DRAFT FEASIBILITY REPORT

SUNWOOD DRIVE RECONSTRUCTION

CITY IMPROVEMENT PROJECT NO. 17-00

January 12, 2017

Prepared By:

City of Ramsey
Engineering Department
7550 Sunwood Drive
Ramsey, MN 55303
763-433-9820
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January 12, 2017

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

Re: Feasibility Report - City of Ramsey Improvement Project #17-00
Sunwood Drive Reconstruction

Dear Mayor and City Council Members:

Transmitted herewith is a Feasibility Report for the proposed Sunwood Drive Reconstruction project between Ramsey Boulevard/CSAH 56 and Bunker Lake Boulevard/CSAH 116 which 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
Diana Lund, Finance Director
Grant Reimer, Public Works Superintendent
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: January 18, 2017 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: January 18, 2017 License No. 21112

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1. EXECUTIVE SUMMARY

City Improvement Project 17-00 proposes to reconstruct Sunwood Drive between Ramsey Boulevard/CSAH 56 and Bunker Lake Boulevard /CSAH 116 which totals approximately 3,050 linear feet (0.58 miles) in length. A map showing the location and scope of the proposed improvements is included as ***Figure 1*** in ***Appendix A***.

This segment of Sunwood Drive was constructed in 1996 using bituminous pavement between B618 concrete curb and gutter. The street was constructed to a width of 40 feet from face-of-curb to face-of-curb, which is centered within an 80 foot wide right-of-way. A storm sewer system also exists under this segment of Sunwood Drive including numerous catch basins which drain runoff from the street to adjacent low-lying areas using concrete storm sewer pipes.

City staff evaluates and rates the condition of pavement sections on all city streets on an annual basis using the Pavement and Surface Evaluation Rating (PASER) system. In the fall of 2016, the pavement section of the above-referenced street segment were rated with PASER ratings of 3 and 4, depending on location, which indicates this street is past the point of applying mill and overlay improvements. The current condition of this street requires City staff to patch the street at least once per year, particularly before winter so the street can be plowed without tearing up the pavement in the process. Pictures of the street are located in ***Appendix A***.

Proposed improvements include removing and replacing damaged sections of concrete curb and gutter and reconstructing the existing bituminous pavement section using a process known as Stabilized Full Depth Reclamation, or SFDR. This process involves milling the top 3 inches of existing bituminous pavement which is then hauled off site, reclaiming (grinding and mixing) the remaining bituminous pavement along with approximately 2 inches of existing aggregate base, injecting an asphalt emulsion stabilizer into the reclaimed material, mixing and spreading the stabilized reclaimed material on top of the reshaped and compacted subgrade, then placing 4 inches of new bituminous pavement on top. This results in a 10-ton pavement design that meets current State Aid standards.

The existing storm sewer system is in good condition and meets all current State Aid standards and is therefore not proposed to be improved. An off-street bike trail exists along the north side Sunwood Drive but is not proposed to be improved as part of this project.

Pavement corings, soil borings, and associated pavement reconstruction design recommendations were just recently completed so staff has not yet had an opportunity to discuss the proposed improvements, or the use of special assessments to help pay for a portion of the improvements, with owners of abutting properties or local business owners. However, Staff recently mailed letters to the owners of abutting properties and area businesses for the purpose of explaining the proposed improvements and requesting meetings with impacted and interested parties to discuss the proposed improvements and gather public input.

The engineer's opinion of probable costs for completing the proposed improvements on Sunwood Drive as outlined in this report is $607,000. Estimated costs include 23% indirect costs for administrative, engineering, finance and legal costs. A summary of the engineer's opinion of probable costs is included in ***Appendix B***.

A total of 9 parcels have been identified as receiving special benefit from the improvements. These parcels are identified in the preliminary assessment map and roll in ***Appendix C***.

Staff recommends the use of special assessments to pay for 25% of all eligible improvement costs, which will then be applied across 9 assessable properties using the "area" method of assessment. All costs for this project are eligible for special assessments since all construction costs are based strictly on reconstructing the street at its existing width using a comparable pavement section design with no subgrade corrections or public utility improvements. The existing street width and pavement section are sufficient to accommodate current State Aid design standards.

Staff recommends ordering a special benefit consultation report for this project to verify that the proposed assessment amount will not exceed the amount of benefit to any of the properties. If the report concludes that the benefit to any of the properties is less than the proposed preliminary assessment rate, Staff will propose to lower the assessment rate accordingly at the Assessment Hearing scheduled for October 10th, 2017. However, if the special benefit consultation report verifies that the assessment rates as proposed are justified, Staff will propose to adopt the final assessment roll using the rate as preliminarily proposed.

This improvement project, which is listed in the City's current Capital Improvement Program, is proposed to be funded using a combination of special assessments to benefiting properties, street reconstruction bond proceeds, and stormwater utility funds.

This project can best be constructed as a stand-alone project, 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 9, 2016. This project has been designated as City Improvement Project No. 17-00.

2.2 Program Overview

In support of the City's long-term Street Maintenance Program, the entire existing bituminous pavement section will be reconstructed using a stabilized full-depth reclamation (SFDR) process. All damaged concrete curb and gutter sections will also be removed and replaced, plus 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 and Surface Evaluation 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 fall of 2016, City staff evaluated and rated the condition of the pavement along this segment of Sunwood Drive. A PASER rating of 4 was determined for the segment of Sunwood Drive between Bunker Lake Boulevard and Ramsey Boulevard.

2.3 Scope

City of Ramsey Improvement Project 17-00 proposes to reconstruct the existing bituminous pavement, to remove and replace damaged concrete curb and gutter sections, and to complete other appurtenant work on Sunwood Drive between Ramsey Boulevard/CSAH 56 and Bunker Lake Boulevard /CSAH 116 which totals approximately 3,050 linear feet (0.58 miles) in length.

The existing bituminous pavement section is proposed to be reconstructed using the SFDR process. This involves milling the top 3 inches of existing bituminous pavement, reclaiming the remaining bituminous pavement along with approximately 2 inches of existing aggregate base, injecting an asphalt emulsion stabilizer into the reclaimed material, mixing and spreading the stabilized reclaimed material on top of the reshaped and compacted subgrade, then placing 4 inches of new bituminous pavement on top. This results in a 10-ton pavement design that meets current State Aid standards.

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 and Soil Conditions

The segment of Sunwood Drive between Ramsey Boulevard/CSAH 56 and Bunker Lake Boulevard/CR 116 was constructed in 1996 using bituminous pavement and B618 concrete curb and gutter. The street has a consistent width of 40 feet from face-of-curb to face-of-curb, and is centered within an 80 foot right-of-way. Striped parking lanes exist along both sides of the street. The existing posted speed is 35 mph along this entire segment of Sunwood Drive.

In 2002 the pavement was cracksealed and sealcoated, and spot spray patching has been applied since on an as-needed basis. In 2016 Staff observed a Pavement and Surface Evaluation Rating (PASER) of 3 to 4, depending on location.

In 2015, the City recorded a traffic volume of 3,500 average annual daily traffic (AADT). While truck counts are not available, Staff believes it is reasonable to assume between 5 and 10 percent of vehicles using this street segment can be classified as truck traffic, and that the percentage of trucks using this corridor could increase slightly over time due to current business expansion projects and since several undeveloped but developable parcels exist along the corridor.

Northern Technologies, Inc. (NTI) was employed to complete a Geotechnical Exploration and Engineering Review for this project, which included eleven (11) soil borings that were spaced at approximately 200 feet along Sunwood Drive. The locations of the borings are shown in the Boring Location Diagram in Appendix C of NTI's report, attached in ***Appendix D.***

The soil borings provide information on existing bituminous pavement and aggregate base course thicknesses, subsurface soil conditions, existing ground water elevations, and potential issues that may be encountered during construction. Recommendations are also provided for excavations, site preparation, engineered fill and compaction, depths of unsuitable soils to be removed, ground water management, and pavement design parameters. All borings terminated at a nominal depth of 11 feet below the existing ground surface.

Groundwater was observed in all soil borings at depths ranging between 7 and 9.5 feet below the existing ground surface. Based on the work being proposed and the recorded water level depths, groundwater is not anticipated to be a significant issue for work completed with this proposed project.

The soil borings generally indicate that existing bituminous pavement thicknesses range between 4.3 to 8.3 inches. Apparent aggregate base was not observed at any of the boring locations. Previously placed fill soils, generally consisting of poorly graded sand with silt (SP-SM), are present at depths ranging from 2.0 to 7.0 feet below the top of the pavement. Native alluvial soils consisting of poorly graded sand (SP), silty sand (SM), and poorly graded sand with silt (SP-SM) generally extend to the bottom of the borings.

3.2 Watermain

Watermain was installed in 1996 under the pavement along the entire segment of Sunwood Drive. Staff believes the existing watermain is in good condition, and that no repairs will be

required prior to reconstructing the pavement. However, if the City Council orders plans and specifications for the proposed improvements, staff proposes to hire a leak detection expert to ensure there are no detectable leaks. If leaks are detected, repairs would be made under separate contract before work commences on this project.

3.3 Sanitary Sewer

Sanitary sewer was installed in 1996 under the pavement along the entire segment of Sunwood Drive. Staff believes the existing sanitary sewer is in good condition, and that no repairs will be required prior to reconstructing the pavement. However, if the City Council orders plans and specifications for the proposed improvements, staff proposes to hire a firm to televise the sewer to ensure the pipes are not deformed, cracked, or broken, and that all joints are sealed. If any issues are detected, repairs would be made under separate contract before work commences on this project.

3.4 Storm Sewer/Drainage

Storm sewer exists along the entire segment of Sunwood Drive. Based on design calculations completed by City staff, no modifications are required to the existing storm sewer system to meet current State Aid standards. Stormwater runoff is currently conveyed within the concrete curb and gutter along the outside edges of Sunwood Drive, where it is then collected in concrete catch basins and routed through concrete storm sewer pipes to existing wetlands, stormwater drainage ditches, and ponding facilities.

3.5 Streets

3.5.1 Existing Typical Sections

Sunwood Drive is centered within 80 feet of City-owned right-of-way. The street section is 40 feet wide from face-of-curb to face-of-curb. All curb along these streets are B618 concrete curb and gutter.

Parking is currently allowed on both sides of the streets and is delineated with striping.

3.5.2 Maintenance History

This segment of Sunwood Drive was originally constructed in 1996 and received a crackseal and sealcoat treatment in 2002. Spot patching has also been completed since then.

3.6 Land Use

The properties abutting this segment of Sunwood Drive are all zoned E1, with the exception of Cottonwood Park.

4. PROPOSED IMPROVEMENTS

4.1 Street and Stormwater Improvements

The segment of Sunwood Drive between Ramsey Boulevard/CSAH 56 and Bunker Lake Boulevard/CR 116 is part of the City's Municipal State Aid System (MSAS). The proposed improvements must therefore be designed and constructed in accordance with current Minnesota Department of Transportation (MnDOT) State Aid standards which are generally based on the street's functional classification, projected traffic volume, design speed, lane designations and widths, and proposed pedestrian facilities.

Based on the proposed design, Sunwood Drive must be reconstructed in accordance with State Aid Rule 8820.9936 or 8820.9946. This will depend on the percentage of damaged curb and gutter that needs to be removed and replaced, which will be determined during final design.

The scope of the proposed surface improvements is shown in ***Figure 1*** in ***Appendix A***.

4.1.1 Street Improvements

Sunwood Drive is proposed to be reconstructed with bituminous pavement matching the existing width while still allowing for on-street parking along both sides of Sunwood Drive. This design will meet current State Aid standards. All damaged B618 concrete curb and gutter is proposed to be removed and replaced in kind. A typical section for the proposed pavement reconstruction improvements is shown in ***Figure 2*** in ***Appendix A.***

The proposed reconstructed pavement design must accommodate a 10-ton design in accordance with State Aid design standards. City staff is proposing a pavement section design of 2 inches bituminous wear course, 2 inches bituminous base course, and 5 inches of base composed of stabilized full depth reclamation. This pavement section would be constructed over the existing subgrade after it is reshaped and compacted.

The proposed pavement design should result in a minimum pavement life of 30 years, assuming that proactive, regular pavement maintenance treatments are performed during the life of the pavement. While staff would typically target a 60-year design life for reconstructed streets, this project is not proposing to remove and replace all curb and gutter due to the good condition of the existing 20 year old curb and gutter. Therefore, it may make sense to replace this pavement section at the time the existing curb and gutter is replaced, which will likely be 30 or more years in the future.

4.1.2 Stormsewer Improvements

The existing storm sewer system is in good condition and meets all current State Aid standards and is therefore not proposed to be improved. The only proposed storm sewer improvements include repairing catch basin castings as needed. No stormwater quality treatment improvements are required for this project since the street is proposed to be reconstructed at its current width.

4.1.3 Geotechnical Considerations

Northern Technologies, Inc. (NTI) was employed to complete a Geotechnical Exploration and Engineering Review for this project, which included eleven (11) soil borings that were spaced at approximately 200 feet along Sunwood Drive. The locations of the borings are shown in the Boring Location Diagram in Appendix C of NTI's report, attached in ***Appendix D.***

4.1.4 Other Considerations

Driveways:
Existing driveways will need to be reconstructed to varying degrees with this project. The limits of construction will vary with each driveway 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:
All developed properties along the project corridor have private irrigation systems. However, impacts to these systems would only occur if the existing curb and gutter is being removed and replaced. In the past, the City has typically repaired private irrigation systems that are damaged as part of a street reconstruction project. However, staff will be requesting Council permission to change this practice on all future projects by instead notifying property owners of pending construction at least 15 business days in advance 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.

4.2 Stormwater Treatment

No stormwater retention and/or treatment improvements will be required as a result of this project.

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 Methods

The existing bituminous pavement section will be reconstructed using the SFDR process outlined within this report. See Pavement Evaluations and Recommendations in ***Appendix D*** for additional detail.

4.6 Private Utilities

Staff has not yet met with the telephone, gas, 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 companies 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 utilities.

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.

4.8 Right-of-Ways/Easements

It is anticipated that all improvements will occur within existing City right-of-ways and/or easements, with the possible exception of tying into private driveways and yards. It is therefore not anticipated that the City will need to acquire additional permanent right-of-way or easements for this project. As such, costs for right-of-way or easement acquisitions are not included in the probable project costs.

If rights of entries will be required from any property owners prior to construction, City staff will obtain the right of entries.

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 2017 construction costs for the proposed improvements plus 23% indirect costs for administrative, engineering, financing and legal costs. No construction contingency costs are included in the estimated 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 D***, at a cost of $4,400.

WSB and Associates, Inc. prepared the Pavement Evaluations and Recommendations included in ***Appendix D***, at the not-to-exceed cost of $2,687.50.

5.2 Funding

5.2.1 Assessments

The City's adopted Special Assessments Policy allows special assessments in an amount not to exceed 25% of eligible street reconstruction project costs to be levied against all benefiting properties. Eligible project costs include all costs required to reconstruct the street at its current width of 40 feet. Benefiting properties include any properties that either currently have, or have the ability to create, one or more direct accesses onto the segment of Sunwood Drive being reconstructed. A total of 9 benefitting properties have been identified for this project.

The engineer's opinion of probable costs for eligible assessment costs totals $607,000. Assessable commercial/industrial parcels are preliminarily proposed to be assessed a total of $151,750.

Staff is proposing to use the "area" method of assessment as identified in the City of Ramsey's Special Assessments Policy. Assessments for this project are proposed to be assessed over a term of fifteen years with interest at two percent above the U.S. Treasury Rate.

Special assessments have not been utilized widely in recent years for street reconstruction projects in Ramsey, and special assessments for commercial and industrial properties have never been applied using the new Special Assessments Policy. In addition, State Statute and the City Charter do not allow for assessments to exceed the benefit to the property. Therefore, Staff wants to ensure that all assessments applied with this project will not exceed the benefit to assessed properties and will therefore request Council authorization to order a benefit appraisal consultation report for this project in accordance with the City's Special Assessments Policy at the time a construction contract is awarded.

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

5.2.2 City Contribution

The City contribution to the project will 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 bonds. Stormwater Utility Funds would be utilized for all storm sewer improvements.

Special assessments would be used to pay back a portion of these costs based on the term of the special assessments as adopted by Council at the end of the project.

Table 1 illustrates the proposed project funding based on the proposed design outlined within this report. This funding program assumes construction will occur in 2017.

TABLE 1
Proposed Project Funding

	ASSESSMENTS	CITY FUNDS	TOTAL
Estimated Costs	**$151,750**	**$455,250**	**$607,000**

Total Project Cost		**$607,000**
Less Special Assessments	-	$151,750
Subtotal	**=**	**$455,250**
Less City Bonding Funds	-	$447,950
Subtotal	**=**	**$7,300**
Less Stormwater Utility Funds	-	$7,300
TOTAL Remaining Cost	**=**	**$0**

6. PROJECT SCHEDULE

The proposed project schedule is as follows:

Council Orders Feasibility Report ..... August 9, 2016

Council Accepts Feasibility Report/Orders Public Hearing ..... January 24, 2017

Staff Publishes Notice of Public Hearing .....January 27 & February 3, 2017

Public Input Meetings .....February 1 - 10, 2017

Council Conducts Public Hearing/Authorizes Plans and Specifications ..... February 14, 2017

Staff Conducts Private Utility Coordination Meeting .....February/March, 2017

Council Approves Plans and Specifications/Authorizes Ad for Bids..... April 11, 2017

Staff Advertises for Bids..... April 14 & 21, 2017

Staff Receives Bids ..... May 15, 2017

Council Awards Contract ..... May 23, 2017

Contractor Begins Construction ..... June 2017

Contractor Completes Construction ..... September 8, 2017

Council Orders Assessment Roll/Hearing ..... September 12, 2017

Council Conducts Assessment Hearing.....October 10, 2017

7. CONCLUSIONS AND RECOMMENDATIONS

City of Ramsey Improvement Project 17-00 proposes to reconstruct the bituminous pavement section, to remove and replace all damaged concrete curb and gutter, and to complete miscellaneous appurtenant work on Sunwood Drive between Ramsey Boulevard/CSAH 56 and Bunker Lake Boulevard /CSAH 116. This street segment measures approximately 3,050 linear feet (0.58 miles).

It is the recommendation of City staff that City Project No. 17-00 is feasible, necessary, and cost-effective from an engineering standpoint.

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

1. Staff recommends reconstructing this street segment in 2017 as outlined in this report.
2. Staff recommends reconstructing the off-road bike trail along the north side of Sunwood Drive at a later date pending adoption of the City's Trail Maintenance Policy / Program.
3. Staff recommends constructing the 10-ton pavement section for Sunwood Drive as proposed herein to accommodate State Aid design standards understanding that 100% of the costs will be eligible for assessment per the City's Special Assessments Policy.
4. Staff recommends ordering an assessment appraisal consultation to ensure that special assessments do not exceed the benefit received as a result of the improvements in accordance with the City's Special Assessments Policy.
5. Staff recommends meeting with the owner of each assessable property, as well as all business owners, in early February of 2017 to inform them on the proposed improvements and to gather public input prior to conducting the public hearing and requesting Council authorization to prepare plans and specifications on February 14th.

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

1. Accept the preliminary commercial/industrial special assessment rates proposed herein.
2. Adopt Resolution #17-01-0XX accepting this Feasibility Report and ordering Plans and Specifications based on the design proposed herein.

APPENDIX A

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

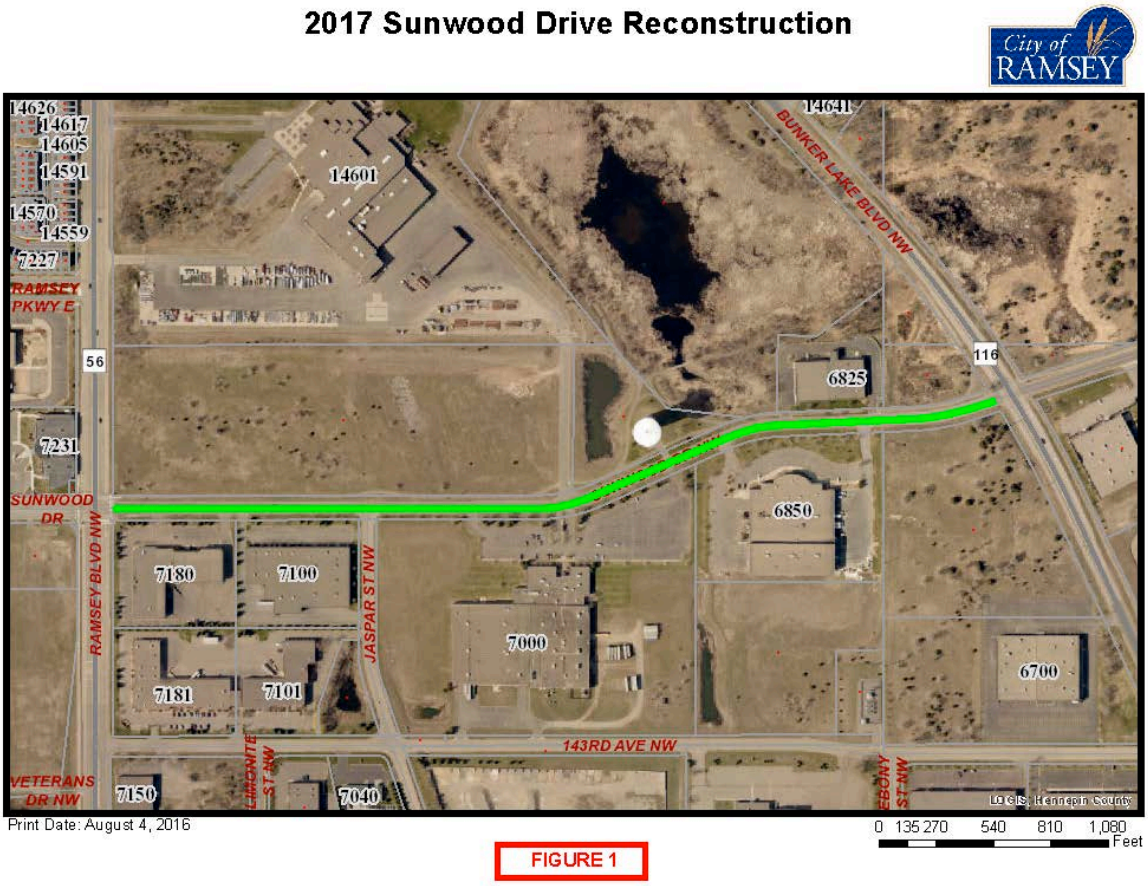


FIGURE 1

FIGURE 1
PROJECT SCOPE

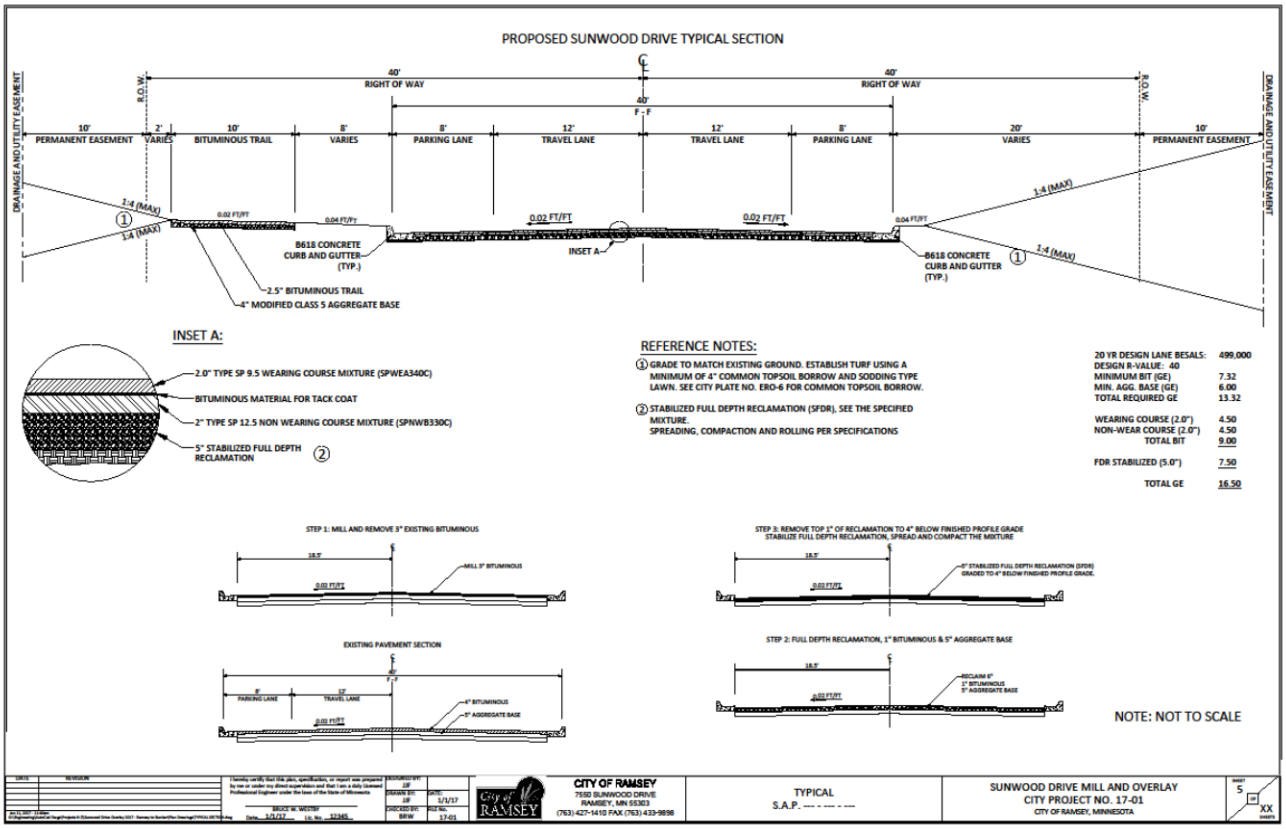


FIGURE 2
TYPICAL SECTION

PROJECT SITE PICTURES

APPENDIX B

Opinion of Probable Costs

17-00 SUNWOOD DRIVE RECONSTRUCTION: RAMSEY BLVD. to BUNKER LAKE BLVD.

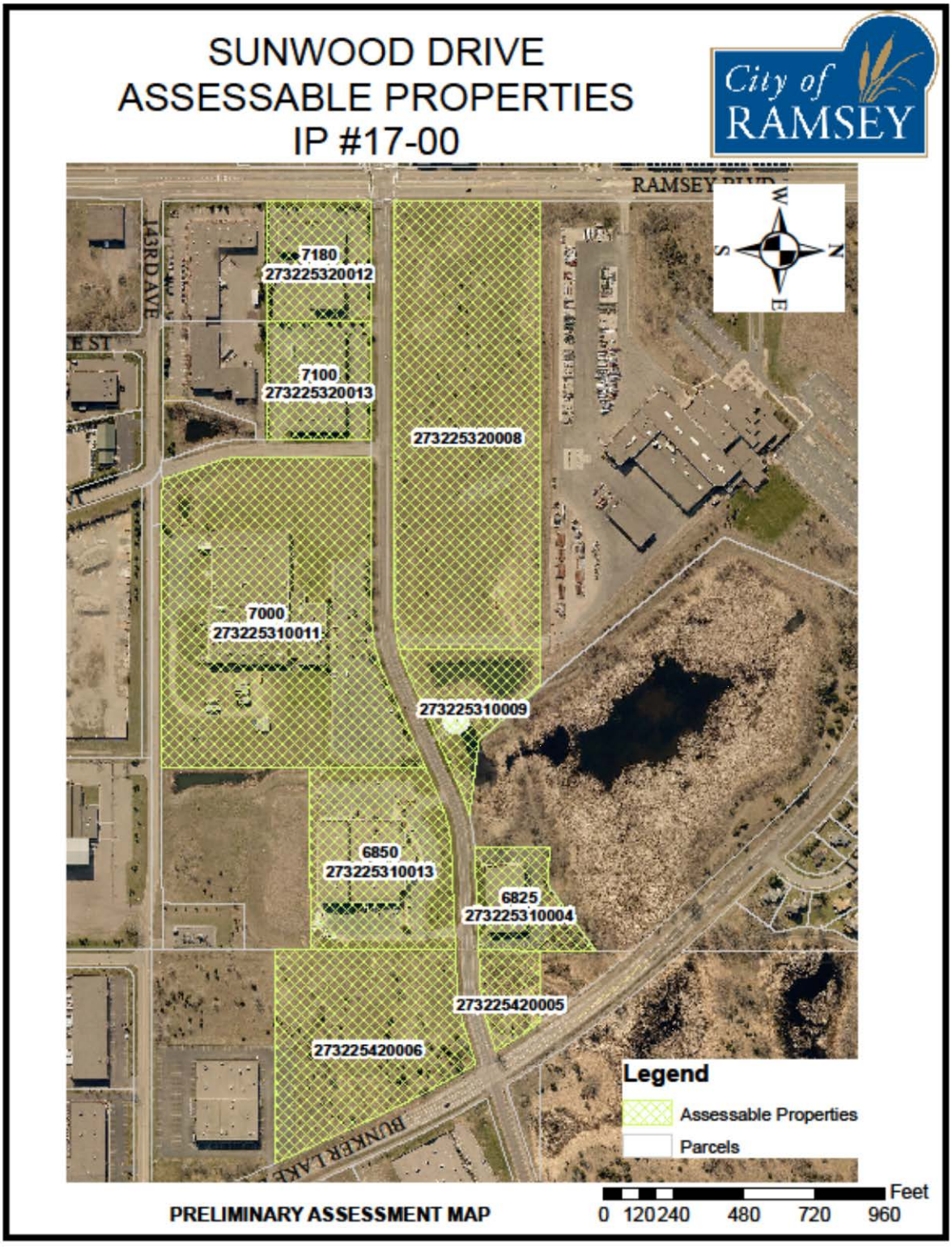
ENGINEER ESTIMATE

1/11/2017

ITEM No.	MNDOT No.	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	COST ESTENSION
1	2021.501	MOBILIZATION (10%)	LS	1	$ 44,841.03	$ 45,000.00
2	2104.501	REMOVE CONCRETE CURB AND GUTTER	LF	1100	$ 6.00	$ 6,600.00
3	2104.505	REMOVE BITUMINOUS PAVEMENT	SY	317	$ 4.50	$ 1,426.50
4	2104.505	REMOVE CONCRET VALLEY GUTTER	SY	179	$ 20.00	$ 3,580.00
5	2104.511	SAWING CONCRETE PAVEMENT - FULL DEPTH	LF	200	$ 8.50	$ 1,700.00
6	2104.513	SAWING BITUMINOUS PAVEMENT - FULL DEPTH	LF	564	$ 5.50	$ 3,102.00
7	2130.501	WATER	MGAL	50	$ 32.50	$ 1,625.00
8	2232.501	MILL BITUMINOUS PAVEMENT (1.5" DEPTH X 2' WIDTH)	SY	62	$ 15.00	$ 930.00
9	2232.501	MILL BITUMINOUS PAVEMENT (3.0" DEPTH)	SY	12707	$ 1.25	$ 15,883.75
10	2215.501	STABILIZED FULL DEPTH RECLAMATION (6" DEPTH)	SY	12707	$ 3.50	$ 44,474.50
11	2331.607	HAUL BIT PAVEMENT RECLAMATION (LV)	CY	459	$ 10.00	$ 4,590.00
12	2331.609	BITUMINOUS MATERIAL FOR MIXTURE	TON	133	$ 600.00	$ 79,800.00
13	2357.502	BITUMINOUS MATERIAL FOR TACK COAT	GAL	896	$ 2.36	$ 2,114.56
14	2360.502	TYPE SP 9.5 WEARING COURSE MIXTURE (SPWEA340C) (2.0")	TON	1719	$ 65.00	$ 111,735.00
15	2360.502	TYPE SP 12.5 NON-WEARING COURSE MIXTURE (SPNWB330C) (2.0")	TON	1689	$ 61.00	$ 103,029.00
16	2506.602	GROUT CATCH BASIN	EA	11	$ 300.00	$ 3,300.00
17	2506.602	ADJUST CATCH BASIN CASTING	EA	4	$ 1,000.00	$ 4,000.00
18	2531.501	CONCRETE CURB & GUTTER DESIGN B618 (ESTIMATED 20% REPLACE)	LF	1100	$ 13.00	$ 14,300.00
19	2504.602	ADJUST VALVE BOX	EA	6	$ 250.00	$ 1,500.00
20	2506.522	ADJUST FRAME AND RING CASTING (SANITARY MH IN STREET)	EA	9	$ 550.00	$ 4,950.00
21	2531.604	7" CONCRETE VALLEY GUTTER	SY	179	$ 85.00	$ 15,215.00
22	2563.601	TRAFFIC CONTROL	LS	1	$ 10,000.00	$ 10,000.00
23	2573.503	SILT FENCE	LF	100	$ 3.00	$ 300.00
24	2573.530	STORM DRAIN INLET PROTECTION	EA	17	$ 200.00	$ 3,400.00
25	2575.525	COMMON TOPSOIL BORROW (LV)	CY	35	$ 30.00	$ 1,050.00
26	2575.505	SODDING TYPE LAWN	SY	262	$ 7.00	$ 1,834.00
27	2582.501	PAVT MSSG (LT ARROW) EPOXY	EA	2	$ 135.00	$ 270.00
28	2582.501	PAVT MSSG (RT-THRU ARROW) EPOXY	EA	1	$ 200.00	$ 200.00
29	2582.502	24" SOLID LINE WHITE - EPOXY	LF	29	$ 10.00	$ 290.00
30	2582.502	24" SOLID LINE YELLOW - EPOXY	LF	52	$ 10.00	$ 520.00
31	2582.502	4" DOUBLE SOLID LINE YELLOW - EPOXY	LF	3182	$ 1.00	$ 3,182.00
32	2582.502	4" SOLID LINE WHITE - EPOXY	LF	5038	$ 0.50	$ 2,519.00
33	2582.503	CROSSWALK MARKING - EPOXY	SF	198	$ 5.00	$ 990.00
					TOTAL CONSTRUCTION COST	$ *493,410.31*
					23% INDIRECT COST	$ *113,484.37*
					TOTAL PROJECT COST	$ *606,894.68*

APPENDIX C

Preliminary Assessment Map
Preliminary Assessment Roll



PRELIMINARY ASSESSMENT MAP

Preliminary Assessment Roll - IP #17-00						
PID No.	Property Owner	Property Address	City	State	Zip	Assessment
273225310004	NORTH SUBURBAN MANAGEMENT LLC	6825 SUNWOOD DR NW	RAMSEY	MN	55303	
273225310009	RAMSEY CITY OF			MN		
273225310011	VISION EASE LP	7000 SUNWOOD DR NW	RAMSEY	MN	55303	
273225310013	KNOLL PROPERTIES LLC	6850 SUNWOOD DR NW	RAMSEY	MN	55303	
273225320008	CONNEXUS ENERGY			MN		
273225320012	RMR CAPITAL LLC	7180 SUNWOOD DR NW	RAMSEY	MN	55303	
273225320013	OBRIEN PROP OF MINNESOTA LLC	7100 SUNWOOD DR NW	RAMSEY	MN	55303	
273225420005	RAMSEY CITY OF			MN		
273225420006	PHILLIPS ALAN C & D V TRUSTEES			MN		
TOTAL PROJECT ASSESSMENTS						$0.00

PRELIMINARY ASSESSMENT ROLL

APPENDIX D

Geotechnical Exploration and Engineering Review (NTI – 30 pages)
Pavement Evaluations and Recommendations (WSB & Associates – 8 pages)

NTI™
NORTHERN TECHNOLOGIES, LLC

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November 23, 2016

City of Ramsey
Attention: Mr. Bruce Westby, P.E.
7550 Sunwood Drive NW
Ramsey, Minnesota 55303

Subject: Geotechnical Exploration and Engineering Review
Sunwood Drive – Street Improvements
Ramsey, Minnesota
NTI Project No. 16.61770.100

Northern Technologies, LLC (NTI) has completed a total of eleven (11) borings for the Sunwood Drive project area in the City of Ramsey, Minnesota.

The scope of services included determining existing bituminous and aggregate base thicknesses, and 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 installation, and pavement design.

Our services were performed in accordance with our proposal dated October 25, 2016.

PROJECT AND SITE DESCRIPTION

The project includes street and possibly utility improvements to a section of Sunwood Drive between Ramsey Boulevard and Bunker Lake Boulevard in Ramsey, Minnesota.

The pavement sections are proposed to be designed using the average annual daily traffic (AADT) information and based on a 20-year design pavement life. The AADT information noted on the Mn/DOT Traffic Data webpage indicates an AADT of 3500 for the project section of Sunwood Drive. 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 on November 8, 2016 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 with the City of Ramsey. The boring locations were staked in the field by NTI. The borings terminated at nominal depths 11.0 feet below the existing pavement surface. .

Elevations were not provided to NTI, therefore, NTI has assumed a ground surface elevation of 100.0 feet for each of the boring locations. Please refer to the Boring Location Diagram, the Boring Logs in Appendix C, and the Pavement Core Photographs in Appendix D.

Sunwood Drive - (Borings S-1 through S-11)

Bituminous pavement thickness in this project area ranged from approximately 4.3 to 8.3 inches at the boring locations. Apparent aggregate base was not observed at the boring locations. Previously placed fill soils, generally consisting of poorly graded sand with silt (SP-SM), were encountered extending to depths ranging from approximately 2.0 to 7.0 feet below the top of pavement.

Native alluvial soils consisting of poorly graded sand (SP), silty sand (SM), and poorly graded sand with silt (SP-SM) were generally observed extending to the boring termination depths. Varying amounts of gravel were encountered throughout the boring locations.

Groundwater was observed in the boreholes at depths ranging from approximately 7.0 to 9.5 feet below the top of pavement at the time of drilling. Table 1 summarizes the encountered subsurface conditions for these project areas.

Table 1: Pavement and Subgrade Summary[1]
Sunwood Drive

Boring No.	Bituminous Pavement Thickness[2] (inches)	Apparent Aggregate Base Thickness[3] (inches)	Fill Subgrade Material[4]	Native Subgrade Material
S-1	8.3	None	SP-SM	SP-SM
S-2	4.5	None	SP-SM	SP, SP-SM
S-3	4.5	None	SP-SM	SM, SP, SP-SM
S-4	4.5	None	SP-SM	SP-SM
S-5	4.8	None	SP-SM	SP-SM
S-6	4.8	None	SP-SM	SP-SM
S-7	4.3	None	SP-SM	SP, SP-SM
S-8	5.8	None	SP-SM	SP-SM
S-9	4.5	None	SP-SM	SP, SP-SM
S-10	5.0	None	SP-SM	SP, SP-SM
S-11	4.8	None	SP-SM	SP, SP-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 and is not mean to confer conformance with DOT specifications.
4. Undocumented fill soils.

GROUNDWATER AND GROUNDWATER CONTROL

Groundwater was observed in the boreholes at depths ranging from approximately 7.0 to 9.5 feet below the top of pavement at the time of drilling.

Depending upon elevations of underground utilities, groundwater may be an issue during construction. It should be noted that if excavations are proposed below the groundwater level, the granular nature of the majority of the on-site soils will likely result in significant volumes of water entering the excavations unless proper dewatering measures are implemented. Well points embedded into the underlying sands will likely be the most suitable method for controlling excess water in deeper excavations. 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.

UTILITY LINE CONSTRUCTION

The native sand soils observed in soil borings were generally suitable for utility support and utility backfill. Due to the encountered groundwater levels and depending on the installation depth of the utilities, temporary dewatering may be required during the utility trench excavations. Stabilization of the trench subgrade may 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.

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 no less than 95 percent standard Proctor maximum 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).

The Geotechnical Engineer of Record or their designated representative should observe the project excavations to determine that conditions are similar to those encountered in the borings, and that adequate bearing support is provided by the exposed soils.

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.

Excavations that penetrate the groundwater surface will require dewatering with sand points or wells. We recommend that the groundwater surface be maintained a minimum of 2 feet below the bottom of the exposed excavation.

Engineered Fill and Winter Construction

The silty sand soils on this site will be susceptible to frost action 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.

PAVEMENT RECOMMENDATIONS

Mill and Overlay Recommendations

Consideration could be made to milling and overlaying the existing pavement. The roadway sections appear to have a sufficiently thick in place pavement section, over a majority of the project alignment, which would lend itself to rehabilitation via mill and overlay techniques.

In general, pavement sections consisting of 3 inches or less of bituminous asphalt can be difficult to effectively mill and overlay as often times the entire pavement section is reclaimed during the attempted partial section milling process. Additionally, in locations where the existing pavement thickness is less than the recommended thickness, a mill and overlay would not be recommended unless a structural overlay were applied to increase the overall thickness.

Pavement Reconstruction

If the pavement section is to be removed and replaced in its entirety, the most conservative method of subgrade preparation would be 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 relatively a-typical method of subgrade preparation for improvements to existing municipal roadways.

If the City is willing to accept some risk in potential long term detrimental performance for the significant upfront savings, the roadway can be reconstructed over the existing fill. NTI recommends that 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.

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. Based on the encountered soil conditions, we estimate that a properly prepared poorly graded sand with silt (SP-SM) soils will have an average stabilometer R-Value of 40.

For a 20-year design pavement life, Table 3 presents our thickness recommendations for flexible (bituminous) pavement. These recommendations were based upon the encountered subgrade conditions, estimated R-value for the existing subgrade soils, the assumed AADT volumes, and the City of Ramsey's typical pavement section for the respective project area.

Table 3: Flexible Pavement Thickness Design[1]
Sunwood Drive

Pavement Section	Calculated Required Pavement Section	City's Typical Pavement Section[2]
Bituminous Wear Course (inches)	1.5	1.5
Bituminous Base Course (inches)	2.0	2.0
Class 5 or 7 Aggregate Base (inches)	6.0	4.0

1. Assumed AADT volume of 3500 and an estimated R-value of 40.
2. The calculated required section was greater than the City's typical section for residential streets, thus NTI recommends that the Calculated Required Pavement Section be implemented.

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.

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 slabs and pavements, resulting in greater than anticipated settlements of the slabs and pavements. 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 site. 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 its agents for specific application to the proposed Sunwood Drive – Street Improvements project in the City of 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

Debra A. Schroeder, P.E.
Senior Engineer

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.

Debra A. Schroeder
Date: 11/23/2016 Reg. No. 52743

Attachments
Appendix A - General Notes
Appendix B - Groundwater Issues, Compaction and Placement of Fill
Appendix C - Attachments: Boring Location Diagram (1), Soil Boring Logs (11)
Appendix D - Photographs (11 cores)

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

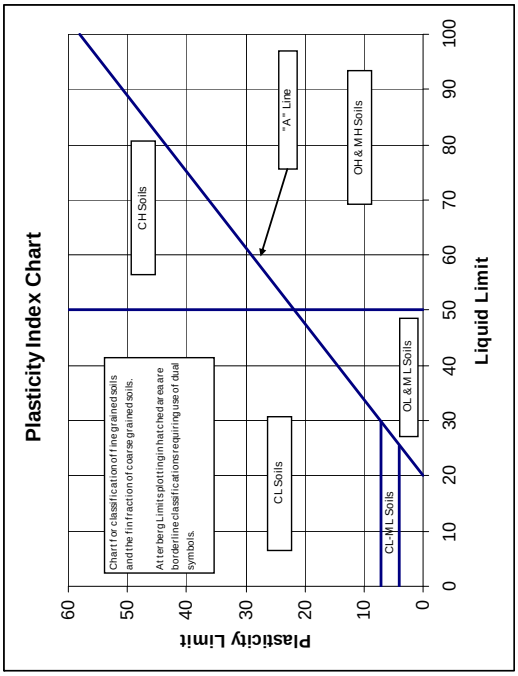
MATERIAL	**DESCRIPTION**	**U.S. SIEVE SIZE**
Boulders		Over 3"
Gravel	Coarse	3" to ¾"
	Medium	¾" to #4
Sand	Coarse	#4 to #10
	Medium	#10 to #40
	Fine	#40 to #200
Silt and Clay	Determined by Hydrometer Test	

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.	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 above "A" line with P.I. greater than 7. — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			GC	Clayey gravels, gravel-sand-clay mixtures.	
	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 above "A" line with P.I. > 7. — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures.	
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.	

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.



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.

We anticipate that a system of sump pits and pumps located outside of the excavation areas would be suitable for control if groundwater were to be encountered. However, a well point system would be more suitable for control of groundwater if excavations were to be advanced into the ground water table at depth in free draining granular soils. Additionally, 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. The groundwater surface should be maintained a minimum of 2 feet below the bottom of the excavation at all times.

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**
General Embankment Fill	Min. 95	Min. 95
Engineered Fill below Foundations	NA	Min. 98
Engineered Fill below Floor Slabs	NA	Min. 98
Engineered Fill placed as Pavement Aggregate Base	NA	Min. 100
Engineered Fill placed to within 3 feet of pavement aggregate base	Min. 95	Min. 95
Engineered Fill placed within 3 feet of pavement aggregate base	Min. 100	Min. 100

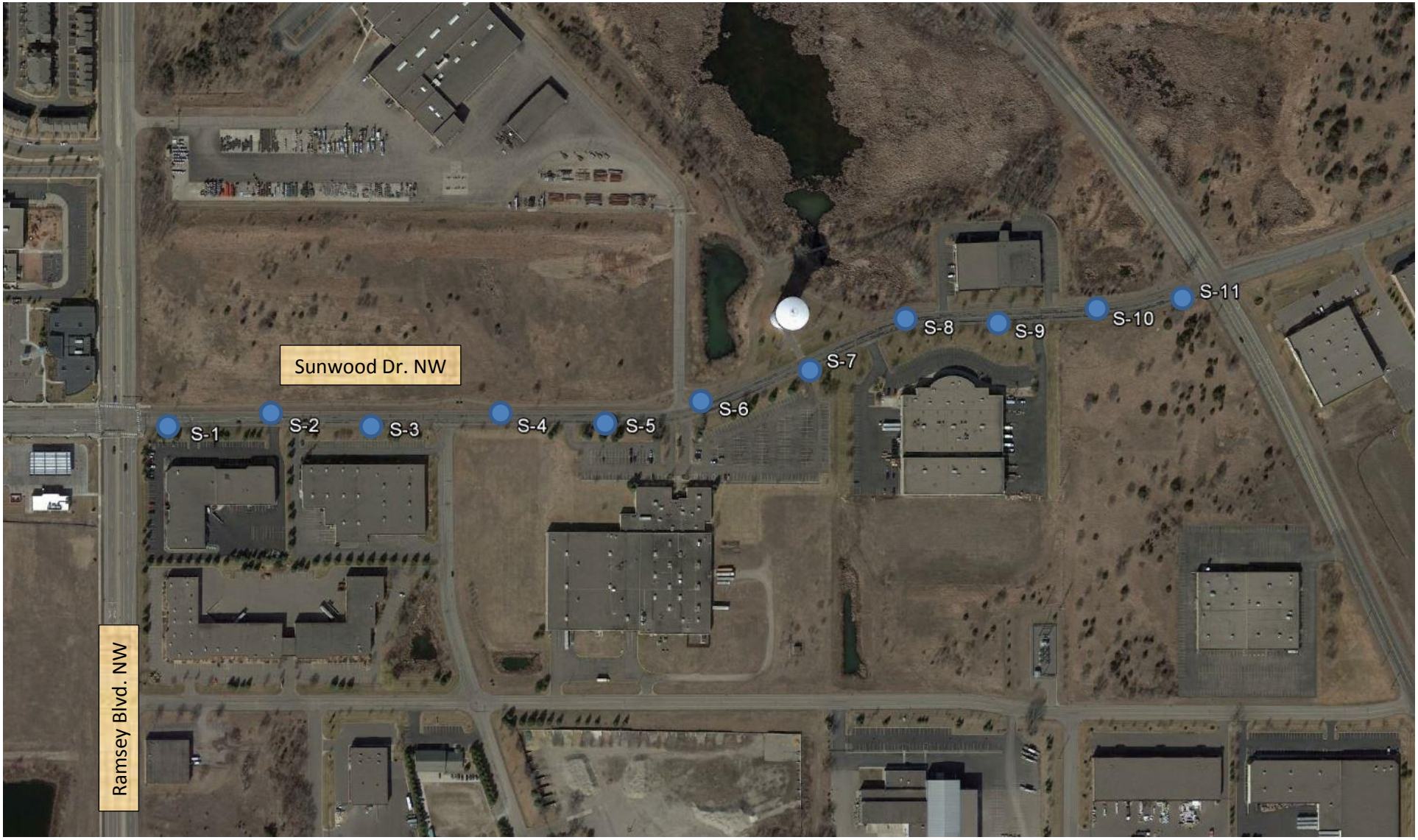
1 Unless otherwise required, compaction shall be based on the Standard Proctor Test (ASTM D698).

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



Boring Location Diagram

Completed Soil Borings:

Alpine and Sunwood Drive – Street Improvements – Sunwood Drive

Ramsey, Minnesota

NTI Project #: 16.61770.100

N

NOTE: Boring locations are approximate.

NTI NORTHERN TECHNOLOGIES, LLC

Inver Grove Heights
6160 Carmen Avenue East
Inver Grove Heights, MN 55076
P: 651-389-4191
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BORING NUMBER S-1

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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 90.50 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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		0.7 BITUMINOUS PAVEMENT (8.3 Inches) 99.3	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel (Fill) NOTE: Brown to dark brown below 2.0 feet.	SS 2	100	7-8-9 (17)			9				
		4.5 95.5										
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist to saturated, medium dense to loose, trace gravel (Alluvial)	SS 3	89	6-7-6 (13)							
			SS 4	94	3-2-3 (5)							
10		▽	SS 5	89	4-6-5 (11)							
		11.0 89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-2

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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 93.00 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (4.5 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to medium grained, moist, trace gravel (Fill)	SS 2	67	3-6-8 (14)							
5			SS 3	83	5-6-5 (11)			6				
		7.0 ▽ 93.0										
		POORLY GRADED SAND, (SP) light brown, fine to medium grained, saturated, loose, trace gravel (Alluvial)	SS 4	100	3-4-3 (7)							
		9.5 90.5										
10		POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to medium grained, saturated, loose, trace gravel (Alluvial)	SS 5	78	3-3-5 (8)							
		11.0 89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-3

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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** 7.50 ft / Elev 92.50 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 3.5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (4.5 Inches)	99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to medium grained, moist, little gravel (Fill)	98.0	SS 2	94	4-5-4 (9)			9				16
5		4.5 SILTY SAND, (SM) brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial)	95.5	SS 3	94	5-6-7 (13)							
		▽ POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist to saturated, medium dense to loose, trace gravel (Alluvial)		SS 4	89	3-4-3 (7)							
10		9.5	90.5										
		11.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, saturated, loose, trace gravel (Alluvial)	89.0	SS 5	83	3-3-4 (7)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-4

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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 93.00 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (4.5 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel (Fill) 2.0 98.0	SS 2	94	5-6-7 (13)			8				9
		POORLY GRADED SAND WITH SILT, (SP-SM) dark brown, fine to medium grained, moist, trace gravel (Fill) 4.5 95.5										
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist to saturated, medium dense to loose, trace gravel (Alluvial) ▽	SS 3	89	5-6-6 (12)							
			SS 4	83	3-4-3 (7)							
10		11.0 89.0	SS 5	89	3-3-4 (7)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-5

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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** 7.50 ft / Elev 92.50 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (4.8 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to medium grained, moist, trace gravel (Fill) NOT: Brown to dark brown below 2.0 feet.	SS 2	78	6-6-8 (14)			5				
		4.5										
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist to saturated, medium dense to loose, trace gravel (Alluvial) ▽	SS 3	83	5-5-6 (11)							
			SS 4	72	3-4-3 (7)							
10		11.0	SS 5	89	3-4-5 (9)							
		89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-6

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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 93.00 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 3.5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (4.8 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, little gravel (Fill)	SS 2	67	4-6-7 (13)							
		4.5 95.5										
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist to saturated, medium dense to loose, trace gravel (Alluvial) ▽	SS 3	89	5-6-6 (12)			12				
			SS 4	94	3-4-3 (7)							
10		11.0 89.0	SS 5	50	3-4-4 (8)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-7

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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 93.00 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 3.5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (4.3 Inches) 99.7	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel, occasional bituminous debris (Fill)	SS 2	89	4-5-5 (10)			4				
5		4.5 95.5 POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, loose, trace gravel (Alluvial)	SS 3	83	4-4-4 (8)							
		7.0 ▽ 93.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, saturated, medium dense, trace gravel (Alluvial)	SS 4	89	3-4-5 (9)							
10		11.0 89.0	SS 5	100	3-5-6 (11)							

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-8

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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 93.00 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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		0.5 BITUMINOUS PAVEMENT (5.8 Inches) 99.5	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel (Fill) NOTE: Brown to dark brown with occasional bituminous debris below 2.0 feet.	SS 2	78	7-8-7 (15)			5				
		4.5		95.5								
5		POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, moist to saturated, loose, trace gravel ▽ (Alluvial)	SS 3	83	3-4-4 (8)							
			SS 4	94	4-3-4 (7)							
10			SS 5	89	3-4-3 (7)							
		11.0		89.0								

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-9

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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** 7.50 ft / Elev 92.50 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (4.5 Inches)	99.6	AU 1					6				8
		2.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel (Fill)	98.0	SS 2	89	6-10-8 (18)							
5		4.5 POORLY GRADED SAND WITH SILT, (SP-SM) orange brown, fine to medium grained, moist, trace gravel (Fill)	95.5	SS 3	100	5-6-5 (11)							
		7.0 POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense, trace gravel (Alluvial)	93.0	SS 4	89	3-4-4 (8)							
10		▽ POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist to saturated, loose to medium dense, trace gravel (Alluvial)		SS 5	89	3-4-5 (9)							
		11.0	89.0										

Bottom of borehole at 11.0 feet.

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P: 651-389-4191
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BORING NUMBER S-10

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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** 7.50 ft / Elev 92.50 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 5 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

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 (5.0 Inches) 99.6	AU 1									
		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, trace gravel, occasional bituminous debris (Fill)	SS 2	100	16-7-8 (15)			4				
		4.5 95.5										
5		POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, loose, trace gravel (Alluvial)	SS 3	100	3-4-4 (8)							
		7.0 93.0										
		▽ POORLY GRADED SAND WITH SILT, (SP-SM) gray, fine to medium grained, moist to saturated, loose, trace gravel (Alluvial)	SS 4	100	2-2-3 (5)							
10			SS 5	89	5-4-4 (8)							
		11.0 89.0										

Bottom of borehole at 11.0 feet.

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BORING NUMBER S-11

CLIENT City of Ramsey
PROJECT NAME Alpine and Sunwood Drive - Street Improvements
PROJECT NUMBER 16.61770.100
PROJECT LOCATION Ramsey, MN
DATE STARTED 11/8/16 **COMPLETED** 11/8/16
GROUND ELEVATION 100 ft **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 90.50 ft
LOGGED BY Robert Hawkins **CHECKED BY** DAS
AT END OF DRILLING ---
CAVE IN (ft) 4 **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES Elevation assumed 100.0 Feet.

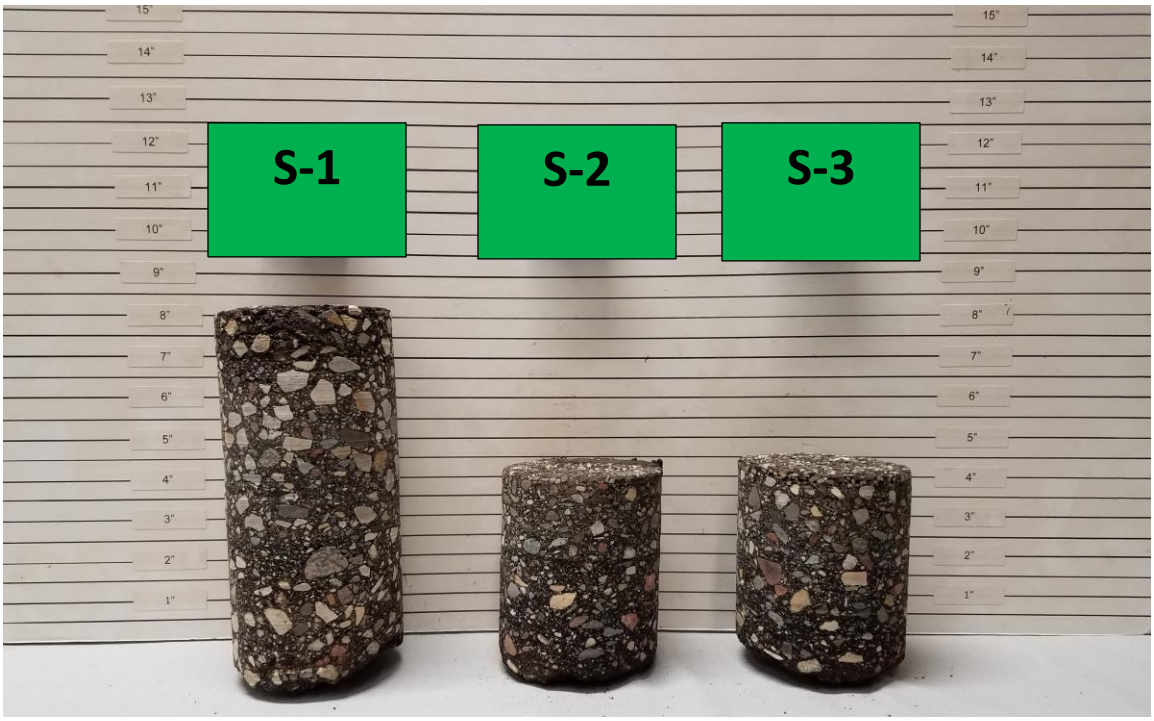
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.4 BITUMINOUS PAVEMENT (4.8 Inches)	99.6	AU 1									
		2.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown to dark brown, fine to medium grained, moist, trace gravel (Fill)	98.0	SS 2	89	3-4-5 (9)							
5		POORLY GRADED SAND, (SP) light brown, fine to medium grained, moist, medium dense to very loose, trace gravel (Alluvial)		SS 3	94	3-3-3 (6)			5				4
				SS 4	83	2-2-2 (4)							
10		9.5 ▽	90.5										
		11.0 POORLY GRADED SAND WITH SILT, (SP-SM) brown to light brown, fine to medium grained, saturated, loose, trace gravel (Alluvial)	89.0	SS 5	78	3-3-4 (7)							

Bottom of borehole at 11.0 feet.

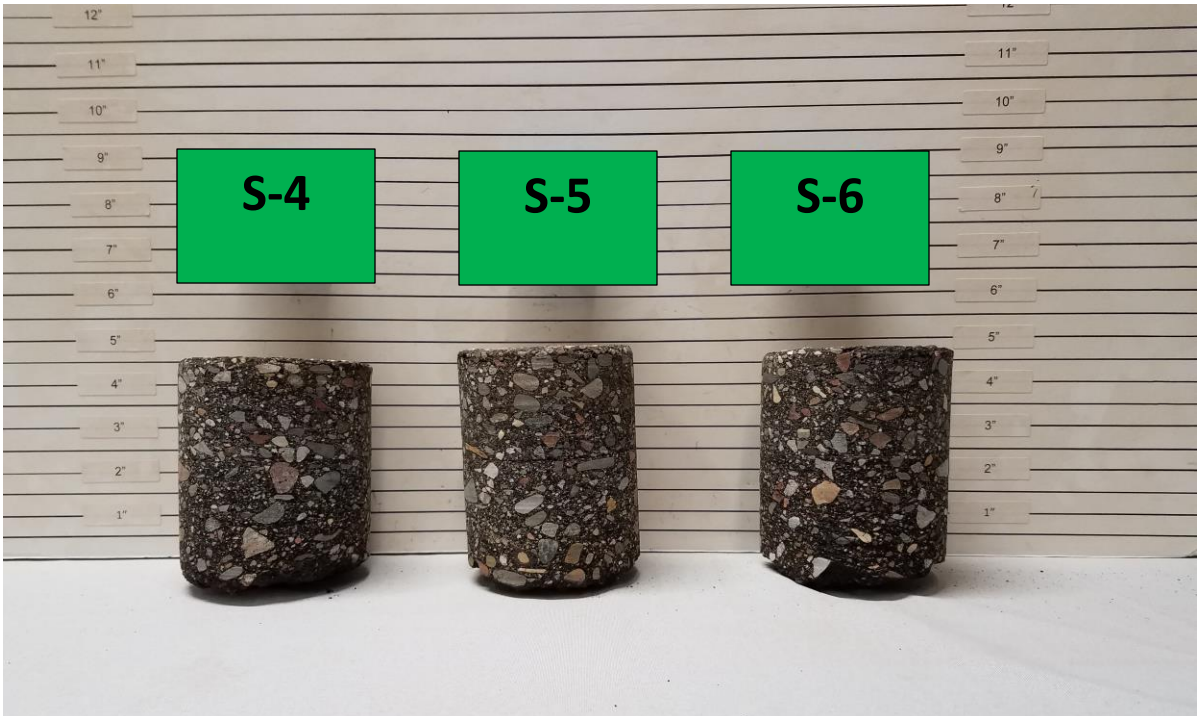
APPENDIX D

PAVEMENT CORE PHOTOGRAPHS

Bituminous Pavement Cores, S-1: 8 ¼ Inches, S-2: 4 ½ Inches, S-3: 4 ½ Inches.



Bituminous Pavement Cores, S-4: 4 ½ Inches, S-5: 4 ¾ Inches, S-6: 4 ¾ Inches.



Bituminous Pavement Cores, S-7: 4 ¼ Inches, S-8: 5 ¾ Inches, S-9: 4 ½ Inches.

Bituminous Pavement Cores, S-10: 5 Inches, S-11: 4 ¾ Inches.

701 Xenia Avenue South | Suite 300 | Minneapolis, MN 55416 | (763) 541-4800

December 27, 2016

Mr. Bruce Westby P.E.
City Engineer
7550 Sunwood Drive NW.
Ramsey, MN 55303

Re: Pavement Evaluations and Recommendations for City of Ramsey Improvement Project #17-00
2017 Sunwood Drive Reconstruction

Observation: On December 20, 2016 WSB & Associates cored Sunwood Drive from Ramsey Blvd. to Bunker Lake Blvd in Ramsey, MN, to verify the thickness of the Hot Mix Asphalt (HMA) and to determine what type of granular base was under the HMA. The pavement is in a light industrial park area and was constructed in 1980s. The main observed distress was cracking caused by aging of the HMA. Some fatigue cracks were observed in the wheel paths which are to be expected as a pavement meets its design life. One other observation was that the some of the warehouses were expanding their building which leads me to believe the truck traffic will only increase over the next 20 years. The cores measured 4 inches thick with a granular base material that appears to be Class 5.

Recommendations: Based on the information above our first recommendation would be to mill off 3 inches of the HMA and then do a 6 inch Stabilized Full Depth Reclamation (SFDR) using asphalt emulsion. The concept of doing SFDR over removing and repaving is that we can increase the structural capacity of the pavement by building down deeper into the pavement structure. This option would completely break up the existing crack pattern. Properly designed and constructed SFDR should yield gravel equivalencies of 1.5 to 2.0 with 1.8 being a good design value to use. Then repave the last 3 inches using SPWEB440C Super Pave. MnDOT gives this option the same value as a complete reconstruction at approximately 40 to 60 percent of the cost.

Option 2 would be to remove all the HMA and re-compact the base and repave. This option should be less expensive than Option 1. The one issue that we have with this option is the belief that truck traffic on Sunwood is only going to increase and that this option may fail prematurely compared to the existing pavement. If this option is chosen we would recommend using 4 inches of the same HMA as spelled out above.

Please let me know if you have any other questions of comments regarding this report.

Sincerely,

WSB & Associates, Inc.

Thomas J. Wood
Project Manager

Appendix A

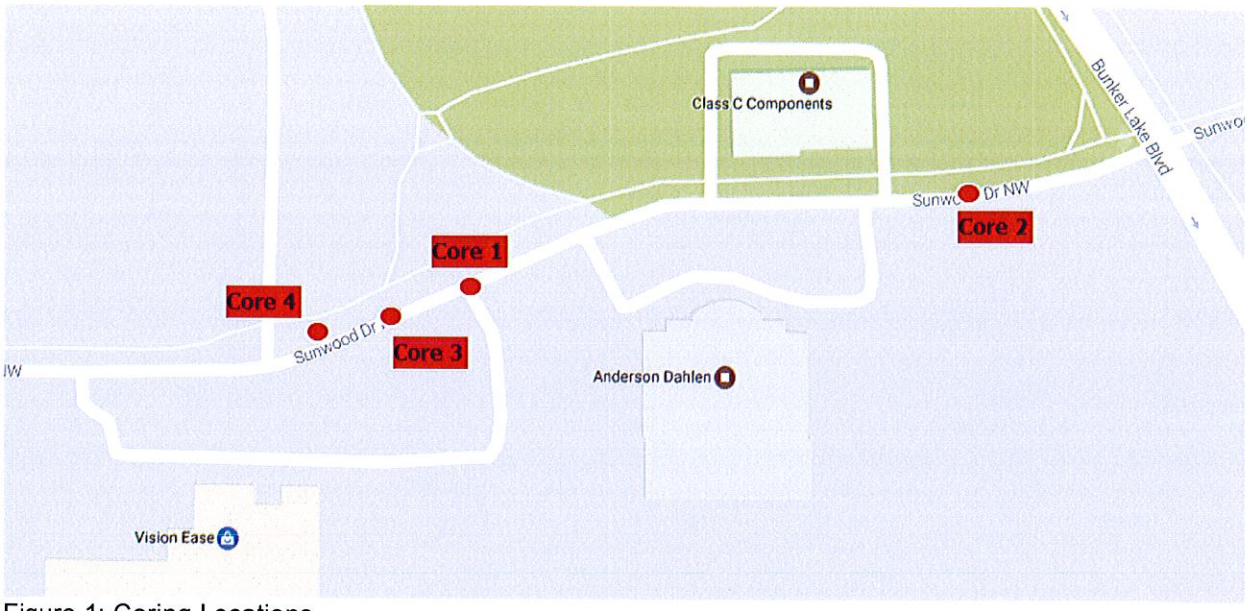


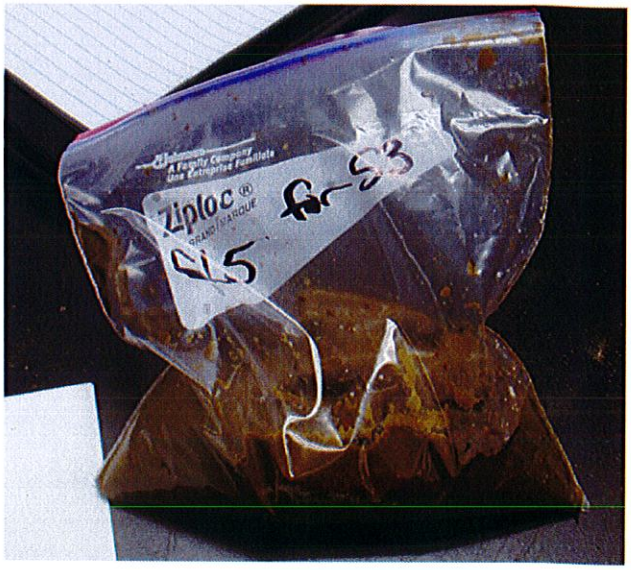
Figure 1: Coring Locations

Appendix B

Core 1

Core 2

Core 3



Core 4