FEASIBILITY REPORT

BROOKVIEW ESTATES
STREET RECONSTRUCTIONS

CITY IMPROVEMENT PROJECT NO. 19-02

October 18, 2018

Prepared By:

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

October 18, 2018

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

Re: Feasibility Report - City of Ramsey Improvement Project #19-02
Brookview Estates Street Reconstructions

Dear Mayor and City Council Members:

Transmitted herewith is a Feasibility Report for the proposed Brookview Estates Street Reconstructions project including; 173rd Avenue from Germanium Street to its termini cul-de-sac, and Germanium Street from 170th Lane to its termini cul-de-sac. The report examines the feasibility 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 determines the necessity, feasibility and general cost-effectiveness of the proposed improvements, including any 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 with any questions.

Sincerely,
City of Ramsey

Bruce Westby, PE
City Engineer

Enclosure

C: Kurt Ulrich, City Administrator
Leonard Linton, Civil Engineer IV

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.

Bruce Westby, PE

Date: October 18, 2018 License No. 40116

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.

Leonard Linton, PE

Date: October 18, 2018 License No. 21112

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1. EXECUTIVE SUMMARY

City Improvement Project No. 19-02 proposes to reconstruct streets within the Brookview Estates neighborhood including 173rd Avenue and Germanium Street. The streets total approximately 2,662 linear feet (0.50 miles) in length. A map showing the location and scope of the proposed improvements is included as ***Figure 1*** in ***Appendix A.***

The streets were constructed in 1979 as rural sections with bituminous pavement to a width of 24 feet, and are generally centered within a 66-foot wide right-of-way.

The storm sewer system generally consists of ditches along both sides of the road within the right-of-way and drainage and utility easements. Storm runoff collects in the ditch along Germanium Street and is carried north to the Trott Brook through an outlet pipe located in the north cul-de-sac. Storm runoff collects in the ditch along 173rd Avenue and goes across land into the Rum River to the east.

The existing bituminous pavement section ranges from 2.0 to 6.0 inches thick, with a median thickness of 3.6-inches, and the aggregate base ranges from 0.8 to 5.0 inches thick, with a median thickness of 2.7-inches. This was determined from Ground Penetrating Radar (GPR) analysis performed by Braun Intertec in 2017, as well as from field observations and record plan documents. Copies of Braun Intertec's GPR results are attached in ***Appendix C***. The pavement section was built on primarily poorly graded sands with silts subgrade material which is generally considered usable for pavement support with the proper preparation.

City staff evaluates and rates the condition of pavement sections on all City streets on an annual basis using the Pavement Surface Evaluation and Rating (PASER) system. In the summer of 2018, the pavement section of the above referenced street segments were rated with a PASER rating of 3 which indicates these streets require complete reconstruction. City staff patch the streets at least once per year, particularly before winter so the streets can be plowed without further damaging the pavement in the process. Pictures of the streets are located in ***Appendix A***.

Proposed improvement include reconstructing the existing bituminous pavement section using the Full Depth Reclamation (FDR) process. This process involves reclaiming the entire existing bituminous pavement section, along with the existing aggregate base material. A portion of this reclaimed (ground and mixed) material would then be spread and compacted on top of the reshaped and compacted subgrade. Then, 3.5 inches of bituminous pavement would be placed, generally meeting the City of Ramsey's standard pavement design for residential streets.

Existing ditches will likely require re-grading and other drainage construction is likely, however, driveway culverts are generally not anticipated to be affected by this project. Additional storm sewer is anticipated to be added to improve storm runoff water quality prior to flowing into Trott Brook. Drainage easements may be needed in one or more locations.

The engineer's opinion of probable costs for completing the proposed improvements outlined in this report is $502,555.46. Estimated costs include 5-percent contingency costs plus 23-percent

indirect costs for administrative, engineering, finance and legal costs. A summary of the engineer's opinion of probably costs is included in ***Appendix B***.

A total of 21 assessable parcels have been identified. Staff recommends applying 25-percent of the eligible project costs equally across the 21 assessable properties using the "per lot" assessment method. Eligible project cost include everything except subgrade corrections and guardrail modification costs. This results in a proposed preliminary assessment rate of $4,418.30 per assessable parcel.

Staff recommends ordering a special benefit consultation report for this project to verify the proposed assessment amount will not exceed the benefit to the properties. If the report concludes the benefit to the properties is less than the proposed preliminary assessment rate, Staff will then propose to lower the assessment rate accordingly during the Assessment Hearing, which is scheduled for October 8, 2019. If the report verifies the assessment rate as proposed is justified, Staff will propose to adopt the final assessment roll using the rate as preliminarily proposed.

Seven (7) soil borings were completed by Northern Technologies (NTI) to assist with the preparation of this report. Pavement design recommendations were offered by NTI, and Staff considered and incorporated NTI's recommendations to varying degrees while preparing this report. Ground Penetrating Radar (GPR) was conducted on street segments within the project. The GPR identifies existing bituminous pavement and aggregate base thicknesses, and is used to help Staff determine the appropriate treatment. Copies of Braun Intertec's GPR results and NTI's Geotechnical Exploration Report are attached in ***Appendix C***.

This improvement project, which is listed in the City's current 10-year Capital Improvement Plan, is proposed to be funded using a combination of special assessments to benefiting properties, street reconstruction bond proceeds, and storm sewer funds.

Staff has not yet discussed the proposed improvements with local property owners. However, Staff has scheduled a neighborhood information meeting for November 8, 2018 for the purpose of explaining the proposed improvements and assessments in more detail, and to gather public input on the project, including any information which should be explored in more detail during development of plans and specifications. Staff will incorporate comments and present this information to Council during the Public Hearing on November 13, 2018.

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

The preparation of this report was authorized by the Ramsey City Council on August 28, 2018. This project has been designated as City Improvement Project No. 19-02.

2.2 Program Overview

In support of the City's long-term Street Maintenance Program, the existing bituminous pavement section will be reconstructed, and existing ditches will be re-graded to enhance drainage. Other appurtenant work will be completed as outlined in this report.

The City's pavement evaluation process involves a visual evaluation of each street's pavement surface based on the type, extent and severity of each pavement distress observed. Numerous types of pavement distresses may exist within a pavement section including, but not limited to, alligator cracking, block cracking, longitudinal cracking, transverse cracking, rutting, raveling, shoving, potholes and patches. This field data is then used to rate the pavement condition.

The City uses the Pavement Surface Evaluation and Rating (PASER) system to rate pavement condition. A PASER rating is a numerical index between 1 and 10 indicating the condition of a pavement based on the various pavement distresses recorded during visual observations. A PASER rating of 10 represents brand new pavement, while a PASER rating of 1 represents a pavement section that has fallen into complete disrepair requiring full reconstruction.

In the summer of 2018, City Staff evaluated and rated the condition of the pavement along the Brookview Estates street segments. A PASER rating of 3 was assigned to 173rd Avenue and Germanium Street.

2.3 Scope

City of Ramsey Improvement project 19-02 proposes to reconstruct the existing bituminous pavement, re-shape the ditches to enhance drainage, and to complete other appurtenant work on 173rd Avenue from Germanium Street to its termini cul-de-sac, and Germanium Street from 170th Lane to its termini cul-de-sac which totals approximately 2,662 linear feet (0.50 miles) in length.

The existing bituminous pavement section is proposed to be reconstructed using the FDR process. This involves reclaiming the entire bituminous pavement section along with a portion of the existing aggregate base, hauling and disposing of excess reclaim material off-site, spreading and compacting the reclaimed material on top of the reshaped and compacted subgrade, then placing 3.5-inches of new bituminous pavement on top. The resulting pavement design will generally meet current City design standards for residential pavement sections.

A map showing the location and scope of the proposed improvements is included as ***Figure 1*** in ***Appendix A***.

3. EXISTING CONDITIONS

3.1 Existing Pavement, Soil, and Traffic Conditions

All streets proposed to be improved were constructed in 1979 with 1.5-inches of bituminous pavement, 3.0-inches of aggregate base, and ditches. The streets are generally centered within a 66-foot wide right-of-way.

Pavement maintenance treatments applied to the street segments included overlay in 1993, and crack seal and seal coat improvements in 2001. Spot patching has been performed on an as-needed basis, and has been a yearly treatment recently. In 2018, Staff assigned a PASER rating of 3 on both street segments.

In September of 2018, City Staff recorded a traffic volume of 72 average annual daily traffic (AADT) on 173rd Avenue east of Germanium Street, and 278 AADT on Germanium Street north of 170th Lane. The speed limit is 30 mph for these street segments.

Northern Technologies, LLC (NTI) was employed to complete a Geotechnical Exploration and Engineering Review for this project, which included seven (7) soil borings spaced evenly along 173rd Avenue and Germanium Street. The locations of the borings are shown in the Soil Boring Location Map in Appendix C of NTI's report, attached in ***Appendix C***.

The soil borings provide information on existing bituminous pavement and aggregate base course thicknesses, subgrade soil conditions, existing ground water elevations, and potential issues, which may be encountered during construction. The borings general terminated at a nominal depth of 10 feet below the existing ground surface, boring number 4 terminated at 20.5 feet as it was following a layer of clay. There was groundwater observed in 4 of 7 borings, with elevations varying from approximately 872.5 to 877, 6.5 to 9.0 feet below the existing surface. Based on the work proposed groundwater is not anticipated to be a significant issue for work completed with this proposed project. There is the small potential for groundwater impacts if storm sewer is required, and is placed at a depth greater than 6-feet below the existing ground.

The soil borings generally indicate the existing bituminous pavement thickness ranges between 2 ¼ to 5 inches, and aggregate base thickness is 5 to 6 inches. The subgrade generally consists of poorly graded sand with silt, silty sand, and poorly graded sand. Below this 4 of the 7 borings had layers of lean clay with sand, clayey sand, and / or lean to fat clay. The depths of the layers varied among the borings, and the pockets with clay seemed to be spread out along the project.

Braun Intertec was employed to complete a ground penetrating radar (GPR) analysis for the project area, which included driving the GPR equipped vehicle throughout all street segments within the project area. A summary table and charts of the GPR Analysis are attached in ***Appendix C***. The GPR data determined a median bituminous pavement thickness of 3.6-inches, and a median aggregate base thickness of 2.7-inches. The median street pavement and base section thickness was 6.2-inches, with a minimum section of 3.7-inches located on Germanium Street, 310 feet north of 173rd Avenue. GPR data was not able to be obtained for 173rd Avenue.

3.2 Watermain

Watermain does not exist on site.

3.3 Sanitary Sewer

Sanitary sewer does not exist on site.

3.4 Storm Sewer / Drainage

The storm sewer system consists of ditches along both sides of the road within the right-of-way and drainage and utility easements, which direct stormwater runoff to the ditch along Germanium Street and north to the Trott Brook through an outlet pipe located in the north cul-de-sac. Stormwater runoff is also directed to the ditch along 173rd Avenue and goes across land into the Rum River to the east.

3.5 Streets

3.5.1 Existing Typical Sections

The pavement width of 173rd Avenue and Germanium Street is 24-feet. The cul-de-sacs on 173rd Avenue and Germanium Street are 95-feet in diameter. The streets are centered within a 66-foot wide City-owned right-of-way, with a 160-foot wide right-of-way around the cul-de-sac on 173rd Avenue, and a 140-foot wide right-of-way around the cul-de-sac on Germanium Street.

3.5.2 Maintenance History

Brookview Estates was originally constructed in 1979. 173rd Avenue and Germanium Street received an overlay in 1993, and crack seal and seal coat improvements in 2001.

3.6 Land Use

The parcels within the construction area are zoned rural developing.

4. PROPOSED IMPROVEMENTS

4.1 Street and Stormwater Improvements

4.1.1 Street Improvements

The streets in Brookview Estates are proposed to be reconstructed by matching existing widths and elevations with bituminous pavement and ditch sections to carry storm water runoff to Ford Brook and the Rum River.

The proposed surface improvements are shown on ***Figure 1*** in ***Appendix A***.

Street Design:
173rd Avenue and Germanium Street are currently rural residential streets with ditch sections, 24-feet wide to the edge of pavement. The cul-de-sacs on 173rd Avenue and Germanium Street are 95-feet in diameter. Existing and proposed traffic counts are consistent with typical residential streets.

All street segments are proposed to be reconstructed at their current width. A typical section for the proposed pavement reconstruction improvements is shown in ***Figure 2*** in ***Appendix A***.

City Staff is proposing a pavement section design of 1.5-inches bituminous wear course, 2-inches bituminous base course, and 4-inches of aggregate base composed of full-depth reclamation material. This pavement section would be constructed over the existing subgrade after it is reshaped and compacted.

4.1.2 Storm Sewer Improvements

The existing ditch sections are in good condition. Re-shaping the ditches may be required due to construction, but ditches will be restored to existing grades. The existing driveway culverts are not anticipated to be replaced. No stormwater treatment improvements are required for this projects since the street is proposed to be reconstructed at its current width, however, Staff is proposing to add a treatment structure to improve storm runoff water going into Trott Brook.

4.1.3 Geotechnical Considerations

Northern Technologies LLC (NTI) completed a Geotechnical Exploration and Engineering Review including seven (7) soil borings, generally evenly spaced along 173rd Avenue and Germanium Street. The locations of the borings are shown in the Boring Location Map in Appendix C of NTI's report, attached in ***Appendix C***. NTI recommends prior to installing the aggregate base, the existing subgrade should be scarified and re-compacted to a depth of at least 12 inches. A proof roll test should then be performed to determine soft or unstable subgrade areas. 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. Based upon the encountered subgrade conditions, estimated R-value of 30 for the existing subgrade soils, the assumed AADT volumes of 600, and the City of Ramsey's typical pavement section for the respective project area NTI recommends a pavement section of 4-inches of aggregate base class 5, and 4-inches of bituminous pavement. City Staff is in close agreement and proposes completing a full-depth reclamation of the existing pavement by placing 4-inches of aggregate base class 5 or reclaim material, and 3.5-inches of new bituminous pavement. The clay layers are generally deep enough to not have a significant impact on the roadway, however Staff will be aware of the potential for pockets of subgrade which will require additional conditioning or possible replacement.

The proposed improvements should have a service life of approximately 60-years, assuming maintenance such as overlays, crack sealing and seal coating is routinely performed.

4.1.4 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 where 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.

Pavement Corings:
Existing pavement thicknesses have been found to be inconsistent throughout the City. It is now standard practice to have City Staff on-site during pavement installation to insure the proper quantities are being placed. As further conformation, Staff is proposing to collect GPR data or to have pavement corings taken at the conclusion of all reconstruction projects. This is already a requirement on all State Aid projects, and will leave more data on the pavement section for future street maintenance projects.

4.2 Stormwater Treatment

No stormwater retention and/or treatment improvements will be required as a result of this project, however, Staff is proposing stormwater treatment for storm runoff into Trott Brook.

4.3 Water Main Improvements

No watermain improvements are proposed with this project.

4.4 Sanitary Sewer Improvements

No sanitary sewer improvements are proposed with this project.

4.5 Construction Method

The existing bituminous pavement section will be reconstructed using the FDR process outlined within this report.

4.6 Private Utilities

Staff has not yet met with the telephone, gas, power and cable utilities regarding this project. 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 streets 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.

4.7 Permits

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

- MPCA General Stormwater Permit (NPDES)…..Grading and Storm Water

A stormwater permit from the Lower Rum River Watershed Management Organization will not be required with this project as street reconstruction projects are exempt.

4.8 Right-of-Ways / Easements

The existing outfall to Trott Brook is currently located on 17331 Germanium Street outside of City-owned drainage and utility easements. Staff will work with the property owner to create additional drainage and utility easement over the existing pipe, move the outfall which would also

require additional easement, or find another solution. This will be dependent upon project design and discussion with the property owner.

A low area exist outside of City-owned drainage and utility easement on 17310 Germanium Street, possible options of filling in the low area, adding addition storm sewer, or acquiring drainage and utility easements will be discussed with the property owner and are also dependent upon project design.

City Staff will obtain required right of entries on a case by case basis.

5. FINANCING

5.1 Opinion of Cost

A detailed opinion of probable costs for the proposed improvements can be found in ***Appendix B*** of this report. The opinion of probable costs incorporates anticipated 2019 construction costs for the proposed improvements with 5-percent contingency costs, plus 23-percent indirect costs for administrative, engineering, financing and legal costs.

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

NTI prepared the Geotechnical Exploration and Engineering Review, included in ***Appendix C***, at a cost of $3,250.00.

5.2 Funding

5.2.1 Assessments

A portion of the project costs is proposed to be recovered through special assessments levied against the 21 identified benefiting properties; 9 along 173rd Avenue, and 12 along Germanium Street. Assessments are proposed to be collected for eligible improvements benefiting residential properties with direct access to the improved segments of Brookview Estates as described below. A preliminary assessment summary is included below in ***Table 1***.

Residential Assessments:
Special assessments are proposed to be levied against residential properties having direct access to improved streets. To be consistent with previous applications of the Special Assessments Policy, each residential property is proposed to be assessed using the "per lot" method.

Each residential property is preliminarily proposed to be assessed at the rate of $4,418.30 per lot. Since State Statute and the City Charter do not allow for assessments to exceed the benefit to the property, Staff requests Council authorization to order a benefit appraisal consultation for this project in accordance with the City's Special Assessment Policy.

The Preliminary Assessment Map and Roll are included in ***Appendix B***.

TABLE 1
Proposed Preliminary Assessments – 173rd Avenue & Germanium Street

STREET SEGMENT	ASSESSMENT PER LOT	No. OF LOTS	TOTAL ASSESSMENTS
173rd Avenue Residential Assessment	$4,418.30	9	$39,764.70
Germanium Street Residential Assessment	$4,418.30	12	$53,019.60
TOTAL PROJECT ASSESSMENTS			**$92,784.30**

5.2.2 City Contribution

The City contribution to the project would include all funding in excess of the amount collected through special assessments to benefiting properties. No funds have been budgeted for this project. The City's share of eligible project costs related to surface (street) improvements is proposed to come from the previously encumbered 5-year Street Reconstruction and Overlay Program bonds. Stormwater Utility Funds are proposed to pay for all storm sewer improvements.

Table 2 illustrates the proposed project funding based on the design proposed within this report. This funding program assumes construction will occur in 2019.

TABLE 2
Proposed Project Funding

	ASSESSMENTS	CITY FUNDS	TOTAL
Surface	$ 80,112.90	$ 371,754.41	$ 451,867.31
Storm Sewer	$ 12,671.40	$ 38,016.75	$ 50,688.15
TOTAL	$ 92,784.30	$ 409,771.16	$ 502,555.46

Total Project Cost		**$ 502,555.46**
Less Special Assessments	-	$ 92,784.30
Subtotal	=	**$ 409,771.16**
Less City Bonding Funds	-	$ 371,754.41
Subtotal	=	**$ 38,016.75**
Less Stormwater Utility Funds	-	$ 38,016.75
TOTAL Remaining Cost	=	**$ 0**

6. PROJECT SCHEDULE

The proposed project schedule is as follows:

Council Orders Feasibility Report ..... August 28, 2018

Council Accepts Feasibility Report / Orders Public Hearing ..... October 23, 2018

Staff Conducts Neighborhood Information Meeting ..... November 8, 2018

Staff Publishes Notices of Public Hearing ..... October 26 & November 2, 2018

Council Conducts Public Hearing / Authorizes Plans and Specifications ..... November 13, 2018

Staff Conducts Private Utility Coordination Meeting ..... November, 2018

Council Approves Plans and Specifications / Authorizes Ad for Bids ..... January 22, 2019

Staff Receives Bids ..... February 20, 2019

Council Awards Contract ..... February 26, 2019

Contractor Begins Construction ..... May, 2019

Contractor Completes Construction ..... August 16, 2019

Council Orders Assessment Hearing ..... September 10, 2019

Council Conducts Assessment Hearing ..... October 8, 2019

7. CONCLUSIONS AND RECOMMENDATIONS

City of Ramsey Improvement Project No. 19-02 proposes to reconstruct the bituminous pavement section, and complete miscellaneous appurtenant work on the following street segments within the Brookview Estates residential subdivision:

1. 173rd Avenue (approx. 850 linear feet) – Germanium Street to east cul-de-sac.
2. Germanium Street (approx. 1810 feet) – 170th Lane to north cul-de-sac.

It is the recommendation of City Staff that City Project No. 19-02 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:

1. Reconstruct the existing bituminous pavement using full-depth reclamation process, meeting the City's standard residential pavement section of 4-inches aggregate base class 5 (or reclaim), 2-inches new bituminous base course, and 1 ½- inches new bituminous wear course.

2. Staff recommends excluding private irrigation system work form this project. Instead, Staff will notify property owners of pending construction as far in advance as possible, and instruct them to relocate their irrigation system(s) away from the construction area during construction, then allow replacement in or near the original location after construction is complete.

3. Staff recommends holding a neighborhood information meeting on November 8, 2018 to inform property owners of the proposed improvements and to gather their input prior to competing plans and specifications and requesting Council approval to advertise for bids as outlined in the project schedule.

4. Order an assessment appraisal consultation to ensure special assessments do not exceed the benefit received as a result of the improvements.

The City Council is asked to act on the following items related to the proposed project:

1. Accept the preliminary residential special assessment rate of $4,418.30 per lot.

2. Authorize an assessment appraisal consultation to ensure all special assessments are commensurate with benefit received from the proposed improvements.

3. Adopt Resolution #18-220 accepting this Feasibility Report and ordering the Public Hearing for November 13, 2018.

APPENDIX A

Figure 1 – Project Scope
Figure 2 – Typical Section
Project Site Pictures

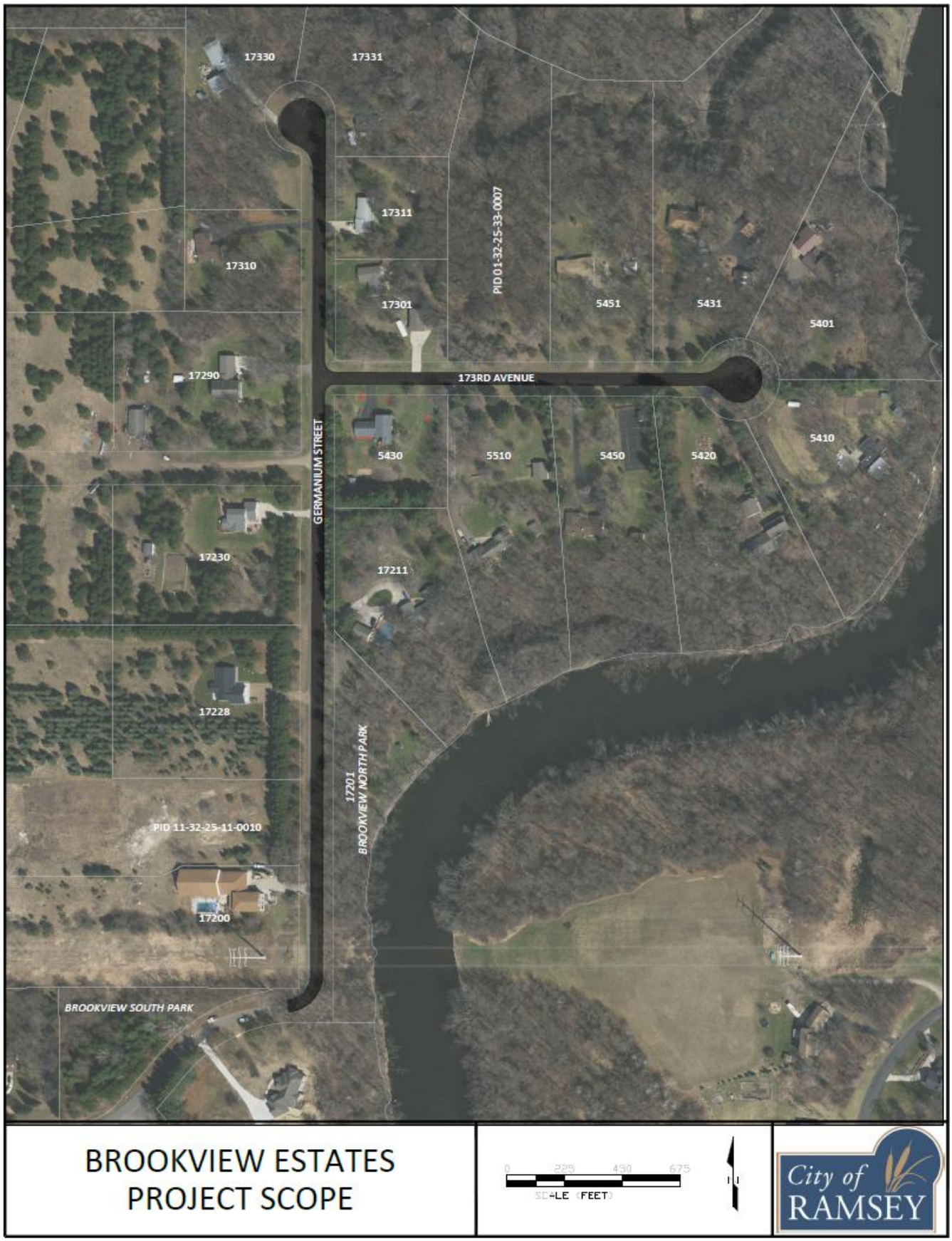

17330
17331
17311
17310
17301
PID 01-32-25-33-0007
5451
5431
5401
17290
173RD AVENUE
GERMANIUM STREET
5430
5510
5450
5420
5410
17230
17211
17228
17201
BROOKVIEW NORTH PARK
PID 11-32-25-11-0010
17200
BROOKVIEW SOUTH PARK
BROOKVIEW ESTATES
PROJECT SCOPE
0
225
450
675
SCALE (FEET)
City of
RAMSEY

FIGURE 1

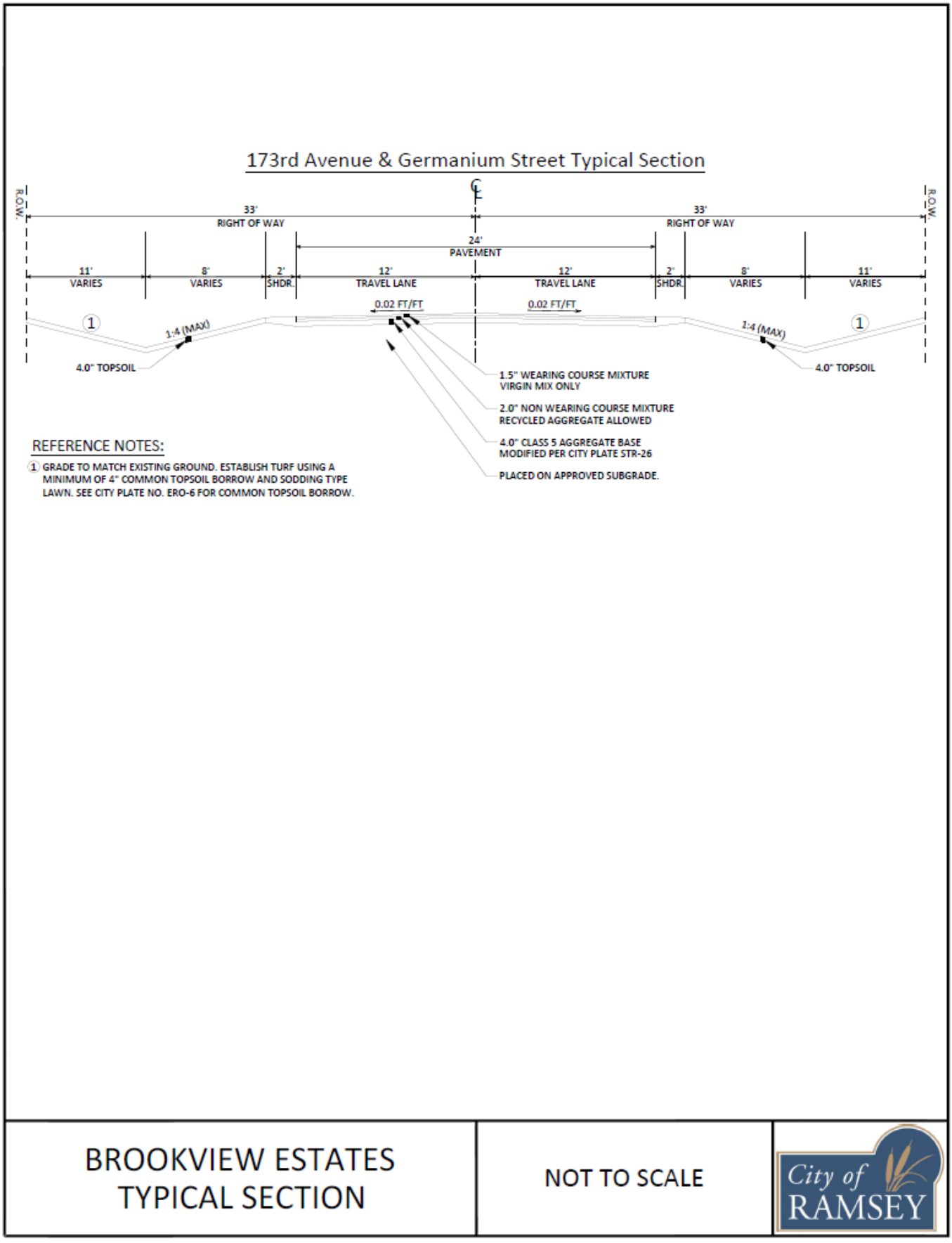

173rd Avenue & Germanium Street Typical Section
R.O.W.
33'
RIGHT OF WAY
33'
RIGHT OF WAY
R.O.W.
24'
PAVEMENT
11'
VARIES
8'
VARIES
2'
SHDR.
12'
TRAVEL LANE
12'
TRAVEL LANE
2'
SHDR.
8'
VARIES
11'
VARIES
0.02 FT/FT
0.02 FT/FT
1
1:4 (MAX)
1:4 (MAX)
1
4.0" TOPSOIL
4.0" TOPSOIL
1.5" WEARING COURSE MIXTURE
VIRGIN MIX ONLY
2.0" NON WEARING COURSE MIXTURE
RECYCLED AGGREGATE ALLOWED
4.0" CLASS 5 AGGREGATE BASE
MODIFIED PER CITY PLATE STR-26
PLACED ON APPROVED SUBGRADE.
REFERENCE NOTES:
1 GRADE TO MATCH EXISTING GROUND. ESTABLISH TURF USING A MINIMUM OF 4" COMMON TOPSOIL BORROW AND SODDING TYPE LAWN. SEE CITY PLATE NO. ERO-6 FOR COMMON TOPSOIL BORROW.
BROOKVIEW ESTATES
TYPICAL SECTION
NOT TO SCALE
City of
RAMSEY

FIGURE 2

PROJECT SITE PICTURES

Picture 1: Germanium Street from 170th Lane

Picture 2: Germanium Street from 173rd Avenue

Picture 3: 173rd Avenue from Germanium Street

Picture 4: 173rd Avenue cul-de-sac, looking west

Picture 5: Germanium Street cul-de-sac, looking south

APPENDIX B

Opinion of Probable Costs (Preliminary Engineer's Estimate)
Preliminary Assessment Map
Preliminary Assessment Roll

19-02 BROOKVIEW ESTATES STREET RECONSTRUCTIONS					
Preliminary Engineer's Estimate					
Street Construction					
Item No.	**Description**	**Unit**	**Estimated Quantity**	**Unit Cost**	**Cost Extension**
1	Mobilization	LS	1	$ 12,000.00	$ 12,000.00
2	Remove Concrete Pavement – Driveways	SF	878	$ 2.50	$ 2,195.00
3	Remove Bituminous Pavement – Driveways	SY	180	$ 7.00	$ 1,260.00
4	Remove Bituminous Pavement	SY	8,145	$ 3.50	$ 28,507.50
5	Sawing Concrete Pavement – Full Depth	LF	98	$ 4.00	$ 392.00
6	Sawing Bituminous Pavement – Full Depth	LF	257	$ 2.50	$ 642.50
7	Salvage and Install Mail Box Support	EA	18	$ 200.00	$ 3,600.00
8	Temporary Mail Box Cluster	EA	2	$ 400.00	$ 800.00
9	Common Excavation (EV)	CY	250	$ 21.00	$ 5,250.00
10	Subgrade Excavation, Remove Unsuitable Material (EV)	CY	500	$ 10.00	$ 5,000.00
11	Select Granular Borrow (CV)	CY	600	$ 15.00	$ 9,000.00
12	Common Topsoil Borrow (CV)	CY	292	$ 31.00	$ 9,052.00
13	Subgrade Preparation	RDST	27	$ 200.00	$ 5,400.00
14	Aggregate Base Class 5	CY	1,345	$ 15.00	$ 20,175.00
15	Mill Bituminous Pavement (2' x 1.5")	SY	21	$ 20.00	$ 420.00
16	Bituminous Material for Tack Coat	GAL	571	$ 2.40	$ 1,370.40
17	Type SP 9.5 Wearing Course Mixture	TON	672	$ 71.00	$ 47,712.00
18	Type SP 12.5 Non Wearing Course Mixture	TON	896	$ 64.00	$ 57,344.00
19	Type SP 9.5 Wearing Course Mixture – Driveways	TON	20	$ 71.00	$ 1,420.00
20	Concrete Curb & Gutter Design B618	LF	646	$ 12.00	$ 7,752.00
21	Drainage Improvements	LS	1	$ 65,000.00	$ 65,000.00
22	6" Concrete Driveway Pavement	SF	878	$ 7.25	$ 6,365.50
23	Landscape Restoration	LS	1	$ 2,500.00	$ 2,500.00
24	Guardrail Modifications	LS	1	$ 15,000.00	$ 15,000.00
25	Traffic Control	LS	1	$ 2,500.00	$ 2,500.00
26	Silt Fence, Type MS	LF	1,860	$ 2.50	$ 4,650.00
27	Storm Drain Inlet Protection	EA	4	$ 175.00	$ 700.00
28	Sodding Type Lawn	SY	4,410	$ 7.00	$ 30,870.00
				Total Street Construction Cost	*$ 349,877.90*
				5% Contingency Cost	*$ 17,493.90*
				23% Indirect Cost	*$ 84,495.51*
				Total Street Project Cost	*$ 451,867.31*

Storm Sewer Construction					
Item No.	**Description**	**Unit**	**Estimated Quantity**	**Unit Cost**	**Cost Extension**
1	Geotextile Fabric Type V	SY	21	$ 3.50	$ 73.50
2	15” RC Pipe Apron	EA	4	$ 600.00	$ 2,400.00
3	Trash Guard for 15” RC Pipe Apron	EA	4	$ 275.00	$ 1,100.00
4	15” RC Pipe Sewer, Design 3006 Class III	LF	628	$ 33.00	$ 20,724.00
5	Construct Drainage Structure Design 48-4020	EA	3	$ 2,500.00	$ 7,500.00
6	Construct Drainage Structure Design Special 48-4020	EA	1	$ 3,500.00	$ 3,500.00
7	F&I Casting Assembly – Storm	EA	4	$ 800.00	$ 3,200.00
8	Random Rip Rap Class III	CY	5	$ 150.00	$ 750.00
				Total Storm Sewer Construction Cost	*$ 39,247.50*
				5% Contingency Cost	*$ 1,962.38*
				23% Indirect Cost	*$ 9,478.27*
				Total Storm Sewer Project Cost	*$ 50,688.15*
				Total Estimated Project Cost	**$ 502,555.46**

BROOKVIEW ESTATES
ASSESSABLE PROPERTIES

0 125 250 375

SCALE (FEET)

N

City of RAMSEY

PRELIMINARY ASSESSMENT ROLL – 19-02 BROOKVIEW ESTATES STREET RECONSTRUCTIONS							
PID	**NAME / OWNER**	**ADDRESS**	**CITY**	**STATE**	**ZIP**	**ASSESSABLE UNITS**	**PROPOSED ASSESSMENT**
013225330002	MC SHANE DANIEL M	17310 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
013225330003	LADEEN JULIE A & MARK A	17330 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
013225330004	JONES DAVID J & DEBORAH A	17331 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
013225330005	LUND DONALD N & MARGERY A	17311 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
013225330006	NORCUTT TRUSTEE KATHLEEN & NORCUTT TRUSTEE RICHARD	17301 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
013225330007	NACHTWEY MICHAEL F & MARY J		RAMSEY	MN	55303	1	$ 4,418.30
013225330008	ROHL MORRIS G & SHARON L	5451 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
013225330009	STEFFEN JAMES W & LISA F	5431 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
013225330010	VOSS WALTER W & SALLY	5401 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
113225110007	CHUBB JEREMY	17200 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
113225110009	OSHAUGHNESSY CORRIN	17228 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
113225110010	OSHAUGHNESSY CORRIN		RAMSEY	MN	55303	1	$ 4,418.30
123225220003	PLACHECKI HALI	5410 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220004	ONGIE CHERYL	5420 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220005	WEBER JAMES J & DIANE M	5450 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220006	KREYER GARY R & JUDITH G	5510 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220007	PETERSON SEAN	5530 173RD AVE NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220008	BOEHLAND LYNN C & JOY L	17211 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220009	RAMSEY CITY OF	17201 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220010	ABERLE RICHARD N & CLAUDIA M	17290 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
123225220011	KANIA HENRY & JANINA	17230 GERMANIUM ST NW	RAMSEY	MN	55303	1	$ 4,418.30
TOTALS						**21**	**$ 92,784.30**

APPENDIX C

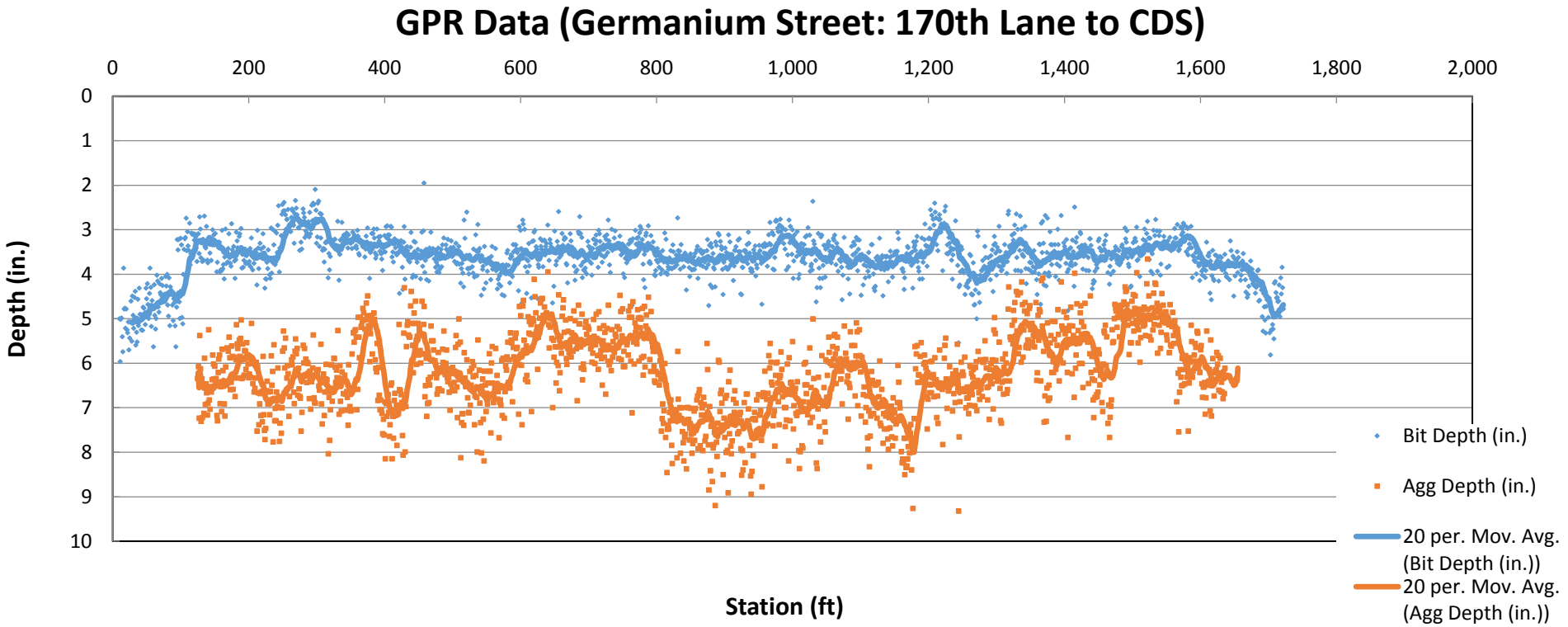
Street Segment Summary
Ground Penetrating Radar (GPR) Results
Geotechnical Exploration and Engineering Review

STREET SEGMENT SUMMARY

Street	Segment Description	Length	Width	Curb	2018 Rating	Year Built	Maint. 1	Maint. 2
173rd Avenue	Germanium Street / CDS	853	24	n/a	3	1979	OL 1993	SC 1 2001
Germanium Street	170th Lane / CDS	1,809	24	n/a	3	1979	OL 1993	SC 1 2001

Brookview Estates GPR Summary										
Project Segment		**Pavement**			**Aggregate**			**Section**		
Street	**Segment Description**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Med**	**Min**	**Location**
173rd Avenue	Germanium Street / CDS	*								
Germanium Street	170th Lane / CDS	2.0	6.0	3.6	0.8	5.0	2.7	6.2	3.7	310' north of 173rd Avenue.
Project Summary		*2.0*	*6.0*	*3.6*	*0.8*	*5.0*	*2.7*	*6.2*	*3.7*	*Germanium Street 310 feet north of 173rd Avenue.*

* GPR Data was not able to be conducted along street segments.



GEOTECHNICAL EXPLORATION AND ENGINEERING REVIEW

Brookview Estates Reconstruction

Ramsey

Minnesota

NTI Project No. 18.MSP06855.000

***Prepared For**:*

City of Ramsey
7550 Sunwood Drive
Ramsey, Minnesota 55303

NTI
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™

October 8, 2018

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

Subject: Geotechnical Exploration and Engineering Review
Brookview Estates Reconstruction
Ramsey, Minnesota
NTI Project No. 18.MSP06855.000

Northern Technologies, LLC (NTI) has completed a total of seven (7) soil borings in the Brookview Estates area. Our services were performed in accordance with our proposal dated September 4, 2018.

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

Robert Hawkins, GIT
Staff Geologist

Steven D. Gerber, P.E.
Senior 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.

Steven D. Gerber
Date: 10/08/2018 Reg. No. 45298

Contents

1.0 Scope of Services

Seven borings were in the project area. 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 pavement design thickness.

1.1 Project and Site Description

The project consists of the complete reconstruction of Germanium Street at 173rd Avenue 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.

The pavement sections are proposed to be designed with a 20-year design pavement life. NTI has assumed an AADT value of 600 for these residential streets.

2.0 Subsurface Exploration Summary

NTI performed the subsurface exploration program during the period of September 26, 2018 with a two-person crew using a truck-mounted CME-55 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." The boring locations and depths were determined by a representative of the City of Ramsey. The boring locations were marked in the field by NTI. The borings terminated at depths ranging from approximately 10.5 to 20.5 feet below the top of pavement. Elevations were determined using a Trimble GeoXH 6000 and rounded to the nearest one-half foot.

Please refer to the Boring Location Diagrams and the Boring Logs in Appendix C.

Groundwater was observed at depths ranging between 6.5 and 9 feet below the ground surface, correspond to elevations ranging between 876.5 and 872.5.

The lack of observed groundwater in the remaining borings is likely due to the short duration for which the boreholes remained open. In addition, the seams of on-site clay and 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.

Table 1 summarizes the encountered subsurface conditions encountered.

Table 1: Pavement and Subgrade Summary[1]

Boring No.	Bituminous Pavement Thickness[2] (inches)	Apparent Aggregate Base Thickness[3] (inches)	Fill Subgrade Material[4]	Native Subgrade Material [5]
SB-1	4 ½	5	SC	SM
SB-2	2 ¼	4	SP-SM	SP
SB-3	4 ½	4	SM	SM
SB-4	4 ½	5	SP-SM	SP-SM
SB-5	5	6	SM	SP-SM
SB-6	5	6	SM	SM
SB-7	4 ¼	6	SM	CL

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 and is not meant to confer conformance with DOT specifications.
4. Undocumented fill soils were encountered immediately under the aggregate base.
5. The native soils underlying the undocumented fill soils.

2.1 Groundwater and Groundwater Control

Groundwater was observed at the time of drilling. Groundwater was observed in four of the seventeen boreholes the Interstate Area ranging from depths of approximately 6.5 to 8.0 feet below the top of pavement. The lack of observed groundwater at the remaining boring locations may be due to the short duration for which the boreholes remained open combined with the low permeability of the on-site clay and silt based soils. In addition, the on-site clay and 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.

2.2 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.

2.3 Utilities

The fill and native soils observed in soil borings were generally suitable for utility support. Due to the observed groundwater levels and depending on the installation depth of the utilities, temporary dewatering would likely be required during the utility trench excavations for deeper utilities, such as sanitary sewer. Stabilization of the trench subgrade may be required, in particular in locations with lean clay subgrade, 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.

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 with a vibratory roller to 95 percent standard Proctor dry density (ASTM D698). Such observations and testing should be performed prior to backfilling.

The on-site, non-organic soils are anticipated to be suitable for reuse if properly moisture conditioned and compacted. 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.

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).

2.4 Pavement Recommendations

Full Reconstruction Option

The most conservative method of subgrade preparation would be to remove the undocumented fill soils and replace them in their entirety with properly compacted engineered fill. This method of subgrade preparation would provide the most uniform subgrade but would also be the most costly method of construction and would be a relatively a-typical method of subgrade preparation for improvements to existing municipal roadways.

If the City were willing to accept some risk in potential long term increased maintenance of the pavement section for the significant upfront savings, the roadway can be reconstructed over the existing fill.

The Contractor should be aware that the silty 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.

Prior to installing the aggregate base, the existing subgrade should be scarified and re-compacted to a depth of at least 12 inches. 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.

For a 20-year design pavement life, Tables 4 presents our thickness recommendations for flexible (bituminous) pavement. These recommendations were based upon the encountered subgrade conditions, estimated R-value of 30 for the existing subgrade soils, the assumed AADT volumes, and the City of Ramsey's typical pavement section for the respective project area.

Table 4: Flexible Pavement Thickness Design[1]
Interstate Area – Residential Area

Pavement Section	Calculated Required Pavement Section[2]	City's Typical Pavement Section[3]
Bituminous Wear Course (inches)	2	1.5
Bituminous Base Course (inches)	2	2
Class 5 or 7 Aggregate Base (inches)	4	4

1. Assumed AADT volume of 600 and an average R-value of 30.
2. Assumed a minimum of 12 inches of engineered subgrade.
3. The subgrade appeared to be less firm at SB-2 and SB-7 (locations closest to the Rum River). Consideration could be made to using the City's standard section in locations north of SB-2 and west of SB-6.

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.

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.

Mill and Overlay Option

Portions of the roadway sections appear to have a sufficiently thick, in-place pavement section, which would lend itself to rehabilitation via mill and overlay techniques.

The existing pavement thickness generally about 4 ½ inches thick, but locally was observed to be about 2 ½ inches thick. If a mill and overlay were performed, we would recommend that thin pavement areas (such as near SB-2) and distressed pavement areas be removed and replaced with a full depth (6 inch) patch.

Full depth reclamation (FDR) would be feasible for this project area. Usually a blend of mineral aggregate base with the bituminous pavement is blended and the teeth of the reclaimers need to extend beyond the bituminous layers in order to prevent overheating.

The pavement could be milled off and removed and replaced with fresh bituminous pavement. The millings can be blended with on-site aggregate base, with imported aggregate base or remixed at the plant to provide fresh aggregate base. The blended material should contain no more than 50 percent bituminous millings. In general, locations suitable for FDR would have aggregate base that is about the same thickness as the pavement plus 3 to 4 inches remaining to support the weight of the heavy machinery required for FDR.

We recommend that the base be proof-rolled prior to placement of the new pavement materials 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 (1”) 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. Excavations for soil corrections (if any) in paved areas should allow for a 2 foot oversize beyond the edges of the pavement.

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.

3.0 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.

3.1 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.

4.0 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 for specific application to the proposed Brookview Estates Street Reconstructions, 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.

Northern Technologies, LLC

APPENDIX A

GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

FIELD EXPLORATION PROCEDURES

GENERAL NOTES

WATER LEVEL SYMBOL

DESCRIPTIVE TERMINOLOGY

RELATIVE PROPORTIONS

PARTICLE SIZES

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

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.

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.

GENERAL NOTES

DRILLING and SAMPLING SYMBOLS		*LABORATORY TEST SYMBOLS*	
SYMBOL	**DEFINITION**	**SYMBOL**	**DEFINITION**
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_U	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
3T	3" Thin Wall Tube Sample	Q_C	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

RELATIVE DENSITY		*CONSISTENCY*	
TERM	**N_{60} Value** (corrected)	**TERM**	**N_{60} Value** (corrected)
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

TERMS	**RANGE**
Trace	0 – 5%
A little	5 – 15%
Some	15 – 30%

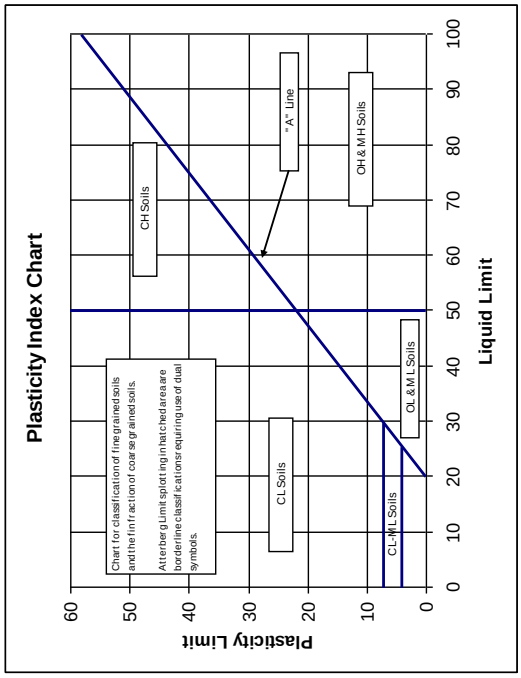
PARTICLE SIZES

MATERIAL	**DESCRIPTION**	**U.S. SIEVE SIZE**
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		
Course Grained Soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve.	Clean Gravels	GW	Well –graded gravels and gravel-sand mixtures, little or no fines.	**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 duel symbols.	Cu = D60 / D10 greater than 4. Cz = (D30)2 / (D10 x D60) between 1 & 3.	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.		Not meeting both criteria for GW materials.	
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures.		Atterberg limits below "A" line, or P.I. less than 4.	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			GC	Clayey gravels, gravel-sand-clay mixtures.		Atterberg limits above "A" line with P.I. greater than 7.	
	Sands More than 50% of coarse fraction passes No 4 sieve.	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines.		Cu = D60 / D10 greater than 6. Cz = (D30)2 / (D10 x D60) between 1 & 3.	
			SP	Poorly-graded sands and gravelly sands, little or no fines.		Not meeting both criteria for SW materials.	
		Sands with Fines	SM	Silty sands, sand-silt mixtures.		Atterberg limits below "A" line, or P.I. less than 4.	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures.		Atterberg limits above "A" line with P.I. > 7.	
Fine Grained Soils More than 50% passes No. 200 sieve *	Silts and Clays Liquid Limit of 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.			
			OL	Organic silts and organic silty clays of low plasticity.			
	Silts and Clays Liquid Limit greater than 50%.		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.			
			CH	Inorganic clays of high plasticity, fat clays.			
			OH	Organic clays of medium to high plasticity.			
	Highly Organic Soils		Pt	Peat, muck and other highly organic soils.			



APPENDIX B

GROUNDWATER ISSUES

PLACEMENT and COMPACTION OF ENGINEERED FILL

GROUNDWATER ISSUES

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

Note that our groundwater 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, groundwater 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 groundwater may be present within sand and silt lenses bedded within cohesive soil formations. Groundwater typically exists at depth within cohesive and cohesionless soils.

Documentation of the local groundwater surface and any perched groundwater conditions at the project site would require installation of temporary piezometers and extended monitoring due to the relatively low permeability exhibited by the site soils. We have not performed such groundwater evaluation due to the scope of services authorized for this project.

We anticipate that a system of sump pits and pumps located outside of the foundation areas would be suitable for control if perched groundwater were to be encountered. NTI cautions that such seepage may be heavy and will vary based on seasonal and annual precipitation, and ground related impacts in the vicinity of the project.

We anticipate that a well point system would be suitable for control of groundwater if excavations were to be advanced into the ground water table at depth in free draining granular soils. However, we caution such seepage from such formations and any water entry from excavations below the groundwater table may be heavy and will vary based on seasonal and annual precipitation, and ground related impacts in the vicinity of the project.

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, or SM. 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.

	Compaction Criteria (% respective Proctor) [1]	
Type of Construction	**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

1. 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). Recommendations for interior fill placement and backfill of foundation walls are presented within other sections of this report.

APPENDIX C

BORING LOCATION DIAGRAM

SOIL BORING LOGS

N

Boring Location Diagram
Brookview Estates Street Reconstructions
Ramsey, Minnesota
NTI Project #: 18.MSP06855.000
NOTE: Boring locations are approximate.

Completed Boring Locations:

NTI NORTHERN TECHNOLOGIES, LLC

Inver Grove Heights
6160 Carmen Avenue East
Inver Grove Heights, MN, 55076
P: 651-389-4191

BORING NUMBER SB-1

CLIENT City of Ramsey
PROJECT NAME Brookview Estates Street Reconstructions
PROJECT NUMBER 18.MS06855.000
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/18 **COMPLETED** 9/26/18
GROUND ELEVATION 884 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 RRH **CHECKED BY** SDG
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation determined using a Trimble GeoXH 6000(NAVD 88 GeoID 09 datum).

DEPTH (ft)	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0	0.4	BITUMINOUS PAVEMENT (4 1/2 Inches) 883.6	AU									
	0.8	APPARENT AGGREGATE BASE (5 Inches) 883.2	SS 1	89	4-3-3 (6)			17				
	1.5	CLAYEY SAND, (SC) black, fine grained, moist, trace gravel **(Undocumented Fill)** NOTE: Organic content in sample 1 = 3.2%. 882.5	SS 2	100	7-14-16 (30)							
	4.0	SILTY SAND, (SM) brown, fine grained, moist, trace gravel (Alluvial) 880.0										
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, moist, medium dense, trace gravel (Alluvial)	SS 3	89	7-5-5 (10)			9				11
	6.5	877.5										
		LEAN CLAY WITH SAND, (CL) brown, moist, medium, trace gravel (Alluvial)	SS 4	100	2-2-3 (5)			32				
	9.0	875.0										
10	10.5	CLAYEY SAND, (SC) brown to light brown, fine grained, moist, medium, stratified, trace gravel, with clay and sand layering (Alluvial) 873.5	SS 5	100	2-2-4 (6)							

Bottom of borehole at 10.5 feet.

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Inver Grove Heights, MN, 55076
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BORING NUMBER SB-2

CLIENT City of Ramsey
PROJECT NAME Brookview Estates Street Reconstructions
PROJECT NUMBER 18.MS06855.000
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/18 **COMPLETED** 9/26/18
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
▽ **AT TIME OF DRILLING** 6.50 ft / Elev 877.00 ft
LOGGED BY RRH **CHECKED BY** SDG
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation determined using a Trimble GeoXH 6000(NAVD 88 GeoID 09 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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.2 BITUMINOUS PAVEMENT (2 1/4 Inches)	883.3	AU									
		0.5 APPARENT AGGREGATE BASE (4 Inches)	883.0	SS 1	100	5-6-9 (15)			6				
		1.5 POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel **(Undocumented Fill)**	882.0	SS 2	89	4-4-5 (9)							
		POORLY GRADED SAND, (SP) light brown, fine grained, moist, medium dense to very loose, trace gravel (Alluvial)											
5		▽		SS 3	100	3-4-4 (8)							
				SS 4	100	2-1-1 (2)							
10				SS 5	100	1-1-1 (2)							
		13.0	870.5	SS	89	4-4-3 (7)							

Bottom of borehole at 13.0 feet.

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Inver Grove Heights, MN, 55076
P: 651-389-4191

BORING NUMBER SB-3

CLIENT City of Ramsey
PROJECT NAME Brookview Estates Street Reconstructions
PROJECT NUMBER 18.MS06855.000
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/18 **COMPLETED** 9/26/18
GROUND ELEVATION 883 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 876.50 ft
LOGGED BY RRH **CHECKED BY** SDG
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation determined using a Trimble GeoXH 6000(NAVD 88 GeoID 09 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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4 1/2 Inches)	882.6	AU									
		0.7 APPARENT AGGREGATE BASE (4 Inches)	882.3	SS 1	89	4-6-8 (14)							
		1.5 SILTY SAND, (SM) dark brown, fine grained, moist, trace gravel **(Undocumented Fill)**	881.5	SS 2	89	5-4-4 (8)			7				
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, loose to very loose, trace gravel (Alluvial)											
5				SS 3	100	3-2-3 (5)							
		▽		SS 4	89	2-2-2 (4)							
		9.0	874.0										
10		LEAN CLAY WITH SAND, (CL) brown, moist, soft, trace gravel (Alluvial)		SS 5	100	2-1-1 (2)							
		13.0	870.0	SS 6	89	2-2-2 (4)			22				
		LEAN TO FAT CLAY, (CH/CL) gray, moist, soft, trace gravel (Alluvial)		SS 7	100	2-1-1 (2)			46				
15		19.0	864.0										
20		CLAYEY SAND, (SC) gray, moist, rather stiff, trace gravel (Glacial Till)		SS 8	100	6-7-7 (14)							
		20.5	862.5										

Bottom of borehole at 20.5 feet.

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BORING NUMBER SB-4

CLIENT City of Ramsey
PROJECT NAME Brookview Estates Street Reconstructions
PROJECT NUMBER 18.MS06855.000
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/18 **COMPLETED** 9/26/18
GROUND ELEVATION 883 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 876.50 ft
LOGGED BY RRH **CHECKED BY** SDG
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation determined using a Trimble GeoXH 6000(NAVD 88 GeoID 09 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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4 1/2 Inches)	882.6	AU									
		0.8 APPARENT AGGREGATE BASE (5 Inches)	882.2	SS 1	100	5-6-9 (15)			6				11
		1.5 POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, moist, trace gravel **(Undocumented Fill)**	881.5	SS 2	89	5-5-5 (10)							
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist, medium dense to loose, trace gravel (Alluvial)											
5				SS 3	100	3-3-3 (6)							
		▽		SS 4	89	4-3-4 (7)							
		9.0	874.0										
10		SANDY LEAN CLAY, (CL) brown, moist, medium, stratified, trace gravel, with silt (ML) layering (Alluvial)		SS 5	100	1-2-3 (5)			34				
		10.5	872.5										

Bottom of borehole at 10.5 feet.

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BORING NUMBER SB-5

CLIENT City of Ramsey
PROJECT NAME Brookview Estates Street Reconstructions
PROJECT NUMBER 18.MS06855.000
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/18 **COMPLETED** 9/26/18
GROUND ELEVATION 881.5 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 872.50 ft
LOGGED BY RRH **CHECKED BY** SDG
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation determined using a Trimble GeoXH 6000(NAVD 88 GeoID 09 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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (5 Inches)	881.1	AU									
		0.9 APPARENT AGGREGATE BASE (6 Inches)	880.6	SS 1	67	5-8-7 (15)							
		1.5 SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel **(Undocumented Fill)**	880.0	SS 2	100	3-6-6 (12)							
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, medium dense to loose, trace gravel (Alluvial)											
5				SS 3	89	5-5-4 (9)							
				SS 4	100	3-3-3 (6)							
10		10.5	871.0	SS 5	89	3-3-3 (6)							

Bottom of borehole at 10.5 feet.

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BORING NUMBER SB-6

CLIENT City of Ramsey
PROJECT NAME Brookview Estates Street Reconstructions
PROJECT NUMBER 18.MS06855.000
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/18 **COMPLETED** 9/26/18
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
AT TIME OF DRILLING --- No Groundwater Observed.
LOGGED BY RRH **CHECKED BY** SDG
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation determined using a Trimble GeoXH 6000(NAVD 88 GeoID 09 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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (5 Inches)	883.1	AU									
		0.9 APPARENT AGGREGATE BASE (6 1/4 Inches)	882.6	SS 1	89	5-6-5 (11)							
		1.5 SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel **(Undocumented Fill)**	882.0	SS 2	100	3-5-5 (10)							
		SILTY SAND, (SM) brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial)											
		4.0	879.5										
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist, loose, trace gravel (Alluvial)		SS 3	89	3-4-3 (7)							
				SS 4	67	3-3-3 (6)							
10				SS 5	100	3-3-3 (6)							
		10.5	873.0										

Bottom of borehole at 10.5 feet.

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Inver Grove Heights, MN, 55076
P: 651-389-4191

BORING NUMBER SB-7

CLIENT City of Ramsey
PROJECT NAME Brookview Estates Street Reconstructions
PROJECT NUMBER 18.MS06855.000
PROJECT LOCATION Ramsey, MN
DATE STARTED 9/26/18 **COMPLETED** 9/26/18
GROUND ELEVATION 882 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 RRH **CHECKED BY** SDG
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation determined using a Trimble GeoXH 6000(NAVD 88 GeoID 09 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: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4 1/4 Inches)	881.7	AU									
		0.9 APPARENT AGGREGATE BASE (6 Inches)	881.2	SS 1	100	5-6-7 (13)			8				
		SILTY SAND, (SM) dark brown, fine to medium grained, moist, trace gravel **(Undocumented Fill)**		SS 2	67	5-5-5 (10)							
		4.0	878.0										
5		SANDY LEAN CLAY, (CL) brown, moist, medium, trace gravel (Alluvial)		SS 3	89	2-2-3 (5)			21				
		6.5	875.5										
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial)		SS 4	100	3-3-3 (6)							
10				SS 5	100	6-6-7 (13)							
		10.5	871.5										

Bottom of borehole at 10.5 feet.