | SS 2             | 58                    | 6-9-10-9 (19)     |                    |                      |                  |               |                  |       |
| 5.0                              |             |                                                                                                                                        |                    | SS 3             | 78                    | 6-5-6 (11)        |                    |                      |                  |               |                  |       |
| 6.5                              |             |                                                                                                                                        | 868.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5                              |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, loose to very loose, trace gravel<br><b>(Glacial Outwash)</b> |                    | SS 4             | 89                    | 5-4-3 (7)         |                    |                      |                  |               |                  |       |
| 10.0                             |             |                                                                                                                                        |                    | SS 5             | 78                    | 2-1-1 (2)         |                    |                      |                  |               |                  |       |
| 12.5                             |             |                                                                                                                                        |                    | SS 6             | 56                    | 2-1-1 (2)         |                    |                      |                  |               |                  |       |
|                                  |             |                                                                                                                                        |                    | SS 7             | 56                    | 1-3-5 (8)         |                    |                      |                  |               |                  |       |
| 14.5                             |             |                                                                                                                                        | 860.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| Bottom of borehole at 14.5 feet. |             |                                                                                                                                        |                    |                  |                       |                   |                    |                      |                  |               |                  |       |



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**BORING NUMBER SB-14**

PAGE 1 OF 1  
 Long: -93° 27' 36.3046"  
 Lat: 45° 15' 57.7322"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 873.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 5.50 ft / Elev 868.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                         | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                              |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                              |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.2        |             | BITUMINOUS PAVEMENT (2.0 inches)*                                                                                                            |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.7        |             | APPARENT AGGREGATE BASE (6.0 inches)                                                                                                         |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 1.5        |             | POORLY GRADED SAND, (SP) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                            | SS 2               | 56               | 7-6-6 (12)            |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist to saturated, medium dense, trace gravel (Glacial Outwash)                     | SS 3               | 67               | 3-4-5 (9)             |                   |                    |                      |                  |               |                  |       |
| 6.5        |             | CLAYEY SAND, (CL) gray, saturated, loose, occasional clean sand seams (Glacial Outwash)                                                      | SS 4               | 78               | 2-2-4 (6)             |                   | 29                 |                      |                  |               | 47               |       |
| 9.0        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, saturated, loose, trace gravel (Glacial Outwash)                                     | SS 5               | 56               | 2-3-5 (8)             |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                              |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.

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**Inver Grove Heights**  
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**BORING NUMBER SB-15**

PAGE 1 OF 1  
 Long: -93° 27' 35.9155"  
 Lat: 45° 15' 58.6729"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 873.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 5.00 ft / Elev 868.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                                                                          | 873.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                      | 872.6              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 871.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist to saturated, medium dense to very loose, trace gravel (Glacial Outwash)       |                    | SS 2             | 58                    | 6-7-6-7 (13)      |                    | 13                   |                  |               |                  |       |
| 5.0        |             | ▽                                                                                                                                                         |                    | SS 3             | 56                    | 9-5-5 (10)        |                    | 18                   |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                           |                    | SS 4             | 67                    | 4-2-2 (4)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, saturated, very loose, trace gravel (Glacial Outwash)                                             | 864.5              | SS 5             | 78                    | 5-2-2 (4)         |                    |                      |                  |               |                  |       |
| 11.5       |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, medium dense, trace gravel (Glacial Outwash)                                     | 862.0              | SS 6             | 78                    | 5-6-3 (9)         |                    |                      |                  |               |                  |       |
| 12.5       |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 13.0       |             |                                                                                                                                                           | 860.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 13.0 feet.



**Inver Grove Heights**  
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**BORING NUMBER SB-16**

PAGE 1 OF 1  
 Long: -93° 27' 36.2795"  
 Lat: 45° 15' 59.6335"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 873 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A ▽ AT TIME OF DRILLING 5.00 ft / Elev 868.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)                                                                                                                          | 872.5              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                      | 872.1              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 871.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist to saturated, medium dense, trace gravel<br>(Glacial Outwash)                  |                    | SS 2             | 42                    | 6-7-9-8 (16)      |                    | 12                   |                  |               |                  | 12    |
| 5.0        |             | ▽                                                                                                                                                         |                    | SS 3             | 78                    | 6-5-5 (10)        |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                           | 866.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, saturated, loose, trace gravel<br>(Glacial Outwash)                                  |                    | SS 4             | 67                    | 4-3-3 (6)         |                    |                      |                  |               |                  |       |
| 9.0        |             |                                                                                                                                                           | 864.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | POORLY GRADED SAND, (SP) dark gray, fine to coarse grained, saturated, medium dense, trace gravel<br>(Glacial Outwash)                                    |                    | SS 5             | 78                    | 5-3-8 (11)        |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 862.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
 6160 Carmen Avenue East  
 Inver Grove Heights, MN 55076  
 P: 651-389-4191  
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**BORING NUMBER SB-17**

PAGE 1 OF 1  
 Long: -93° 27' 35.9023"  
 Lat: 45° 16' 0.6304"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 874 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 867.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft)                       | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                           | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|----------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|                                  |             |                                                                                                                                                |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0                              |             |                                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6                              |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                                               | 873.4              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0                              |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel (Undocumented Fill)                                   | 872.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5                              |             | SILTY SAND, (SM) brown, fine to medium grained, moist, medium dense, trace gravel (Glacial Outwash)                                            |                    | SS 2             | 58                    | 5-6-6-10 (12)     |                    |                      |                  |               |                  |       |
| 4.0                              |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist to saturated, medium dense to loose, trace gravel (Glacial Outwash) | 870.0              | SS 3             | 83                    | 10-6-7 (13)       |                    |                      |                  |               |                  |       |
| 7.5                              |             | ▽                                                                                                                                              |                    | SS 4             | 78                    | 7-3-3 (6)         |                    |                      |                  |               |                  |       |
| 9.0                              |             | POORLY GRADED SAND, (SP) gray, fine to coarse grained, saturated, loose to very loose, trace gravel (Glacial Outwash)                          | 865.0              | SS 5             | 56                    | 4-3-2 (5)         |                    |                      |                  |               |                  |       |
| 12.5                             |             |                                                                                                                                                |                    | SS 6             | 67                    | 0-1-1 (2)         |                    |                      |                  |               |                  |       |
| 14.5                             |             |                                                                                                                                                | 859.5              | AU 7             |                       |                   |                    |                      |                  |               |                  |       |
| Bottom of borehole at 14.5 feet. |             |                                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

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**Inver Grove Heights**  
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**BORING NUMBER SB-18**

PAGE 1 OF 1  
 Long: -93° 27' 36.2474"  
 Lat: 45° 16' 1.9274"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 873.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 3.75 ft / Elev 869.75 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                  | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                       |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             | BITUMINOUS PAVEMENT (7.5 inches)                                                                                      | CORE               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             |                                                                                                                       |                    | 872.9            |                       |                   |                    |                      |                  |               |                  |       |
| 0.8        |             | APPARENT AGGREGATE BASE (3.0 inches)                                                                                  |                    | 872.7            |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel (Undocumented Fill)     | AU 1               | 871.5            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown, fine to coarse grained, moist to saturated, trace gravel (Undocumented Fill)                  | SS 2               |                  | 42                    | 12-22-13-12 (35)  |                    | 8                    |                  |               |                  |       |
| 4.0        | ▽           |                                                                                                                       |                    | 869.5            |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, medium dense, trace gravel (Glacial Outwash) | SS 3               |                  | 56                    | 13-5-4 (9)        |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                       |                    | 867.0            |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | SILTY SAND, (SM) dark brown, fine to coarse grained, saturated, loose, trace gravel (Glacial Outwash)                 | SS 4               |                  | 67                    | 4-3-3 (6)         |                    |                      |                  |               |                  |       |
| 9.0        |             |                                                                                                                       |                    | 864.5            |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, loose, trace gravel (Glacial Outwash)        | SS 5               |                  | 67                    | 4-3-3 (6)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                       |                    | 863.0            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-19**

PAGE 1 OF 1  
 Long: -93° 27' 35.8488"  
 Lat: 45° 16' 2.6149"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/23/19 **COMPLETED** 9/23/19 **GROUND ELEVATION** 873.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A  $\nabla$  **AT TIME OF DRILLING** 3.75 ft / Elev 869.75 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.4        |             | BITUMINOUS PAVEMENT (5.0 inches)*                                                                                                                         | 873.1              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.8        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                      | 872.8              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 871.5              | AU 1             |                       |                   |                    | 4                    |                  |               |                  | 12    |
| 2.5        |             | SILTY SAND, (SM) brown, fine to medium grained, moist to saturated, trace gravel, occasional silt seams<br><b>(Undocumented Fill)</b>                     |                    | SS 2             | 50                    | 6-7-7-5 (14)      |                    |                      |                  |               |                  |       |
| 4.0        | $\nabla$    |                                                                                                                                                           | 869.5              | SS 3             | 78                    | 6-6-4 (10)        |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, saturated, medium dense, trace gravel (Glacial Outwash)                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                           | 867.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, saturated, loose, trace gravel (Glacial Outwash)                                            |                    | SS 4             | 78                    | 5-3-4 (7)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 863.0              | SS 5             | 78                    | 4-2-4 (6)         |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.

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**BORING NUMBER SB-20**

PAGE 1 OF 1  
 Long: -93° 27' 36.2132"  
 Lat: 45° 16' 3.5961"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 874 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** ▽ 6.50 ft / Elev 867.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                        | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                             |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                             |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                            | 873.4              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.4        |             | APPARENT AGGREGATE BASE (10.0 inches)                                                                                       | 872.6              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                           |                    | SS 2             | 67                    | 4-5-6 (11)        |                    | 10                   |                  |               |                  |       |
| 4.0        |             |                                                                                                                             | 870.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, medium dense, trace gravel<br>(Glacial Outwash) |                    | SS 3             | 67                    | 3-4-5 (9)         |                    |                      |                  |               |                  |       |
| 6.5        | ▽           |                                                                                                                             | 867.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, saturated, very loose to loose, trace gravel<br>(Glacial Outwash)   |                    | SS 4             | 67                    | 2-1-2 (3)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                             |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                             | 863.5              | SS 5             | 67                    | 3-3-3 (6)         |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



**Inver Grove Heights**  
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**BORING NUMBER SB-21**

PAGE 1 OF 1  
 Long: -93° 27' 35.8305"  
 Lat: 45° 16' 4.5971"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 874 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 5.00 ft / Elev 869.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft)                       | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|----------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|                                  |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0                              |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                                                                     | CORE               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5                              |             |                                                                                                                                                      | 873.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.8                              |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                 | 873.3              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0                              |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 872.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5                              |             | SILTY SAND, (SM) brown to dark brown, fine to medium grained, moist to saturated, trace gravel<br><b>(Undocumented Fill)</b>                         |                    | SS 2             | 78                    | 6-8-5 (13)        |                    | 12                   |                  |               |                  |       |
| 5.0                              | ▽           |                                                                                                                                                      |                    | SS 3             | 67                    | 6-5-5 (10)        |                    | 20                   |                  |               |                  |       |
| 6.5                              |             |                                                                                                                                                      | 867.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5                              |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, saturated, medium dense, trace gravel (Glacial Outwash)                                      |                    | SS 4             | 67                    | 7-5-4 (9)         |                    |                      |                  |               |                  |       |
| 9.0                              |             |                                                                                                                                                      | 865.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0                             |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, saturated, very loose to loose, trace gravel (Glacial Outwash)                         |                    | SS 5             | 89                    | 1-0-1 (1)         |                    |                      |                  |               |                  |       |
| 12.5                             |             |                                                                                                                                                      |                    | SS 6             | 56                    | 1-1-1 (2)         |                    |                      |                  |               |                  |       |
|                                  |             |                                                                                                                                                      |                    | SS 7             | 44                    | 2-3-2 (5)         |                    |                      |                  |               |                  |       |
| 14.5                             |             |                                                                                                                                                      | 859.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| Bottom of borehole at 14.5 feet. |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ





**Inver Grove Heights**  
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**BORING NUMBER SB-23**

PAGE 1 OF 1  
 Long: -93° 27' 35.8092"  
 Lat: 45° 16' 6.5669"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 874.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 5.00 ft / Elev 869.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                                       | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                                            |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                                            |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                                                                                           | 874.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                                       | 873.6              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b>         | 872.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown to black, fine to medium grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b><br>NOTE: Organic content in Sample No. 2 = 1.4% |                    | SS 2             | 100                   | 11-11-12 (23)     |                    | 12                   |                  |               |                  |       |
| 4.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) light gray, fine to medium grained, moist to saturated, medium dense, trace gravel<br>(Swamp Deposit)                                | 870.0              | SS 3             | 100                   | 6-5-8 (13)        |                    |                      |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, medium dense, trace gravel<br>(Swamp Deposit)                                                     | 868.0              | SS 4             | 67                    | 9-7-7 (14)        |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) light brown to gray, fine to coarse grained, saturated, loose, trace gravel<br>(Swamp Deposit)                                       | 865.5              | SS 5             | 56                    | 5-5-3 (8)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                                            | 864.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



**Inver Grove Heights**  
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**BORING NUMBER SB-24**

PAGE 1 OF 1  
 Long: -93° 27' 36.146"  
 Lat: 45° 16' 7.4597"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 875 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 868.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                           | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)                                                                               | 874.5              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.4        |             | APPARENT AGGREGATE BASE (10.0 inches)                                                                          | 873.6              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, moist, trace gravel (Undocumented Fill)          |                    | SS 2             | 56                    | 4-7-9 (16)        |                    |                      |                  |               |                  |       |
| 4.0        |             | SILTY SAND, (SM) gray, fine to medium grained, moist, medium dense, trace gravel (Swamp Deposit)               | 871.0              | SS 3             | 56                    | 5-7-7 (14)        |                    |                      |                  |               |                  |       |
| 6.5        | ▽           | POORLY GRADED SAND, (SP) brown, fine to coarse grained, saturated, loose, trace gravel (Glacial Outwash)       | 868.5              | SS 4             | 67                    | 4-4-4 (8)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, loose, trace gravel (Glacial Outwash) | 866.0              | SS 5             | 89                    | 2-2-3 (5)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                | 864.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-25**

PAGE 1 OF 1  
 Long: -93° 27' 35.7726"  
 Lat: 45° 16' 8.5477"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 874.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A  $\nabla$  **AT TIME OF DRILLING** 4.75 ft / Elev 869.75 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                          | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                               |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                               |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                                                              | 873.9              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.0        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                          | 873.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b>          | 872.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                                        |                    | SS 2             | 83                    | 10-10-9 (19)      |                    | 10                   |                  |               |                  | 16    |
| 4.5        |             | $\nabla$ POORLY GRADED SAND WITH SILT, (SP-SM) light brown, fine to medium grained, moist to saturated, loose to medium dense, trace gravel (Glacial Outwash) | 870.0              | SS 3             | 83                    | 5-3-4-4 (7)       |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                               |                    | SS 4             | 44                    | 7-5-5 (10)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                               |                    | SS 5             | 56                    | 8-4-3 (7)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                               | 864.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-26**

PAGE 1 OF 1  
 Long: -93° 27' 36.1191"  
 Lat: 45° 16' 9.4588"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 875.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 869.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                               | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                                    |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                                    |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS PAVEMENT (7.5 inches)                                                                                                                                   | CORE               | 874.9            |                       |                   |                    |                      |                  |               |                  |       |
| 1.0        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                               |                    | 874.5            |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | AU 1               | 873.5            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, some gravel<br><b>(Undocumented Fill)</b>                                              | SS 2               |                  | 58                    | 9-11-12-10 (23)   |                    |                      |                  |               |                  |       |
| 4.0        |             | SILTY SAND, (SM) light brown to gray, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                                    | SS 3               |                  | 89                    | 5-6-4 (10)        |                    |                      |                  |               |                  |       |
| 6.5        | ▽           |                                                                                                                                                                    |                    | 869.0            |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, saturated, loose, trace gravel (Glacial Outwash)                                                           | SS 4               |                  | 78                    | 4-3-3 (6)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, loose, trace gravel (Glacial Outwash)                                                            | SS 5               |                  | 78                    | 1-2-3 (5)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                                    |                    | 865.0            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-27**

PAGE 1 OF 1  
 Long: -93° 27' 35.7025"  
 Lat: 45° 16' 10.4648"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 875.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A  $\nabla$  **AT TIME OF DRILLING** 5.25 ft / Elev 870.25 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (4.0 inches)*                                                                                                                    | 875.2              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | APPARENT AGGREGATE BASE (3.5 inches)                                                                                                                 | 874.9              |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 873.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) dark brown to light brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                | 871.5              | SS 2             | 100                   | 7-8-7 (15)        |                    | 12                   |                  |               |                  | 22    |
| 5.0        |             | SILTY SAND, (SM) light brown to dark brown, fine grained, moist to saturated, loose, trace gravel (Glacial Outwash)<br>$\nabla$                      | 871.5              | SS 3             | 67                    | 5-3-2 (5)         |                    | 18                   |                  |               |                  | 25    |
| 7.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) gray, fine to coarse grained, saturated, loose, trace gravel, occasional silt seams (Glacial Outwash)          | 868.5              | SS 4             | 56                    | 5-3-4 (7)         |                    |                      |                  |               |                  |       |
| 10.0       |             | SILTY SAND, (SM) brown, fine to medium grained, saturated, medium dense, trace gravel (Glacial Outwash)                                              | 866.5              | SS 5             | 44                    | 6-6-7 (13)        |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                      | 865.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-28**

PAGE 1 OF 1  
 Long: -93° 27' 36.0893"  
 Lat: 45° 16' 11.518"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 876 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 8.00 ft / Elev 868.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                     | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                          |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                          |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                                         | 875.4              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
|            |             | APPARENT AGGREGATE BASE (16.0 inches)                                                                                                    |                    | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 1.9        |             | SILTY SAND, (SM) brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                        | 874.1              | SS 2             | 44                    | 2-3-4 (7)         |                    | 6                    |                  |               |                  | 13    |
| 4.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist to saturated, medium dense, trace gravel<br>(Glacial Outwash) | 872.0              | SS 3             | 56                    | 6-6-6 (12)        |                    |                      |                  |               |                  |       |
| 7.5        |             | ▽                                                                                                                                        |                    | SS 4             | 67                    | 6-4-5 (9)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, loose, trace gravel<br>(Glacial Outwash)                        | 867.0              | SS 5             | 50                    | 3-3-3 (6)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                          | 865.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-29**

PAGE 1 OF 1  
 Long: -93° 27' 35.577"  
 Lat: 45° 16' 16.4618"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 885 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                                                     | 884.4              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                 | 884.1              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 883.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                      |                    | SS 2             | 89                    | 8-20-18 (38)      |                    |                      |                  |               |                  |       |
| 4.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense, trace gravel<br>(Glacial Outwash)                                 | 880.5              | SS 3             | 56                    | 9-6-6 (12)        |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                      |                    | SS 4             | 67                    | 7-5-4 (9)         |                    |                      |                  |               |                  |       |
| 9.0        |             | SILTY SAND, (SM) brown, fine to medium grained, moist, medium dense, trace gravel<br>(Glacial Outwash)                                               | 876.0              | SS 5             | 100                   | 8-6-5 (11)        |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                      | 874.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



**Inver Grove Heights**  
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**BORING NUMBER SB-30**

PAGE 1 OF 1  
 Long: -93° 27' 35.9113"  
 Lat: 45° 16' 19.2242"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 886.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (4.0 inches)                                                                                                                     | 886.2              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.7        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                 | 885.8              |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             | SILTY SAND, (SM) dark brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                               |                    | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             |                                                                                                                                                      | 884.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, some gravel<br><b>(Undocumented Fill)</b>                                       |                    | SS 2             | 58                    | 11-16-15-18 (31)  |                    |                      |                  |               |                  |       |
| 4.0        |             |                                                                                                                                                      | 882.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, moist, loose to medium dense, trace gravel, occasional silt seams<br>(Glacial Outwash) |                    | SS 3             | 78                    | 6-4-2 (6)         |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                      |                    | SS 4             | 78                    | 7-4-6 (10)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                      |                    | SS 5             | 78                    | 6-5-4 (9)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                      | 876.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
 6160 Carmen Avenue East  
 Inver Grove Heights, MN 55076  
 P: 651-389-4191  
 www.NTIgeo.com

**BORING NUMBER SB-31**

PAGE 1 OF 1  
 Long: -93° 27' 35.548"  
 Lat: 45° 16' 20.4406"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 886 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)*                                                                                                                    | 885.5              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                 | 885.1              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> |                    | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                               | 883.5              | SS 2             | 67                    | 6-17-26 (43)      |                    |                      |                  |               |                  |       |
| 4.5        |             | SILTY SAND, (SM) dark brown, fine to medium grained, moist, very dense, trace gravel (Glacial Outwash)                                               | 881.5              | SS 3             | 100                   | 6-12-20 (32)      |                    |                      |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, dense, trace gravel (Glacial Outwash)                                           | 879.5              | SS 4             | 100                   | 9-10-11 (21)      |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                      |                    | SS 5             | 33                    | 9-11-9 (20)       |                    | 4                    |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                      | 875.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-32**

PAGE 1 OF 1  
 Long: -93° 27' 35.895"  
 Lat: 45° 16' 21.3561"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 881 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                   | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                        |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                        |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.7        |             | BITUMINOUS PAVEMENT (8.0 inches)                                                                                       | CORE               | 880.3            |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | APPARENT AGGREGATE BASE (24.0 inches)                                                                                  | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.7        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, trace gravel, occasional clay seams (Undocumented Fill) | SS 2               | 878.3            | 72                    | 12-10-10 (20)     |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, moist, dense, trace gravel (Glacial Outwash)             | SS 3               | 877.0            | 72                    | 6-7-10 (17)       |                    |                      |                  |               |                  |       |
| 6.5        |             | SILTY SAND, (SM) brown, fine to medium grained, moist, medium dense, trace gravel (Glacial Till)                       | SS 4               | 874.5            | 56                    | 7-5-7 (12)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                        | SS 5               |                  | 78                    | 5-5-4 (9)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                        |                    | 870.5            |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-33**

PAGE 1 OF 1  
 Long: -93° 27' 35.529"  
 Lat: 45° 16' 22.3737"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 877.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                             | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                  |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                  |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (5.5 inches)                                                                                                 | 877.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.0        |             | APPARENT AGGREGATE BASE (6.0 inches)                                                                                             | 876.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) brown to dark brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                  | 875.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, trace gravel, occasional silt seams<br><b>(Undocumented Fill)</b> |                    | SS 2             | 78                    | 7-13-15 (28)      |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                  |                    | SS 3             | 89                    | 8-12-21 (33)      |                    |                      |                  |               |                  |       |
| 7.0        |             | SANDY LEAN CLAY, (CL) brown, moist, stiff, trace gravel<br><b>(Glacial Till)</b>                                                 | 870.5              | SS 4             | 100                   | 7-8-10 (18)       |                    |                      |                  |               |                  |       |
| 8.0        |             | SILTY SAND, (SM) gray, fine to coarse grained, saturated, dense, trace gravel<br><b>(Glacial Till)</b>                           | 869.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                  |                    | SS 5             | 83                    | 8-12-10 (22)      |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                  | 867.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**BORING NUMBER SB-34**

PAGE 1 OF 1  
 Long: -93° 27' 35.9464"  
 Lat: 45° 16' 23.409"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 874 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 867.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|---------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.1        |             | BITUMINOUS PAVEMENT (1.5 inches)*                                                                                         | CORE               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.1        |             | APPARENT AGGREGATE BASE (20.0 inches)                                                                                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             |                                                                                                                           | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                         | SS 2               | 11               | 15-11-11 (22)         |                   |                    |                      |                  |               |                  |       |
| 4.0        |             |                                                                                                                           | SS 3               | 56               | 9-6-6 (12)            |                   | 12                 |                      |                  |               |                  | 16    |
| 5.0        |             | SILTY SAND, (SM) gray to black, fine to coarse grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b> | SS 4               | 56               | 6-5-3 (8)             |                   |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                           | SS 5               | 56               | 2-2-3 (5)             |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | SILTY SAND, (SM) gray, fine to medium grained, saturated, loose, trace gravel, occasional clay seams (Glacial Till)       |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-35**

PAGE 1 OF 1  
 Long: -93° 27' 35.5595"  
 Lat: 45° 16' 24.3356"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 872 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 10.00 ft / Elev 862.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                   | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                        |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                        |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS BASE (7.5 inches)*                                                                                                          | 871.4              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.0        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                   | 871.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b>   | 870.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                        | 869.0              | SS 2             | 83                    | 6-10-12-14 (22)   |                    |                      |                  |               |                  |       |
| 5.0        |             | SILTY SAND, (SM) dark gray, fine to medium grained, moist, dense to loose, trace gravel, trace organics (Swamp Deposit)                |                    | SS 3             | 83                    | 7-7-8 (15)        |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                        |                    | SS 4             | 100                   | 4-3-2 (5)         |                    |                      |                  |               |                  |       |
| 9.0        |             | SILTY SAND, (SM) dark gray to black, fine to coarse grained, moist to saturated, loose, trace gravel, slightly organic (Swamp Deposit) | 863.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       | ▽           | NOTE: Organic content in Sample No. 5 = 2.1%                                                                                           |                    | SS 5             | 100                   | 4-3-2 (5)         |                    | 26                   |                  |               |                  |       |
| 10.5       |             |                                                                                                                                        | 861.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-36**

PAGE 1 OF 1  
 Long: -93° 27' 35.9401"  
 Lat: 45° 16' 25.2666"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 870 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 4.00 ft / Elev 866.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                           | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.4        |             | BITUMINOUS PAVEMENT (4.5 inches)                                                                                               | 869.6              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | APPARENT AGGREGATE BASE (3.0 inches)                                                                                           | 869.4              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel (Undocumented Fill)              | 868.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist to saturated, medium dense, trace gravel (Glacial Outwash) |                    | SS 2             | 67                    | 7-8-7-7 (15)      |                    |                      |                  |               |                  |       |
| 4.0        | ▽           | POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, loose, trace gravel (Glacial Outwash)                        | 866.0              | SS 3             | 78                    | 4-3-3 (6)         |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 6.5        |             | SILTY SAND, (SM) gray, fine to medium grained, saturated, loose, trace gravel (Glacial Till)                                   | 863.5              | SS 4             | 78                    | 6-3-2 (5)         |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                | 859.5              | SS 5             | 67                    | 6-3-2 (5)         |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-37**

PAGE 1 OF 1  
 Long: -93° 27' 35.5735"  
 Lat: 45° 16' 26.3459"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 867.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 9.50 ft / Elev 858.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.4        |             | BITUMINOUS PAVEMENT (4.0 inches)                                                                                                                          | 867.1              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.7        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                      | 866.8              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 865.5              | AU 1             |                       |                   |                    | 5                    |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) gray, fine to medium grained, moist, medium dense, trace gravel<br>(Swamp Deposit)                                               |                    | SS 2             | 100                   | 6-7-8 (15)        |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                           |                    | SS 3             | 67                    | 7-8-7 (15)        |                    |                      |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                           | 861.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) gray, fine to medium grained, moist to saturated, medium dense, trace gravel<br>(Swamp Deposit)                     |                    | SS 4             | 56                    | 7-9-7 (16)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    | SS 5             | 56                    | 8-6-5 (11)        |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 857.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-38**

PAGE 1 OF 1  
 Long: -93° 27' 35.9565"  
 Lat: 45° 16' 27.3554"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 868 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 861.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (4.0 inches)                                                                                     | 867.7              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.8        |             | APPARENT AGGREGATE BASE (18.0 inches)                                                                                | 866.2              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light gray, fine to coarse grained, saturated, medium dense, trace gravel (Glacial Outwash) |                    | SS 2             | 56                    | 4-6-7 (13)        |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                      |                    | SS 3             | 56                    | 4-7-6 (13)        |                    |                      |                  |               |                  |       |
| 6.5        | ▽           |                                                                                                                      | 861.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | SILTY SAND, (SM) gray, fine to coarse grained, saturated, medium dense to loose, trace gravel (Glacial Till)         |                    | SS 4             | 50                    | 6-8-6 (14)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                      |                    | SS 5             | 39                    | 2-3-3 (6)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                      | 857.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**Inver Grove Heights**  
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**BORING NUMBER SB-39**

PAGE 1 OF 2  
 Long: -93° 27' 35.5876"  
 Lat: 45° 16' 28.2537"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 868.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 11.50 ft / Elev 857.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                              | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                                   |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                                   |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (5.5 inches)*                                                                                                                                 | 868.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                              | 867.6              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel, occasional bituminous pieces, trace organics<br><b>(Undocumented Fill)</b>              | 866.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark gray to brown, fine to medium grained, moist, loose to very loose, trace gravel<br>(Swamp Deposit)                     |                    | SS 2             | 83                    | 2-3-4-3 (7)       |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                                   |                    | SS 3             | 67                    | 4-2-2 (4)         |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                                   |                    | SS 4             | 100                   | 4-2-3 (5)         |                    |                      |                  |               |                  |       |
| 7.5        |             | SILTY SAND, (SM) dark gray, fine to medium grained, moist, loose, trace gravel, occasional peat seams, occasional clay seams, slightly organic<br>(Swamp Deposit) | 861.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 9.0        |             | SANDY SILT, (ML) gray, moist, medium, trace gravel, trace organics<br>(Swamp Deposit)                                                                             | 859.5              | SS 5             | 83                    | 4-2-4 (6)         |                    | 17                   |                  |               | 61               |       |
| 11.5       | ▽           |                                                                                                                                                                   | 857.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 12.5       |             | POORLY GRADED SAND WITH SILT, (SP-SM) gray, fine to coarse grained, saturated, very loose, trace gravel, occasional peat seams and shells<br>(Swamp Deposit)      |                    | SS 6             | 100                   | 5-2-2 (4)         |                    |                      |                  |               |                  |       |
| 14.0       |             |                                                                                                                                                                   | 854.5              | SS 7             | 67                    | 1-2-4 (6)         |                    |                      |                  |               |                  |       |
| 15.0       |             | PEAT, (Pt) black, moist, soft<br>(Swamp Deposit)                                                                                                                  |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

(Continued Next Page)

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**BORING NUMBER SB-39**

PAGE 2 OF 2  
 Long: -93° 27' 35.5876"  
 Lat: 45° 16' 28.2537"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                             | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                  |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 17.5       |             | PEAT, (Pt) black, moist, soft (Swamp Deposit) <i>(continued)</i> |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             | NOTE: Organic content in Sample No. 8 = 53.7%                    |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 18.5       |             |                                                                  | SS 8               | 78               | 1-2-2 (4)             |                   |                    | 236                  |                  |               |                  |       |
|            |             |                                                                  | 850.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 18.5 feet.



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**BORING NUMBER SB-40**

PAGE 1 OF 1  
 Long: -93° 27' 35.9729"  
 Lat: 45° 16' 29.3656"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 869 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** 7.00 ft / Elev 862.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (4.0 inches)*                                                                                                                         | 868.7              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
|            |             | APPARENT AGGREGATE BASE (10.0 inches)                                                                                                                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 1.2        |             |                                                                                                                                                           | 867.8              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 1.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown to brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                      | 867.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown, fine to medium grained, saturated, trace gravel<br><b>(Undocumented Fill)</b>                                                     |                    | SS 2             | 72                    | 9-9-4 (13)        |                    | 12                   |                  |               |                  | 8     |
| 4.0        |             |                                                                                                                                                           | 865.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark gray to gray, fine to medium grained, moist to saturated, loose to very loose, trace gravel<br>(Swamp Deposit) |                    | SS 3             | 78                    | 2-3-3 (6)         |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                           |                    | SS 4             | 83                    | 2-3-2 (5)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    | SS 5             | 72                    | 2-2-2 (4)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 858.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VAROLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-41**

PAGE 1 OF 1  
 Long: -93° 27' 35.6226"  
 Lat: 45° 16' 30.2587"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 870 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 5.50 ft / Elev 864.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                               | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                                    |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                                    |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                                                                                   | 869.5              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                               | 869.1              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                             | 868.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                             |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 3.5        |             | POORLY GRADED SAND, (SP) gray, fine to medium grained, moist to saturated, dense to medium dense, trace gravel<br>(Swamp Deposit)                                  | 866.5              | SS 2             | 63                    | 7-9-8-6 (17)      |                    |                      |                  |               |                  |       |
| 5.0        |             | ▽                                                                                                                                                                  |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 6.5        |             | SILTY SAND, (SM) dark gray, fine to medium grained, saturated, very loose, trace gravel, occasional silt seams<br>(Swamp Deposit)                                  | 863.5              | SS 4             | 56                    | 4-2-2 (4)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark gray, fine to coarse grained, saturated, very loose, trace gravel, trace organics, occasional shells<br>(Swamp Deposit) | 861.0              | SS 5             | 89                    | 1-2-2 (4)         |                    | 27                   |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                                    |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                                    | 859.5              |                  |                       |                   |                    |                      |                  |               |                  | 7     |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
 6160 Carmen Avenue East  
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**BORING NUMBER SB-42**

PAGE 1 OF 1  
 Long: -93° 27' 35.9686"  
 Lat: 45° 16' 31.212"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/26/19 **COMPLETED** 9/26/19 **GROUND ELEVATION** 870.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** 9.00 ft / Elev 861.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                           | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (3.5 inches)                                                                                               | 870.2              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                           | 869.9              |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             | SILTY SAND, (SM) dark brown, fine to coarse grained, moist, trace gravel, trace organics (Undocumented Fill)                   |                    | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             |                                                                                                                                | 868.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) gray, fine to coarse grained, moist, medium dense to loose, trace gravel (Swamp Deposit) |                    | SS 2             | 67                    | 4-5-4-6 (9)       |                    | 12                   |                  |               |                  |       |
| 5.0        |             |                                                                                                                                |                    | SS 3             | 89                    | 5-3-4 (7)         |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                |                    | SS 4             | 78                    | 5-3-4 (7)         |                    |                      |                  |               |                  |       |
| 9.0        | ▽           |                                                                                                                                | 861.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             | SANDY SILT, (ML) brown, wet, medium, trace gravel (Swamp Deposit)                                                              |                    | SS 5             | 78                    | 3-3-3 (6)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                | 860.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-43**

PAGE 1 OF 1  
 Long: -93° 27' 35.9598"  
 Lat: 45° 16' 31.8671"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 871.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A ▽ AT TIME OF DRILLING 2.50 ft / Elev 869.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (3.0 inches)*                                                                                                                         | 871.3              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.8        |             | APPARENT AGGREGATE BASE (6.5 inches)                                                                                                                      | 870.7              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 869.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | ▽ POORLY GRADED SAND WITH SILT, (SP-SM) dark gray, fine to medium grained, saturated, medium dense, trace gravel<br>(Swamp Deposit)                       |                    | SS 2             | 92                    | 9-6-6-8 (12)      |                    |                      |                  |               |                  |       |
| 4.0        |             |                                                                                                                                                           | 867.5              | SS 3             | 67                    | 6-7-7 (14)        |                    | 15                   |                  |               | 73               |       |
| 5.0        |             | SANDY SILT, (ML) brown, wet to moist, rather stiff to medium, trace gravel<br>(Swamp Deposit)                                                             |                    | SS 4             | 44                    | 1-4-4 (8)         |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                           |                    | SS 5             | 67                    | 4-2-3 (5)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 861.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GIN\TARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-44**

PAGE 1 OF 1  
 Long: -93° 27' 35.957"  
 Lat: 45° 16' 33.1465"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 872.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 866.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:00 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VAROLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)*                                                                                                    | 872.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.0        |             | APPARENT AGGREGATE BASE (6.0 inches)                                                                                                 | 871.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 870.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) dark gray, fine to medium grained, moist, trace gravel, occasional silt seams<br><b>(Undocumented Fill)</b>         |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | SILTY SAND, (SM) brown to gray, fine to coarse grained, moist, trace gravel, occasional silt seams<br><b>(Undocumented Fill)</b>     | 868.5              | SS 2             | 63                    | 7-8-9-10 (17)     |                    |                      |                  |               |                  |       |
| 5.0        |             | SILTY SAND, (SM) brown to gray, fine to coarse grained, moist, trace gravel, occasional silt seams<br><b>(Undocumented Fill)</b>     |                    | SS 3             | 67                    | 8-8-7 (15)        |                    |                      |                  |               |                  |       |
| 6.5        | ▽           |                                                                                                                                      | 866.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | SILTY SAND, (SM) dark gray, fine to coarse grained, saturated, very loose, trace gravel, trace organics<br>(Swamp Deposit)           | 865.0              | SS 4             | 44                    | 3-2-2 (4)         |                    |                      |                  |               |                  |       |
|            |             | PEAT, (Pt) black, moist, soft, trace gravel<br>(Swamp Deposit)                                                                       |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | NOTE: Organic content in Sample No. 5 = 44.5%                                                                                        |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                      | 862.0              | SS 5             | 44                    | 1-1-1 (2)         |                    | 205                  |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-45**

PAGE 1 OF 1  
 Long: -93° 27' 35.9337"  
 Lat: 45° 16' 34.1427"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 874.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.00 ft / Elev 868.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                     |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)                                                                                                                    | 874.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.1        |             | APPARENT AGGREGATE BASE (6.5 inches)                                                                                                                | 873.4              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) dark brown to brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b>       | 872.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, dense, trace gravel (Glacial Outwash)                                          |                    | SS 2             | 63                    | 9-9-8-7 (17)      |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist to saturated, loose, trace gravel (Glacial Outwash)                             | 870.5              | SS 3             | 100                   | 6-4-4 (8)         |                    |                      |                  |               |                  |       |
| 6.5        | ▽           |                                                                                                                                                     | 868.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, saturated, very loose to loose, trace gravel, occasional peat seams (Glacial Outwash) |                    | SS 4             | 100                   | 4-2-1 (3)         |                    | 26                   |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                     |                    | SS 5             | 44                    | 2-3-3 (6)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                     | 864.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-46**

PAGE 1 OF 1  
 Long: -93° 27' 35.9034"  
 Lat: 45° 16' 35.2406"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 877.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A  $\nabla$  **AT TIME OF DRILLING** 3.00 ft / Elev 874.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                   | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                        |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                        |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)                                                                                                                       | 877.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.1        |             | APPARENT AGGREGATE BASE (7.0 inches)                                                                                                                   | 876.4              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown, fine to coarse grained, moist to saturated, trace gravel, occasional bituminous pieces (Undocumented Fill)                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 4.0        |             |                                                                                                                                                        | 873.5              | SS 2             | 0                     | 13-7-7-7 (14)     |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) light brown, fine to coarse grained, saturated, loose, trace gravel (Swamp Deposit)                              | 872.5              | SS 3             | 67                    | 6-3-3 (6)         |                    |                      |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) brown to gray, fine to coarse grained, saturated, loose, trace gravel (Swamp Deposit)                                         | 871.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) dark gray, fine to medium grained, saturated, very loose, trace gravel, occasional silt seams, trace organics (Swamp Deposit) |                    | SS 4             | 67                    | 2-1-2 (3)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                        |                    | SS 5             | 67                    | 0-0-1 (1)         |                    | 24                   |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                        | 867.0              |                  |                       |                   |                    |                      |                  |               |                  | 3     |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-47**

PAGE 1 OF 1  
 Long: -93° 27' 35.5649"  
 Lat: 45° 16' 36.1481"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/24/19 **COMPLETED** 9/24/19 **GROUND ELEVATION** 877.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 3.00 ft / Elev 874.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                       | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                            |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             | BITUMINOUS PAVEMENT (5.0 inches)                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.4        |             | 877.1                                                                                                                                                      | CORE               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.7        |             | 876.8                                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             | SILTY SAND, (SM) brown to dark brown, fine to coarse grained, moist to saturated, trace gravel, trace organics (Undocumented Fill)                         | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | ▽                                                                                                                                                          | SS 2               | 92               | 5-4-4-4 (8)           |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | 873.5                                                                                                                                                      | SS 3               | 100              | 2-2-3 (5)             |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | SILTY SAND, (SM) light brown, fine to medium grained, saturated, loose to very loose, trace gravel (Swamp Deposit)                                         |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.0        |             | 870.5                                                                                                                                                      | SS 4               | 67               | 4-3-1 (4)             |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, saturated, very loose, trace gravel, slightly organic, occasional peat seams (Swamp Deposit) |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | NOTE: Organic content in Sample No. 5 = 5.2%                                                                                                               | SS 5               | 100              | 2-1-1 (2)             |                   |                    | 56                   |                  |               |                  |       |
| 10.5       |             | 867.0                                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\IGNTVARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-48**

PAGE 1 OF 1  
 Long: -93° 27' 35.9317"  
 Lat: 45° 16' 37.1461"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 881 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 3.50 ft / Elev 877.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                              | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                   |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             | BITUMINOUS PAVEMENT (7.5 inches)                                                                                                                  |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             |                                                                                                                                                   | 880.4              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.2        |             | APPARENT AGGREGATE BASE (7.0 inches)                                                                                                              | 879.8              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) dark brown, fine to coarse grained, moist to saturated, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 879.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, saturated, medium dense to very loose, trace gravel<br>▽ (Swamp Deposit)                  |                    | SS 2             | 50                    | 5-6-7-6 (13)      |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                   |                    | SS 3             | 83                    | 4-3-3 (6)         |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                   |                    | SS 4             | 100                   | 1-2-0 (2)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                   |                    | SS 5             | 56                    | 0-0-0 (0)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                   | 870.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GIN\2019 VARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-49**

PAGE 1 OF 1  
 Long: -93° 27' 35.5362"  
 Lat: 45° 16' 38.1224"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 883.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A  $\nabla$  **AT TIME OF DRILLING** 6.50 ft / Elev 877.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                       | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                            |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                            |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (3.0 inches)                                                                                                                           | 883.3              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | APPARENT AGGREGATE BASE (4.0 inches)                                                                                                                       | 882.9              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, little gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 881.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                     |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | SILTY SAND, (SM) gray, fine to medium grained, moist, medium dense, trace gravel, trace organics (Swamp Deposit)                                           | 878.5              |                  | 12-15-17 (30)         |                   |                    |                      |                  |               |                  |       |
| 6.5        |             | SANDY SILT, (ML) gray, wet to moist, medium, trace gravel, occasional peat seams (Swamp Deposit)                                                           | 877.0              |                  | 10-8-5 (13)           |                   |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                            |                    |                  | 5-3-3 (6)             |                   |                    | 13                   |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                            |                    |                  | 3-2-3 (5)             |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                            | 873.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



**Inver Grove Heights**  
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**BORING NUMBER SB-50**

PAGE 1 OF 1  
 Long: -93° 27' 35.8941"  
 Lat: 45° 16' 39.1191"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 885.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 879.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GIN\2019 VARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf)  | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|--------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                      |                    |                  |                       |                    |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                      |                    |                  |                       |                    |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)*                                                                                                    | 885.0              | CORE             |                       |                    |                    |                      |                  |               |                  |       |
| 1.2        |             | APPARENT AGGREGATE BASE (8.0 inches)                                                                                                 | 884.3              | AU 1             |                       |                    |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 883.5              |                  |                       |                    |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown to brown, fine to coarse grained, moist, dense, trace gravel<br>(Glacial Outwash)               |                    | SS 2             | 75                    | 9-12-11-10<br>(23) |                    |                      |                  |               |                  |       |
| 4.0        |             | CLAYEY SAND, (SC) reddish brown, fine to coarse grained, moist, loose, trace gravel<br>(Glacial Till)                                | 881.5              | SS 3             | 67                    | 5-2-3<br>(5)       |                    | 12                   |                  |               |                  |       |
| 6.5        | ▽           | POORLY GRADED SAND, (SP) dark brown, fine to medium grained, saturated, loose, trace gravel, trace organics<br>(Glacial Outwash)     | 879.0              | SS 4             | 72                    | 5-4-3<br>(7)       |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                      |                    | SS 5             | 56                    | 2-3-3<br>(6)       |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                      | 875.0              |                  |                       |                    |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-51**

PAGE 1 OF 1  
 Long: -93° 27' 35.4952"  
 Lat: 45° 16' 40.1027"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 887 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A  $\nabla$  **AT TIME OF DRILLING** 7.50 ft / Elev 879.50 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI\2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\IGNITVARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                       | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                            |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                            |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)                                                                                                           | 886.5              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (4.5 inches)                                                                                                       | 886.1              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                     | 885.0              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown to dark brown, fine to medium grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b>            |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) light brown to dark brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b> | 883.0              | SS 2             | 75                    | 7-11-13-16 (24)   |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                            |                    | SS 3             | 100                   | 6-6-7 (13)        |                    |                      |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist to saturated, loose, trace gravel<br>$\nabla$ (Glacial Outwash)              | 880.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                            |                    | SS 4             | 67                    | 4-3-4 (7)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                            |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                            | 876.5              | SS 5             | 67                    | 3-2-3 (5)         |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-52**

PAGE 1 OF 1  
 Long: -93° 27' 35.8"  
 Lat: 45° 16' 41.0174"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 889.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 8.50 ft / Elev 881.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                    | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                         |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                         |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (5.5 inches)                                                                                                                        | 889.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (5.0 inches)                                                                                                                    | 888.6              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                               | 887.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) dark brown, fine to coarse grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b>                                  | 887.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel, occasional organic seams<br><b>(Undocumented Fill)</b>   | 885.5              | SS 2             | 75                    | 10-11-11-10 (22)  |                    |                      |                  |               |                  |       |
| 5.0        |             | SANDY LEAN CLAY, (CL) dark gray to brown, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b>                                             |                    | SS 3             | 83                    | 4-3-2 (5)         |                    | 26                   |                  |               |                  |       |
| 6.5        |             |                                                                                                                                                         | 883.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | POORLY GRADED SAND, (SP) gray to brown, fine to coarse grained, moist to saturated, medium dense, trace gravel, occasional clay seams (Glacial Outwash) |                    | SS 4             | 67                    | 6-7-7 (14)        |                    |                      |                  |               |                  |       |
| 9.0        | ▽           |                                                                                                                                                         | 880.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, saturated, loose, trace gravel (Glacial Outwash)                                   |                    | SS 5             | 100                   | 1-3-2 (5)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                         | 879.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**BORING NUMBER SB-53**

PAGE 1 OF 1  
 Long: -93° 27' 35.3739"  
 Lat: 45° 16' 46.1415"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 894.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.6        |             | BITUMINOUS PAVEMENT (7.0 inches)                                                                                                                          | 893.9              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.2        |             | APPARENT AGGREGATE BASE (7.0 inches)                                                                                                                      | 893.3              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 892.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, dense, trace gravel (Glacial Outwash)                                                      |                    | SS 2             | 58                    | 11-14-12-11 (26)  |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense to loose, trace gravel (Glacial Outwash)                                | 890.5              | SS 3             | 56                    | 7-6-5 (11)        |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                           |                    | SS 4             | 50                    | 8-3-4 (7)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND WITH GRAVEL, (SP) dark brown, fine to coarse grained, moist, medium dense (Glacial Outwash)                                            | 885.5              | SS 5             | 56                    | 7-5-6 (11)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 884.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**BORING NUMBER SB-54**

PAGE 1 OF 1  
 Long: -93° 27' 35.6145"  
 Lat: 45° 16' 50.9392"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 903.4 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                      | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)                                                                                                                          | 902.9              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.0        |             | APPARENT AGGREGATE BASE (6.0 inches)                                                                                                                      | 902.4              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 901.4              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to coarse grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                     |                    | SS 2             | 83                    | 6-7-7-7 (14)      |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, medium dense to loose, trace gravel (Glacial Outwash)                                      | 899.4              | SS 3             | 67                    | 3-6-5 (11)        |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                                           |                    | SS 4             | 56                    | 4-4-2 (6)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) light brown to white, fine grained, moist, loose, trace gravel (Glacial Outwash)                                                 | 894.4              | SS 5             | 56                    | 6-4-3 (7)         |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                           |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                           | 892.9              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\ARIOLITE BORING LOGS.GPJ



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**BORING NUMBER SB-55**

PAGE 1 OF 1  
 Long: -93° 27' 35.2133"  
 Lat: 45° 16' 55.8969"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 905.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\IGNT\ARIOLITE BORING LOGS.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                               | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                                    |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                                    |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.5 inches)                                                                                                                                   | 905.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.2        |             | APPARENT AGGREGATE BASE (8.0 inches)                                                                                                                               | 904.3              | AU 1             |                       |                   |                    | 4                    |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> |                    | SS 2             | 88                    | 11-18-19-13 (37)  |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) light brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                                       | 901.5              | SS 3             | 100                   | 6-4-6 (10)        |                    |                      |                  |               |                  |       |
| 4.5        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, medium dense, trace gravel (Glacial Outwash)                                                        | 901.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense to loose, trace gravel, occasional silt seams (Glacial Outwash)                  | 899.0              | SS 4             | 83                    | 5-5-5 (10)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                                                                    |                    | SS 5             | 67                    | 4-4-3 (7)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                                    | 895.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.



**Inver Grove Heights**  
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**BORING NUMBER SB-56**

PAGE 1 OF 1  
 Long: -93° 27' 35.519"  
 Lat: 45° 17' 1.1925"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 904.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                            | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                 |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                 |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)*                                                                                               | 904.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.2        |             | APPARENT AGGREGATE BASE (8.0 inches)                                                                                            | 903.3              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | SILTY SAND, (SM) brown, fine to medium grained, moist, trace gravel<br><b>(Undocumented Fill)</b>                               | 902.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) dark brown to brown, fine to medium grained, moist, trace gravel, trace organics<br><b>(Undocumented Fill)</b> | 900.5              | SS 2             | 75                    | 4-3-7-9 (10)      |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose, trace gravel<br>(Glacial Outwash)                         | 898.0              | SS 3             | 83                    | 6-4-4 (8)         |                    |                      |                  |               |                  |       |
| 6.5        |             | SILTY SAND, (SM) brown, fine to coarse grained, moist, loose, trace gravel<br>(Glacial Outwash)                                 | 895.5              | SS 4             | 100                   | 4-4-3 (7)         |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) brown, fine to coarse grained, moist, loose<br>(Glacial Outwash)               | 894.0              | SS 5             | 44                    | 3-2-4 (6)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                 |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-57**

PAGE 1 OF 1  
 Long: -93° 27' 35.1487"  
 Lat: 45° 17' 3.8128"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 903.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

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| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                          | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                               |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                               |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.5        |             | BITUMINOUS PAVEMENT (6.0 inches)*                                                                                             | 903.0              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.1        |             | APPARENT AGGREGATE BASE (7.0 inches)                                                                                          | 902.4              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.0        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, little gravel<br><b>(Undocumented Fill)</b>       | 901.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) tan, fine to medium grained, moist, dense, trace gravel<br>(Glacial Outwash)                         |                    | SS 2             | 75                    | 7-10-8-10 (18)    |                    |                      |                  |               |                  |       |
| 4.0        |             |                                                                                                                               | 899.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense to loose, trace gravel<br>(Glacial Outwash) |                    | SS 3             | 83                    | 5-5-5 (10)        |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                               |                    | SS 4             | 67                    | 4-4-3 (7)         |                    |                      |                  |               |                  |       |
| 9.0        |             |                                                                                                                               | 894.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, moist, medium dense, little gravel<br>(Glacial Outwash)         |                    | SS 5             | 67                    | 5-5-5 (10)        |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                               | 893.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

\*Pavement core thickness may not be representative due to crumbling during coring process.  
 Bottom of borehole at 10.5 feet.



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**BORING NUMBER SB-58**

PAGE 1 OF 1  
 Long: -93° 27' 39.0901"  
 Lat: 45° 15' 46.7893"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 901 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                               | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                    |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                    |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (3.0 inches)                                                                                   | 900.8              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.3        |             | APPARENT AGGREGATE BASE (12.0 inches)                                                                              | 899.8              | AU 1             |                       |                   |                    | 6                    |                  |               |                  |       |
| 2.5        |             | SILTY SAND, (SM) brown to dark brown, fine to coarse grained, trace gravel<br><b>(Undocumented Fill)</b>           |                    | SS 2             | 67                    | 6-6-7 (13)        |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, moist, medium dense, trace gravel (Glacial Outwash)  | 897.0              | SS 3             | 100                   | 5-5-4 (9)         |                    |                      |                  |               |                  |       |
| 6.5        |             | POORLY GRADED SAND, (SP) light gray, fine to coarse grained, medium dense to loose, trace gravel (Glacial Outwash) | 894.5              | SS 4             | 100                   | 4-6-5 (11)        |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                    |                    | SS 5             | 89                    | 3-3-4 (7)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                    | 890.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**BORING NUMBER SB-59**

PAGE 1 OF 1  
 Long: -93° 27' 41.7199"  
 Lat: 45° 15' 46.7856"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 900.5 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **▽ AT TIME OF DRILLING** 6.50 ft / Elev 894.00 ft  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                                                                              | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                                                                                   |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                                                                                   |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (3.0 inches)                                                                                                                                                                  | 900.3              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 0.9        |             | APPARENT AGGREGATE BASE (8.0 inches)                                                                                                                                                              | 899.6              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 1.5        |             | SILTY SAND, (SM) black, fine to coarse grained, moist, trace gravel, occasional bituminous pieces, slightly organic<br><b>(Undocumented Fill)</b><br>NOTE: Organic content in Sample No. 1 = 3.0% | 899.0              | AU 1             |                       |                   |                    | 4                    |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense to loose, trace gravel (Glacial Outwash)                                                                        |                    | SS 2             | 67                    | 4-5-6 (11)        |                    |                      |                  |               |                  |       |
| 5.0        |             |                                                                                                                                                                                                   |                    | SS 3             | 78                    | 4-4-3 (7)         |                    |                      |                  |               |                  |       |
| 6.5        | ▽           |                                                                                                                                                                                                   | 894.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 7.5        |             | SILTY SAND, (SM) brown, fine to medium grained, saturated, loose, trace gravel (Glacial Outwash)                                                                                                  |                    | SS 4             | 89                    | 4-4-4 (8)         |                    |                      |                  |               |                  |       |
| 9.0        |             |                                                                                                                                                                                                   | 891.5              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 10.0       |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, saturated, loose, trace gravel (Glacial Outwash)                                                                                    |                    | SS 5             | 78                    | 2-3-3 (6)         |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                                                                                   | 890.0              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**Inver Grove Heights**  
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**BORING NUMBER SB-60**

PAGE 1 OF 1  
 Long: -93° 27' 44.5573"  
 Lat: 45° 15' 46.7916"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 900 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                                 | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                                      |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                                      |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (3.5 inches)                                                                                                     | 899.7              | CORE             |                       |                   |                    |                      |                  |               |                  |       |
| 1.0        |             | APPARENT AGGREGATE BASE (8.0 inches)                                                                                                 | 899.0              |                  |                       |                   |                    |                      |                  |               |                  |       |
| 1.5        |             | SILTY SAND, (SM) dark brown, fine to coarse grained, moist, trace gravel, occasional bituminous pieces<br><b>(Undocumented Fill)</b> | 898.5              | AU 1             |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, loose, trace gravel<br>(Glacial Outwash)                 |                    | SS 2             | 89                    | 4-4-4<br>(8)      |                    |                      |                  |               |                  |       |
| 4.0        |             | POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense to loose, trace gravel<br>(Glacial Outwash)        | 896.0              | SS 3             | 100                   | 4-4-5<br>(9)      |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                                      |                    | SS 4             | 89                    | 4-4-3<br>(7)      |                    |                      |                  |               |                  |       |
| 9.0        |             | POORLY GRADED SAND, (SP) light brown, fine to coarse grained, moist, medium dense, trace gravel<br>(Glacial Outwash)                 | 891.0              | SS 5             | 100                   | 4-4-5<br>(9)      |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                                      | 889.5              |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

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**Inver Grove Heights**  
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**BORING NUMBER SB-61**

PAGE 1 OF 1  
 Long: -93° 27' 47.4813"  
 Lat: 45° 15' 46.8017"

**CLIENT** City of Ramsey **PROJECT NAME** 20-01 Variolite Street Reconstruction  
**PROJECT NUMBER** 19.MSP09109.000 **PROJECT LOCATION** Ramsey, Minnesota  
**DATE STARTED** 9/25/19 **COMPLETED** 9/25/19 **GROUND ELEVATION** 900 feet **HOLE SIZE** 6 1/2 in.  
**DRILLING CONTRACTOR** NTI **GROUND WATER LEVELS:**  
**DRILLING METHOD** 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No Groundwater observed  
**LOGGED BY** Drew Faherty **CHECKED BY** Deb Schroeder **AT END OF DRILLING** ---  
**CAVE IN (ft)** --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---  
**NOTES** Elevation determined using Trimble GeoXH 6000 (Anoka County datum).

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION                                                                                                 | ELEVATION (ft) | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS |               |                  | FINES |
|------------|-------------|----------------------------------------------------------------------------------------------------------------------|----------------|--------------------|------------------|-----------------------|-------------------|--------------------|----------------------|------------------|---------------|------------------|-------|
|            |             |                                                                                                                      |                |                    |                  |                       |                   |                    |                      | LIQUID LIMIT     | PLASTIC LIMIT | PLASTICITY INDEX |       |
| 0.0        |             |                                                                                                                      |                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 0.3        |             | BITUMINOUS PAVEMENT (3.5 inches)                                                                                     | 899.7          | CORE               |                  |                       |                   |                    |                      |                  |               |                  |       |
|            |             | APPARENT AGGREGATE BASE (18.0 inches)                                                                                |                |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 1.8        |             |                                                                                                                      | 898.2          | AU 1               |                  |                       |                   |                    |                      |                  |               |                  |       |
| 2.5        |             | POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, moist, trace gravel (Undocumented Fill)         |                | SS 2               | 78               | 4-5-6 (11)            |                   |                    |                      |                  |               |                  |       |
| 4.0        |             |                                                                                                                      | 896.0          |                    |                  |                       |                   |                    |                      |                  |               |                  |       |
| 5.0        |             | POORLY GRADED SAND, (SP) brown, fine to coarse grained, moist, loose to medium dense, trace gravel (Glacial Outwash) |                | SS 3               | 89               | 3-4-4 (8)             |                   |                    |                      |                  |               |                  |       |
| 7.5        |             |                                                                                                                      |                | SS 4               | 100              | 4-4-3 (7)             |                   |                    |                      |                  |               |                  |       |
| 10.0       |             |                                                                                                                      |                | SS 5               | 100              | 9-6-6 (12)            |                   |                    |                      |                  |               |                  |       |
| 10.5       |             |                                                                                                                      | 889.5          |                    |                  |                       |                   |                    |                      |                  |               |                  |       |

Bottom of borehole at 10.5 feet.

NTI LOG - GENERAL (USE THIS ONE) - NTI-2017-09-14.GDT - 10/10/19 14:01 - R:\RAMSEY\PROJECTS\2019 PROJECTS\20-01 VARIOLITE STREET RECONSTRUCTION\_GEO\_19.MSP\_09109.000\ENGINEERING REPORTS\GINT\VARIOLITE BORING LOGS.GPJ



**APPENDIX D**

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**NTI**<sup>™</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-1 and SB-2**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-1 Core Photograph*



*SB-2 Core Photograph*



**NTI**<sup>TM</sup>  
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**SB-3 and SB-4**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-3 Core Photograph*



*SB-4 Core Photograph*



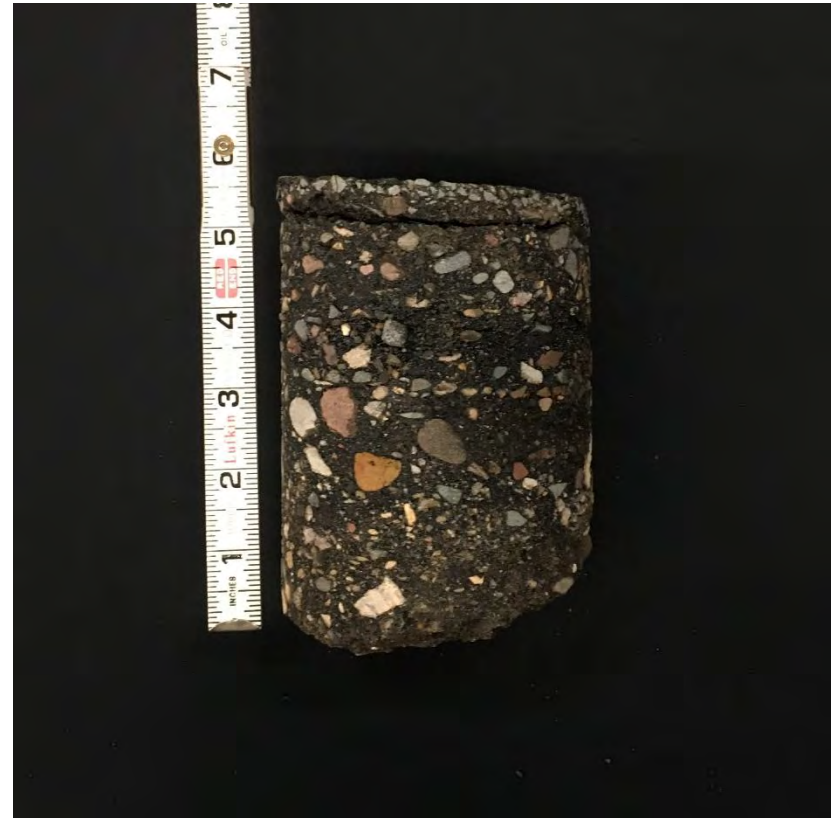
**NTI**<sup>TM</sup>  
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**SB-5 and SB-6**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-5 Core Photograph*



*SB-6 Core Photograph*



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**SB-7 and SB-8**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-7 Core Photograph*



*SB-8 Core Photograph*



**NTI**<sup>TM</sup>  
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**SB-9 and SB-10**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-9 Core Photograph*



*SB-10 Core Photograph*



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**SB-11 and SB-12**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-11 Core Photograph*



*SB-12 Core Photograph*



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**SB-13 and SB-14**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-13 Core Photograph*



*SB-14 Core Photograph*



**NTI**<sup>TM</sup>  
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**SB-15 and SB-16**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-15 Core Photograph*



*SB-16 Core Photograph*



**NTI**<sup>TM</sup>  
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**SB-17 and SB-18**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-17 Core Photograph*



*SB-18 Core Photograph*



**NTI**<sup>TM</sup>  
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**SB-19 and SB-20**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-19 Core Photograph*



*SB-20 Core Photograph*



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NORTHERN  
TECHNOLOGIES, LLC

**SB-21 and SB-22**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-21 Core Photograph*



*SB-22 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-23 and SB-24**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-23 Core Photograph*



*SB-24 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-25 and SB-26**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-25 Core Photograph*



*SB-26 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-27 and SB-28**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-27 Core Photograph*



*SB-28 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-29 and SB-30**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-29 Core Photograph*



*SB-30 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-31 and SB-32**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-31 Core Photograph*



*SB-32 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-33 and SB-34**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-33 Core Photograph*



*SB-34 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-35 and SB-36**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-35 Core Photograph*



*SB-36 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-37 and SB-38**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-37 Core Photograph*



*SB-38 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-39 and SB-40**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-39 Core Photograph*



*SB-40 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-41 and SB-42**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-41 Core Photograph*



*SB-42 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-43 and SB-44**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-43 Core Photograph*



*SB-44 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-45 and SB-46**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-45 Core Photograph*



*SB-46 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-47 and SB-48**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-47 Core Photograph*



*SB-48 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-49 and SB-50**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-49 Core Photograph*



*SB-50 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-51 and SB-52**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-51 Core Photograph*



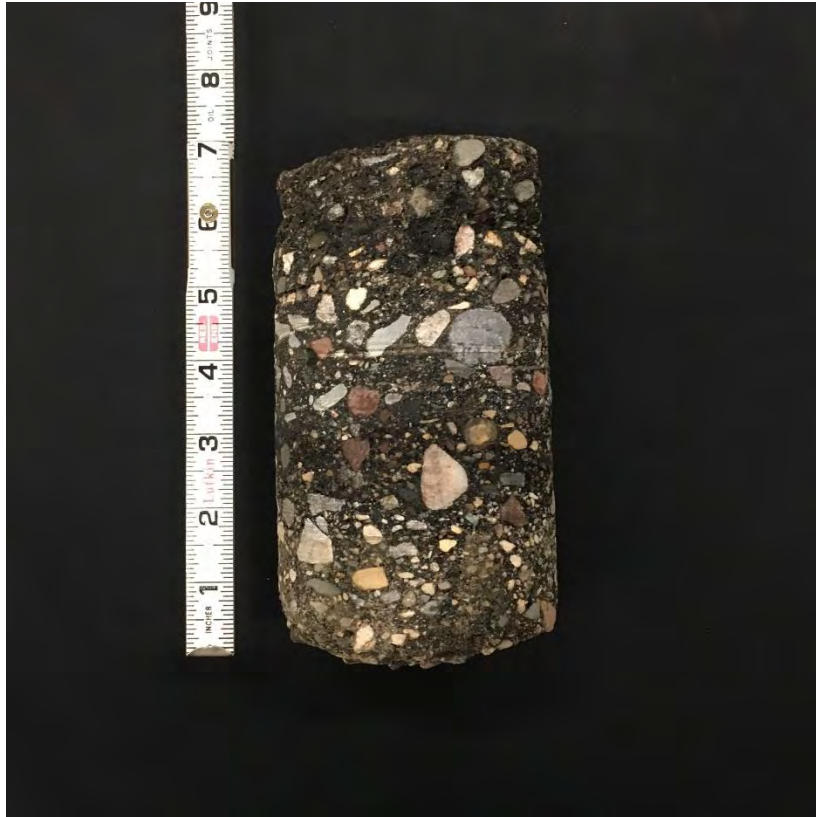
*SB-52 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-53 and SB-54**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-53 Core Photograph*



*SB-54 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-55 and SB-56**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-55 Core Photograph*



*SB-56 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-57 and SB-58**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-57 Core Photograph*



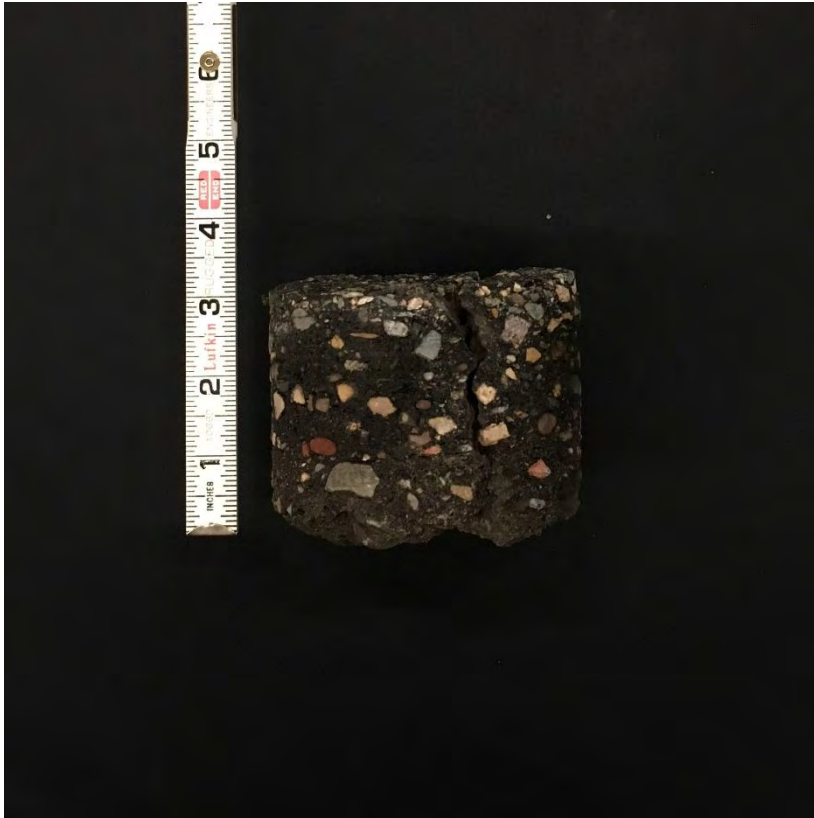
*SB-58 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-59 and SB-60**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-59 Core Photograph*



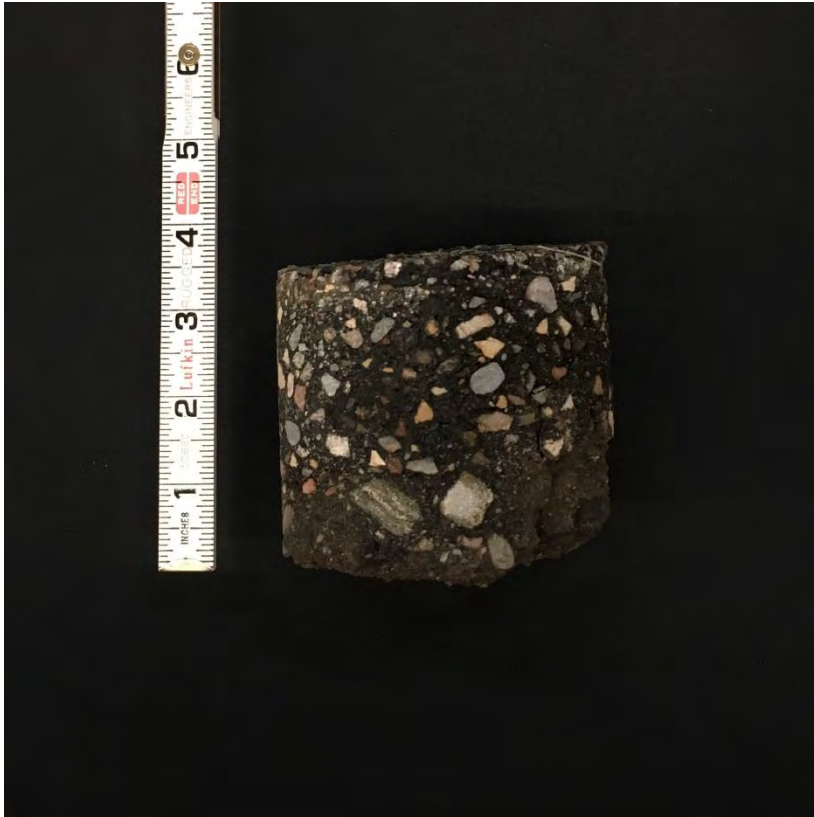
*SB-60 Core Photograph*



**NTI**<sup>TM</sup>  
NORTHERN  
TECHNOLOGIES, LLC

**SB-61**

20-01 Variolite Street Reconstruction  
19.MSP09109.000



*SB-61 Core Photograph*

March 5, 2020

Project B2001583

Joe Feriancek, PE  
City of Ramsey  
7550 Sunwood Drive NW  
Ramsey, MN 55303

Re: Summary Letter – Drain Tile Design Recommendations  
20-01 Variolite Street Reconstruction  
168th Avenue and 169th Lane  
Ramsey, Minnesota

Dear Mr. Feriancek:

This letter serves as a summary of drain tile design recommendations for a 200-foot section of Variolite Street as part of the overall street reconstruction of Variolite Street, from Alpine Drive to 173rd Avenue.

## **Our Understanding of Project**

The City of Ramsey (City) has requested the analysis and design recommendation of a drain tile system for a 200-foot section of Variolite Street which has been displaying high groundwater conditions. According to the RFP, the high groundwater condition is occurring approximately 700 feet north of the Trott Brook and adjacent wetland.

The City completed a patch of the 200-foot section back in 2015, backfilling the road with 4 feet of select granular before placing a standard pavement section on top. According to the City, it appears the patched roadway is failing, and the City has determined that high groundwater conditions are contributing to the pavement deterioration.

## **Background Information and Reference Documents**

We reviewed the following information:

- Previous geotechnical report prepared by Northern Technologies, LLC (NTI) and dated October 11, 2019 (NTI Project No. 19.MSP09109.000).

- Plan and Profile Drawing of Variolite Street from Trott Brook to 169th Lane prepared by the City and dated February 14, 2020.
- Cross Section of Variolite Street from Trott Brook to 169th Lane prepared by the City and dated February 21, 2020.
- Photographs of the patch area provided by the City with no date or time stamp available.
- Communications with the City.

## Observations

Based on our review of the background information and reference documents listed above, we have made the following observations.

- Based on our review of the soil borings and laboratory testing previously performed by NTI, it appears the soils present directly beneath the apparent aggregate base are variable, and range from poorly graded sand to silty sand with percent passing the #200 sieve ranging from 3 to 15 percent.
- Based on our review of cross sections of the study area, it appears the ditches coincidental to the subject 200-foot section of Variolite Street are relatively flat and almost non-existent with adjacent grades extending to the road surface. It is a possibility that the compromised ditch within the study area may have been a result of the construction related to the patch work previously conducted in 2015.
- After reviewing the photographs and the cross sections, it appears the patch area is retaining a significant amount of water within the aggregate base and subgrade soils. This may be the result of a bath-tub like condition where the aggregate base and subgrade soils are not allowed to drain water downhill due to increased silt within the subgrade soils. Additionally, it appears that water drainage is limited laterally by a lack of daylighted subgrade materials extending to the current relatively flat ditches that are in close proximity to the pavement surface in this area.



## Remarks

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.

If you have any questions about this summary letter, please contact Brian Schreurs at 952.995.2256 or (bschreurs@braunintertec.com) or Ray Huber at 952.995.2260 or (rhuber@braunintertec.com).

Sincerely,

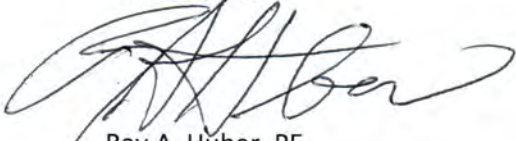
BRAUN INTERTEC CORPORATION

### 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.



Brian J. Schreurs, PE  
Project Engineer  
License Number: 53147  
March 5, 2020



Ray A. Huber, PE  
Vice President, Principal Engineer

## Memorandum

To: Joe Feriancek, PE

From: Andrea Blanchette, PE  
Tom Wood  
Sheue Torng Lee

Date: January 10, 2020

Re: Variolite Street Pavement Coring Forensic Report  
City of Ramsey  
WSB Project No. 015406-000

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### Introduction

WSB is pleased to submit this pavement forensics report detailing the results of the pavement coring which was completed on January 9, 2020 in the City of Ramsey. The various characteristics of the pavement cores were summarized to provide information to the City to assist in determining the appropriate pavement maintenance or rehabilitation method for Variolite Street.

A total of 8 pavement cores were obtained along the shoulder of Variolite Street between Alpine Drive and 173<sup>rd</sup> Avenue. The locations of the pavement cores are summarized in **Figure 1**. A summary of the pavement depths and conditions for the shoulder of the street are shown in **Table 1**. Pictures of the cores obtained can be found in the **Appendix**.



Figure 1. Pavement core locations along the shoulder of Variolite Street.

**Table 1. Pavement core location and information.**

| <b>Core ID</b> | <b>Location</b> | <b>Bituminous Depth (inches)</b> | <b>Notes</b>                                                                                                                                                                                                 |
|----------------|-----------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1              | Northbound      | 3.75                             | Top lift was 2 inches. Core was in fair condition, started to exhibit signs of deterioration. Aggregate base material was observed to be sand and gravel, with select granular material underneath the base. |
| 2              |                 | 3                                | Top lift was 1.5 inches. Core was in good condition.                                                                                                                                                         |
| 3              |                 | 4                                | Top lift was 2.25 inches. Core was in very poor condition and it had severely deterioration.                                                                                                                 |
| 4              |                 | 3.5                              | Top lift was 1.5 inches. Core was in poor condition, losing fines and binder.                                                                                                                                |
| 5              | Southbound      | 3.75                             | Top lift was 2.25 inches. Core was in good condition.                                                                                                                                                        |
| 6              |                 | 3.75                             | Top lift was 2 inches. Core was in good condition.                                                                                                                                                           |
| 7              |                 | 3.5                              | Top lift was 1.5 inches. Core was in good condition.                                                                                                                                                         |
| 8              |                 | 3.5                              | Top lift was 2 inches and it was in good condition. Bottom lift of the core was in poor condition, which part of the lift raveled off.                                                                       |

**\*Underlying the bituminous was at least 10 inches of sandy native select granular material. Underlying Core 1, there was 6 inches of a sandy gravel aggregate base.**

### **Summary of Findings**

A total of 8 cores were obtained along the shoulder of Variolite Street as shown in Figure 1. Four cores obtained along the northbound shoulder had bituminous depths ranging from 3 inches to 4 inches. 6 inches of sand and gravel was found where Core 1 was obtained, while the remaining core locations (north of Core 1) did not have gravel but a sandy select granular material was observed. Half of the cores were in poor condition showing deterioration.

Four cores obtained along the southbound shoulder had bituminous thicknesses of 3.5 inches to 3.75 inches. No gravel was found underneath the bituminous shoulder; underlying material was select granular material. One of the cores had bottom lift exhibited poor condition, while the remaining three cores were in good condition.

# **Appendix**

## Variolite Street (Shoulder)

### Coring Pictures

**Core 1 (Northbound – 157<sup>th</sup> Avenue and 158<sup>th</sup> Avenue)**



**Core 2 (Northbound – 161<sup>st</sup> Avenue and 163<sup>rd</sup> Avenue)**



Select granular material found



**Core 3 (Northbound – 166<sup>th</sup> Avenue and 168<sup>th</sup> Avenue)**



**Core 4 (Northbound – 171<sup>st</sup> Avenue and 173<sup>rd</sup> Avenue)**



**Core 5 (Southbound – 169<sup>th</sup> Avenue and 171<sup>st</sup> Avenue)**



**Core 6 (Southbound – 163<sup>rd</sup> Avenue and 164<sup>th</sup> Avenue)**



**Core 7 (Southbound – 159<sup>th</sup> Avenue and 161<sup>st</sup> Avenue)**



**Core 8 (Southbound – Alpine Drive and 156<sup>th</sup> Avenue)**

