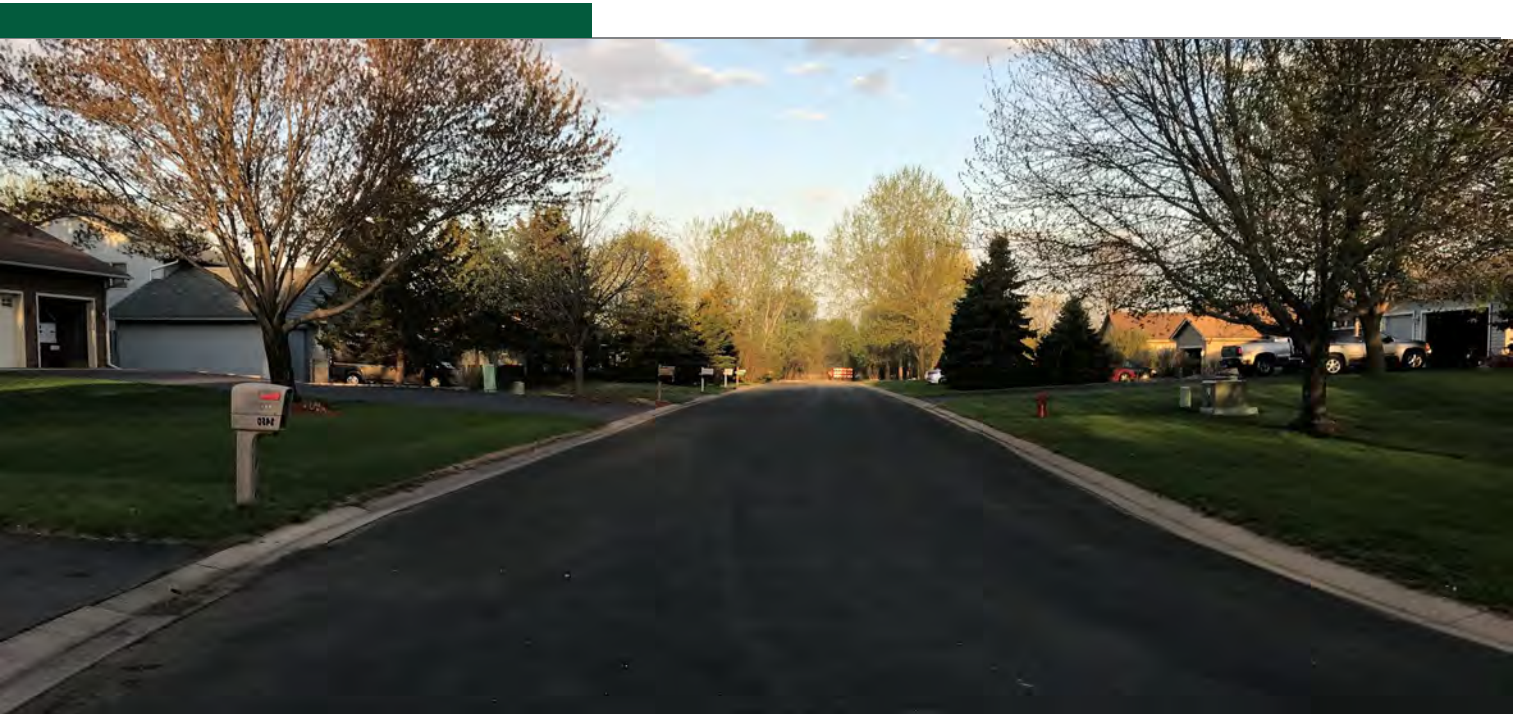




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Feasibility Report for **2019 Street Improvements**

Empire Township, MN
BMI Project No. T18.115336

December, 2018

Submitted by:
Bolton & Menk, Inc.
12224 Nicollet Avenue
Burnsville, MN 55337-1649
P: 952-890-0509
F: 952-890-8065



Certification

Feasibility Report

for

2019 Street Improvements Project

Empire Township, MN

BMI Project No. T18.115336

December 2018

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.

By:

Brian Hilgardner, P.E.
License No. 42875

Date:

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1.0 INTRODUCTION

This report examines the proposed street improvements for Empire Township's 2019 Street Improvements Project. This project is part of the Township's Capital Improvement Plan. The Capital Improvement Plan lays out a plan for street improvements over the next 10 years.

The report focuses primarily on rehabilitation improvements (reclamation of existing pavement, spot replacement of concrete curb and gutter, and spot replacement of residential driveway aprons). Some roads scheduled for improvements do not currently have concrete curb and gutter or drainage systems. As such, two options were considered for project areas. Option 1 includes concrete curb and gutter and storm sewer systems for roads without them. Option 2 does not include curb and gutter and storm sewer system improvements.

The addition of curb and gutter and storm sewer improvements to Option 1 makes equivalent street lengths more expensive in Option 1 than in Option 2. Option 2 includes more street segments for approximately the same total cost as Option 1. The streets proposed to be included in Option 1 are the following:

- 170th Street West between the Western Township Limits and Trunk Highway (TH) 3,
- 200th Street between TH 3 and Cabrilla Way,
- Chili Avenue between 200th Street and 197th Street,
- Chevelle Avenue between 200th Street and 197th Street,
- Cascade Avenue between 200th Street and 201st Street,
- 201st Street between Chesterfield Way and Calgary Trail,
- Chesterfield Way/202nd Street between TH 3 and 201st Street,
- 203rd Street between Chesterfield Way and the east end,
- Butternut Trail between Cabrilla Way and 197th Street,

The proposed improvements in Option 2 include everything in Option 1 with the following changes/additions:

- 200th Street between TH 3 and Cascade Avenue,
- Cabrilla Way between Butternut Trail and Butternut Trail,
- Cabrilla Court between Cabrilla Way and the cul-de-sac.

See Figure 1 and Figure 2 for proposed project location and improvements maps for each option.

This report reviews the existing conditions in the project areas and discusses, in detail, the proposed improvements. It also provides preliminary cost estimates for the proposed improvements. Financing for the Project comes from a combination of the Township's Stormwater Utility Fund, and the Township's bond sale process.

If the Township decides to proceed with the proposed street and utility improvements described in this report, construction is anticipated to begin in 2019 as shown in the project schedule found on Page 22.

2.0 STREET REHABILITATION (FULL-DEPTH RECLAMATION)

2.1 170TH STREET WEST / COUNTY ROAD 58

2.1.1 Background

170th Street West, from the western limits of Empire Township to TH 3, is a rural highway in Empire Township. It is classified as a major collector road and runs east/west in the northwestern portion of the Township. The road receives a large amount of truck traffic to support surrounding mines. Average Annual Daily Traffic (AADT) data for this road segment indicates volumes of 3,350 vehicles per day. The roadway used to be County Road 58, but ownership and maintenance has since been turned over to the Township.

170th Street West is a bituminous roadway with a ditch system along both sides. The roadway width, measured from edge of bituminous to edge of bituminous, is 24' along the project area. Both sides of the roadway have an 8' wide gravel shoulder. There are no sidewalks or trails located along the roadway corridor. Parking is not permitted on 170th Street. An at grade railroad crossing with the Union Pacific Railroad exists in the road segment.

Township records show that 170th Street was constructed from the Western Township Limits to TH 3 in 1970.

2.1.2 Existing Conditions

A geotechnical investigation was performed by Braun Intertec which included five cores, two borings, and ground penetrating radar (GPR) testing along 170th Street West. The data indicates that the bituminous thickness ranges between 2 inches and 6 inches with an average of 3.5 inches and the aggregate base thickness ranges between 3 inches and 13 inches with an average of 7.5 inches. The complete geotechnical report is included in Appendix C.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, polished aggregate, and potholes.

In the winter of 2012-2013, Empire Township began a Pavement Management System. The Pavement Management System included a survey of every street in the Township. Each survey rated the street segment based off the presence of defects such as cracks, rutting, potholes, and polished aggregates. This information was then used to compute a Pavement Condition Index (PCI) for each street section. PCI is a tool for comparing streets when considering where roadway improvements are most needed within the Township. The street PCI is a number between 0-100, with 100 being the best or signifying a newly paved street and 0 indicating a street in extremely bad condition. Industry standards classify rehabilitation and maintenance methods based on the following PCI groupings:

70 – 100	Maintenance
50 – 70	Mill and Overlay or Reclamation
30 – 50	Reclamation or Reconstruction
0 – 30	Complete Reconstruction

A pavement condition survey of 170th Street was completed in 2013 and 2018. From the survey, the following PCI results were generated:

Table 1 – 170 th Street West PCI			
From	To	2013 PCI	2018 PCI
Western Township Limits	TH 3	46	40

170th Street is not located within the Municipal Urban Service Area (MUSA) and therefore does not include any sanitary sewer or watermain. The ditch system does include culverts running under driveways and the railroad tracks. West of the railroad tracks the ditch flows west past the Township Limits, and east of the railroad water flows east past TH 3.

See Figure 3 for a depiction of 170th Street.

2.1.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for 170th Street is a full depth reclamation. The existing pavement thickness and underlying aggregate base is proposed to be ground up (reclaimed) to a maximum depth of 12 inches. The process removes all cracking in the pavement and improves the upper portions of the aggregate base by combining existing aggregate base and bituminous pavement into a new aggregate base. If any spots are determined in the field to have unacceptable base soil, those areas are excavated to a further depth in order to remove and replace the affected soils.

The reclaimed material is graded and compacted as a base course for the roadway. After the reclaim material is shaped, a bituminous base course is placed. Since, all of the reclaim material is used for the road's base section, the vertical alignment shifts up the height of the new pavement section.

The pavement is rehabilitated to a minimum 10-ton design requirement. Based on typical standards for a 10-ton road the proposed road section includes:

- 2" Wearing Course
- 2.5" Non-Wearing Course
- 8" Compacted Reclaim Material

The reclaimed road consists of two 12-foot driving lanes and one 8-foot shoulder on each side of the road. The roadway horizontal alignment stays the same.

2.1.4 Proposed Storm Sewer Improvements

No improvements are recommended as a part of the proposed project.

2.2 200TH STREET WEST

2.2.1 Background

200th Street West, from TH 3 to Cabrilla Way, is a local residential road in Empire Township. The road runs east/west in the southwestern portion of the Township and serves the residential single family homes on and around it.

200th Street West is a bituminous roadway. West of Cascade Avenue the roadway does not have curb and gutter. Bituminous curb exists 100' west of Cascade Avenue. The curb and gutter between Cascade Avenue and Cabrilla Way is concrete. The roadway width, measured from edge of bituminous to edge of bituminous and from back of curb to back of curb, is 31' along the project area. There is no existing sidewalk or trail along 200th Street. Mature trees are found in the boulevard on both sides of the road. Township records show that the roadway from TH 3 to Cascade Avenue was constructed in 1982. From Cascade Avenue to Calgary Trail the roadway

was constructed in 1996. From Calgary Trail to Cabrilla Way the roadway was constructed in 2002.

2.2.2 Existing Conditions

The geotechnical investigation included three pavement cores, one soil boring, and GPR testing along 200th Street. The data indicates that the bituminous thickness ranges between 2.5 inches and 7 inches with an average of 4 inches and the aggregate base thickness ranges between 7 inches and 10 inches with an average of 8.5 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, polished aggregates, and deficient drainage.

A pavement condition survey of 200th Street was completed in 2013 and 2018. From the survey, the following PCI results were generated:

Table 2 – 200 th Street West PCI			
From	To	2013 PCI	2018 PCI
TH 3	Chili Avenue	57	66
Chili Avenue	Chevelle Avenue	57	66
Chevelle Avenue	Cascade Avenue	57	66
Cascade Avenue	California Avenue	80	74
California Avenue	Calgary Trail	77	74
Calgary Trail	Cabrilla Way	80	80

There is an existing 8-inch diameter watermain which runs the entire length of 200th Street. Township records show that watermain between TH 3 and Cascade Avenue was constructed in 1975. Between Cascade Avenue and Calgary Trail the watermain was constructed in 1996. From Calgary Trail to Cabrilla Way the watermain was constructed in 2002.

There are existing sanitary sewer mains within 200th Street between TH 3 and Calgary Trail that generally run along street centerline. The mains are polyvinyl chloride (PVC) pipe and are 8 inches in diameter. One segment of the sanitary sewer main flows west from Cascade Avenue to TH 3 where it flows south out of the project area. The other segment flows eastward from Cascade Avenue to Calgary Trail. The existing condition of the sanitary sewer system is documented by videotaping the sewer main. Videotapes show that the system is in good working condition. All manholes on 200th Street are concrete structures. Township records show that sanitary sewer between TH 3 and Cascade Avenue was constructed in 1975. The sanitary sewer between Cascade Avenue and Calgary Trail was constructed in 1996.

There are two distinct storm sewer catchment and distribution network areas within 200th Street West. Between TH 3 and Chili Avenue, all water flows west to the TH 3 ditch system. A 27" culvert carries the water under 200th Street. East of Chili Avenue all water flows east to the catch basins near California Avenue and Calgary Trail. The storm sewer at California Avenue is constructed of reinforced concrete pipe (RCP) that ranges in size from 12" to 21" before it flows out of the project area. Water from both Chili and Chevelle Avenue flow south to 200th Street and then flow along 200th Street along the described path.

Most of the 200th Street area does not contain curb and gutter or a ditch system. All of the runoff water flows along the edge of the pavement. Water running along the edge of the pavement has led to erosion and deterioration of the pavement (see the image to the right). Cascade Avenue to Calgary Trail was constructed in 1996 with curb and gutter and storm sewer. Calgary Trail to Cabrilla Way was constructed in 2002 with curb and gutter and storm sewer.

See Figure 4 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.2.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for 200th Street includes two options. Both options include a full depth reclamation of 12 inches. Option 1 also includes concrete curb and gutter and storm sewer improvements. Option 2 does not include any curb and gutter or storm sewer improvements after the reclamation.

Option 1

With this option, the roadway width is proposed to remain at 31' back of curb to back of curb. The horizontal alignment is expected to remain the same. To achieve proper boulevard drainage the top of the curb and gutter is proposed to be placed at the same elevation as the existing edge of bituminous. With surmountable curb and gutter the top of the curb is 3.5" higher than the pavement, so the road vertical profile drops approximately 3.5". The street needs to be excavated below the reclaim depth to have an adequate aggregate section. Before excavating beneath the reclaim section, the reclaim material needs to be salvaged and stockpiled. Any soft spots that are observed in the field are excavated and replaced with suitable material. In addition to the subgrade repairs, a 6-inch section of select granular will be added above the subgrade to provide drainage of the road base. After the select granular has been installed, the salvaged reclaim material is hauled back and placed as aggregate base.

Concrete curb and gutter is installed after the reclaim material has been graded. The road is then ready to be paved with 4 inches of new bituminous pavement, a 2-inch non-wearing course and a 2-inch wearing course. All driveways need to be removed and replaced about 8 feet to match the elevation of the curb and gutter and make room for the curb and gutter. Disturbed boulevard areas are restored with 5 inches of topsoil and new sod.

Option 1 requires reclamation from TH 3 to Cabrilla Way. The PCI value of 200th Street between Cascade Avenue and Cabrilla Way does not require rehabilitation at this time. However, to connect the proposed storm sewer to the existing system, Cascade Avenue to California Avenue needs to be included in the project. California Avenue to Cabrilla Way makes sense to include in the project since it connects to the project area further to the east.

Option 2

The differences between this option and Option 1 is that the vertical profile remains the same as existing, and curb and gutter is not installed. Since the vertical profile is not changing, the



Pavement deterioration along the edges of 200th Street

reclaim material will be left in place instead of stockpiled unless soft spots are observed. The top of the reclaim section will be removed in preparation of paving the 4 inches of bituminous.

Option 2 has a full depth reclamation of 200th Street from TH 3 to Cascade Avenue. 200th Street between California and Cascade Avenue does not require major maintenance at this time.

2.2.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.2.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, it was determined no improvements are necessary for the existing sanitary sewer along the reclamation project area. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.2.6 Proposed Storm Sewer Improvements

Option 1

Catch basins and storm sewer are proposed to be installed along 200th Street West. Storm structures are proposed to be placed at Chili Avenue, Chevelle Avenue, and Cascade Avenue. The new storm sewer connects to the existing 21" RCP storm sewer located just east of California Avenue. If storm sewer is not added with the curb and gutter, overtopping of the curb and gutter may occur during large rain events. Adding storm structures improves drainage along the roadway.

Option 2

No improvements are recommended as part of the proposed project.

2.3 CHILI AND CHEVELLE AVENUE

2.3.1 Background

Chili and Chevelle Avenue, from 200th Street West to 197th Street West, are local residential roads in Empire Township. The roads run north/south in the southwestern portion of the Township and serves the residential single family homes on and around it.

Chili and Chevelle Avenue are bituminous roadways that do not have curb and gutter. The roadway widths, measured from edge of bituminous to edge of bituminous are 31' along the project area. There is no existing sidewalk or trail along Chili or Chevelle Avenue. Mature trees are found in the boulevard on both sides of the road. Township records show that the roadways were constructed in 1982.

2.3.2 Existing Conditions

The geotechnical investigation included two pavement cores, one soil boring, and GPR testing along 200th Street. The data indicates that the bituminous thickness ranges between 3 inches and 5.5 inches with an average of 4 inches and the aggregate base thickness ranges between 1 inches and 10 inches with an average of 5.5 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, polished aggregates, and deficient drainage.

A pavement condition survey of Chili and Chevelle Avenue was completed in 2013 and 2018.

From the survey, the following PCI results were generated:

Table 3 – Chili and Chevelle Avenue PCI				
Street	From	To	2013 PCI	2018 PCI
Chili Avenue	200 th Street West	197 th Street West	77	77
Chevelle Avenue	200 th Street West	197 th Street West	80	77

An existing 6-inch diameter watermain which runs the entire length of both Chili and Chevelle Avenue. Township records show that watermain was constructed in 1975.

There are existing sanitary sewer mains within Chili and Chevelle Avenue. The mains are polyvinyl chloride (PVC) pipe and are 8 inches in diameter. On both streets, the sanitary flows south to connect to 200th Street West. The existing condition of the sanitary sewer system is documented by videotaping the sewer main. Videotapes show that the system is in good working condition. All manholes on Chili and Chevelle Avenue are concrete structures. Township records show that the sanitary sewer was constructed in 1975.

The Chili and Chevelle Avenue area does not contain curb and gutter or a ditch system. All of the runoff water flows along the edge of the pavement. Water running along the edge of the pavement can lead to erosion and deterioration of the pavement. All water flows south along the roadway to 200th Street West.

See Figure 4 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.3.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, sub-soils, and lack of curb and gutter, the proposed improvement for Chili and Chevelle Avenue is a full depth reclamation of 12 inches with the addition of concrete curb and gutter.

The proposed roadway width is to stay at 31' from back of curb to back of curb. The roadway's vertical profile is proposed to change. See Option 1 for 200th Street for a description of the construction method.

2.3.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.3.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, it was determined no improvements are necessary for the existing sanitary sewer along the reclamation project area. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.3.6 Proposed Storm Sewer Improvements

Catch basins and storm sewer are proposed to be installed approximately 400' north of 200th Street West on both Chili and Chevelle Avenue. The new storm sewer will connect to the proposed storm sewer on 200th Street West. If storm sewer is not added with the curb and gutter, overtopping of the curb and gutter may occur during large rain events. Adding storm structures improves drainage along the roadway.

2.4 CASCADE AVENUE

2.4.1 Background

Cascade Avenue, from 201st Street to 200th Street, is a local residential road in Empire Township. The road runs north/south in the southwestern part of the Township and serves the residential single family homes on and around it.

Cascade Avenue is 31' wide from back of curb to back of curb and is a bituminous roadway with concrete curb and gutter on both sides. There are no existing sidewalks or trails located along the roadway corridor. Township records show that the road was constructed in 1986.



Existing Condition of Cascade Avenue

2.4.2 Existing Conditions

The geotechnical investigation included one pavement core, one soil boring, and GPR testing along Cascade Avenue. The data indicates that the bituminous thickness ranges between 2 inches and 5 inches with an average of 2.5 inches and the aggregate base thickness ranges between 5 inches and 7 inches with an average of 6 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, shrinkage cracking, and deficient drainage.

A pavement condition survey of Cascade Avenue was completed in 2013 and 2018. From the survey, the following PCI results were generated:

Table 4 – Cascade Avenue PCI			
From	To	2013 PCI	2018 PCI
201 st Street	200 th Street	69	69

Cascade Avenue has an existing 6-inch diameter ductile iron watermain which runs the entire length of Cascade Avenue. Township records show that watermain improvements were constructed in 1985.

Cascade Avenue does not have sanitary or storm sewer mains. The northern half of Cascade Avenue flows north to 200th Street, and the southern half of Cascade Avenue flows south to 201st.

See Figure 4 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.4.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for Cascade Avenue is a full depth reclamation. The proposed roadway width is to stay at 31' from back of curb to back of curb. The horizontal and vertical profile are expected to remain similar to the existing roadway. Any cracked/damaged/heaved existing concrete curb and gutter and driveway aprons will be removed and replaced with new concrete.

2.4.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.5 201ST STREET WEST

2.5.1 Background

201st Street, from Chesterfield Way to Calgary Trail, is a local residential road in Empire Township. The road runs east/west in the southwestern part of the Township and serves the residential single family homes on and around it.

Most of 201st Street is a 31' wide back of curb to back of curb bituminous roadway with concrete curb and gutter on both sides. One segment spanning from Chesterfield Way to 120' east of Chesterfield Way has bituminous curb instead of concrete curb and gutter. There are no existing sidewalks or trails located along the roadway corridor. Township records show that the road was constructed in two different segments. The first segment between Chesterfield Way and 120' east of Chesterfield Way was constructed in 1983. The segment between 120' east of Chesterfield Way and Calgary Trail was constructed in 1985.



Existing Condition of 201st Street

2.5.2 Existing Conditions

The geotechnical investigation included two pavement cores, one soil boring, and GPR testing along 201st Street. The data indicates that the bituminous thickness ranges between 2 inches and 5 inches with an average of 3 inches and the aggregate base thickness ranges between 5 inches and 7 inches with an average of 6 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, pot holes and polished aggregate.

Table 5 – 201 st Street West PCI			
From	To	2013 PCI	2018 PCI
Chesterfield Way	Cascade Avenue	63	63
Cascade Avenue	Calgary Trail	63	63

201st Street has an existing 6-inch diameter ductile iron watermain which runs the entire length of Cascade Avenue. Township records show that watermain improvements were constructed in 1983 from Chesterfield Way to 120' east of Chesterfield Way and in 1985 from 120' east of Chesterfield Way west of Calgary Trail.

The sanitary sewer along 201st Street flows west to Chesterfield Way. Generally the sewer runs along the street centerline. The main is 8 inches in diameter and is made of PVC. The existing condition of the sanitary sewer system is documented by videotapes showing the sewer main and is found to be in good condition.

There are three different storm sewer catchment areas within 201st Street. The segment from Chesterfield Way to 120' east of Chesterfield Way flows west and then south down Chesterfield Way. The segment from 120' east of Chesterfield Way to 330' east of Cascade Avenue flows to the storm structures just west of Cascade Avenue where it then flows south. From 330' east of Cascade Avenue all the way to Calgary Trail water flows east where the water is collected by storm sewer structures at the intersection of 201st Street and Calgary Trail.

See Figure 4 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.5.3 Proposed Street Improvements

The proposed improvement for 201st Street includes two options. Both options include a full depth reclamation of about 8 inches. Option 1 also includes adding concrete curb and gutter to the portion that is currently bituminous curb. Option 2 does not include any curb and gutter improvements to the area that has bituminous curb after the reclamation.

Option 1

With this option, the proposed roadway width is to stay at 31' from back of curb to back of curb. The portion of the roadway that has bituminous curb would have a change in the vertical profile. See Option 1 for 200th Street for a description of the construction method. The portion with concrete curb and gutter would retain the same horizontal and vertical profile. The method of reclamation is the same as described for Cascade Avenue.

Option 2

With this option, the proposed roadway width is to stay at 31' from back of curb to back of curb. The entire roadway is reclaimed using the method described for Cascade Avenue.

2.5.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.5.5 Proposed Sanitary Sewer Improvements

Based on the sewer pipe age, material type, and televising results, it was determined improvements are not necessary for the existing sanitary sewer along the reclamation project area. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.5.6 Proposed Storm Sewer Improvements

Based on the storm sewer pipe age, it was determined no improvements are necessary for the existing storm sewer along the reclamation project area.

2.6 CHESTERFIELD WAY

2.6.1 Background

Chesterfield Way, from TH 3 to 201st Street, is a local residential road in Empire Township. The road runs east/west and north/south in the southwestern portion of the Township and serves the residential single family homes on and around it.

Chesterfield Way is a bituminous roadway with bituminous curb. The roadway width, measured from edge of bituminous to edge of bituminous, is 31' along the project area. There is no existing sidewalk or trail along Chesterfield Way. Mature trees are found in the boulevard on both sides of the road. Township records show that the roadway from TH 3 to 201st Street was constructed in 1983.

2.6.2 Existing Conditions

The geotechnical investigation included two pavement cores, one soil boring, and GPR testing along Chesterfield Way. The data indicates that the bituminous thickness ranges between 2 inches and 6 inches with an average of 3.5 inches and the aggregate base thickness ranges between 5 inches and 13 inches with an average of 8.5 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, and polished aggregates.

A pavement condition survey of Chesterfield Way was completed in 2013 and 2018. From the survey, the following PCI results were generated:

Table 6 – Chesterfield Way PCI			
From	To	2013 PCI	2018 PCI
TH 3	203 rd Street	80	80
203 rd Street	202 nd Street	80	80
202 nd Street	201 st Street	80	80

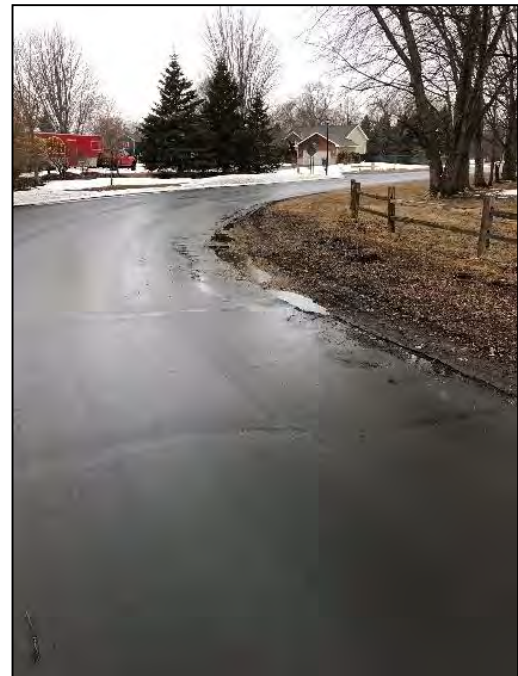
There is an existing 6-inch diameter watermain, which runs the entire length of Chesterfield Way. Township records show that watermain between TH 3 and 201st Street was constructed in 1983.

There is an existing sanitary sewer main within Chesterfield Way that flows north to south and then east to west before connecting to a trunk main along TH 3. The mains are PVC pipe and are 8 inches in diameter. The existing condition of the sanitary sewer system is documented by videotapes showing the sewer main. Videotapes show that the system is in good working condition. All manholes on Chesterfield Way are concrete structures. Township records show that sanitary sewer between TH 3 and 201st Street was constructed in 1983.

There is one distinct storm sewer catchment and distribution network area within Chesterfield Way. Between TH 3 and 202nd Street, all water flows east to the catch basins at the intersection of Chesterfield Way and 202nd Street. An 18" RCP storm sewer system carries the water eastward out of the project area. Between 202nd Street and 201st Street all water flows south to the same catch basins at the intersection of Chesterfield Way and 202nd Street.

The Chesterfield Way area does not contain curb and gutter or a ditch system. All of the runoff water flows along the edge of the pavement, contained by bituminous curb. Water running along the edge of the pavement has led to erosion along the road edges and deterioration of the pavement, especially at driveway locations.

See Figure 4 for a depiction of the existing watermain, sanitary sewer, and storm sewer.



Pavement deterioration along the edge of Chesterfield Way

2.6.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for Chesterfield Way includes two options. Both options include a full depth reclamation of 12 inches. Option 1 also includes concrete curb and gutter and storm sewer improvements. Option 2 does not include any curb and gutter improvements after the reclamation.

Option 1

With this option, the proposed roadway width is to stay at 31' from back of curb to back of curb. The roadway's vertical profile is proposed to change. See Option 1 for 200th Street for a description of the construction method.

Option 2

With this option, the proposed roadway width is to stay at 31' from edge of bituminous to edge of bituminous. Both the horizontal and vertical profile are expected to stay the same. The roadway is reclaimed with the same method described in Option 2 for 200th Street.

2.6.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.6.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, it was determined no improvements are necessary for the existing sanitary sewer along the reclamation project area. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings meeting Township standards.

2.6.6 Proposed Storm Sewer Improvements

Option 1

Catch basins and storm sewer are proposed to be installed along Chesterfield Way. Township records show a 4' stub of 15" RCP coming out of the storm structure at the south east corner of Chesterfield Way and 202nd Street. The new storm sewer connects to the existing 15" RCP storm sewer. Additionally, storm structures are added 400' north of the intersection. Water flowing from 201st Street currently travels over 900' before it is collected. If storm sewer is not added with the curb and gutter, overtopping of the curb and gutter may occur during large rain events. Adding storm structures improves drainage along the roadway.

Option 2

One catch basin is proposed to be added. Township records show a 4' stub of 15" RCP coming out of the storm structure at the south east corner of Chesterfield Way and 202nd Street. The new storm sewer connects to the existing 15" RCP storm sewer. A new catch basin is proposed to be placed on the west side of Chesterfield Way.

2.7 203RD STREET WEST

2.7.1 Background

203rd Street, from Chesterfield Way to the temporary cul-de-sac, is a local residential road in Empire Township. The road runs north/south and east/west in the southwestern part of the Township and serves the residential single family homes on it.

203rd Street is a 31' back of curb to back of curb bituminous roadway with concrete curb and gutter on both sides. There are no existing sidewalks or trails located along the roadway corridor. Township records show that the road was constructed in 1990.

2.7.2 Existing Conditions

The geotechnical investigation included one pavement core, one soil boring, and GPR testing along 203rd Street. The data indicates that the bituminous thickness ranges between 2 inches and 4 inches with an average of 3 inches and the aggregate base thickness ranges between 6 inches and 7 inches with an average of 6.5 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, pot holes, polished aggregates, and deficient drainage.

A pavement condition survey of 203rd Street was completed in 2013 and 2018. From the survey, the following PCI results were generated:



Existing Condition of 203rd Street

Table 7 – 203 rd Street PCI			
From	To	2013 PCI	2018 PCI
Chesterfield Way	East End	60	57

203rd Street has an existing 6-inch diameter ductile iron watermain which runs the entire length of 203rd Street. Township records show that watermain improvements were constructed in 1990.

An existing 8-inch diameter PVC sanitary sewer main flows east to west within 203rd Street. The main connects to a Metropolitan Council Environmental Services (MCES) line just east of TH 3. The existing condition of the sanitary sewer system is documented by videotapes showing the sewer main. Videotapes show that the system is in good working condition. All manholes on 203rd Street are concrete structures. Township records show that sanitary sewer was constructed in 1990.

Two distinct storm sewer catchments exist within 203rd Street. The first 450' south of Chesterfield Way flow to two catch basins at the low point of 203rd Street. From the catch basins, 12" RCP carries the water eastward where it enters a ditch system. Beyond the first 450', 203rd Street flows east towards the end of the road. From here the water makes its way towards the Vermillion River.

See Figure 4 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.7.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for 203rd Street is a full depth reclamation. The proposed roadway width is to stay at 31' from back of curb to back of curb. The horizontal and vertical profile are expected to remain similar to the existing roadway.

2.7.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.7.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, it was determined no improvements are necessary for the existing sanitary sewer along the reclamation project area. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.7.6 Proposed Storm Sewer Improvements

Based on the storm sewer pipe age, it was determined no improvements are necessary for the existing storm sewer along the reclamation project area.

2.8 BUTTERNUT TRAIL

2.8.1 Background

Butternut Trail, from Cabrilla Way to 197th Street, is a local residential road in Empire Township. The road runs east/west and north/south in the southwestern part of the Township and serves the residential single family homes on and around it.

Butternut Trail is a 34' back of curb to back of curb bituminous roadway with concrete curb and gutter on both sides. There is a sidewalk located on the east side of the roadway corridor. Township records show that the road was constructed in 2002.

2.8.2 Existing Conditions

The geotechnical investigation included one pavement core, one soil boring, and GPR testing along Butternut Trail. The data indicates that the bituminous thickness ranges between 2.5 inches and 5 inches with an average of 4 inches and the aggregate base thickness ranges between 4 inches and 9 inches with an average of 6 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, and deficient drainage.

A pavement condition survey of Butternut Trail was completed in 2013 and 2018. From the survey, the following PCI results were generated:

Table 8 – Butternut Trail PCI			
From	To	2013 PCI	2018 PCI
Cabrilla Way	Cabrilla Way	83	63
Cabrilla Way	Burlington Path	83	63
Burlington Path	Cabrilla Way	83	63
Cabrilla Way	197 th Street	83	63

Butternut Trail has an existing 8-inch diameter ductile iron watermain that turns into 10-inch diameter watermain near 197th Street. The main is located approximately 10 feet off of

centerline on the south and east side of the roadway. Township records show that watermain improvements were constructed in 2002.

Butternut Trail has an existing sanitary sewer system that generally flows along the street centerline. The main is PVC and ranges in size from 8 inches to 10 inches in diameter. Generally the main flows north to south towards Cabrilla Way on the east side of Butternut Trail. There is a main along the east/west part of Butternut Trail that flows west to Cabrilla Way near 200th Street. The existing condition of the sanitary sewer system is documented by videotapes showing the sewer main. The televising reveals the pipe is in good condition with no physical defects.

Three distinct storm sewer catchment and distribution networks are located within Butternut Trail. All of the storm sewer is RCP, and varies in size from 18" to 27". On the east/west portion of the roadway there are two different low points. Each low point contains a set of catch basins that collect water and convey the water to the ponds to the south. The portion of Butternut Trail that goes north/south has one storm sewer system that carries the water south to Cabrilla Way.

See Figure 5 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.8.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for Butternut Trail is a full depth reclamation. The proposed roadway width is to stay at 34' from back of curb to back of curb. The horizontal and vertical profile are expected to remain similar to the existing roadway.

2.8.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.8.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, it was determined no improvements are necessary for the existing sanitary sewer along the reclamation project area. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.8.6 Proposed Storm Sewer Improvements

Based on the storm sewer pipe age, it was determined no improvements are necessary for the existing storm sewer along the reclamation project area.

2.9 BURLINGTON PATH

2.9.1 Background

Burlington Path, from Cabrilla Way to the east end, is a local residential road in Empire Township. The road runs east/west in the southwestern part of the Township and serves the residential single family homes on and around it.

Burlington Path is a 34' back of curb to back of curb bituminous roadway with concrete curb and gutter on both sides. There are no existing sidewalks or trails located along the roadway corridor. Township records show that the road was constructed in 2002.

2.9.2 Existing Conditions

The geotechnical investigation included one pavement core, one soil boring, and GPR testing along Burlington Path. The data indicates that the bituminous thickness ranges between 2 inches and 5.5 inches with an average of 4 inches and the aggregate base thickness ranges between 3 inches and 7 inches with an average of 5 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, polished aggregates, and deficient drainage.

A pavement condition survey of Burlington Path was completed in 2013 and 2018. From the survey, the following PCI results were generated:



Existing Condition of Burlington Path

Table 9 – Burlington Path PCI			
From	To	2013 PCI	2018 PCI
Cabrilla Way	Butternut Trail	80	63
Butternut Trail	East End	80	63

Burlington Path has an existing 8-inch diameter ductile iron watermain. Township records show that watermain improvements were constructed in 2002.

Burlington Path has an existing sanitary sewer system that generally flows along the street centerline. An existing 8-inch diameter PVC main flows to the 10-inch diameter main on Butternut Trail. The existing condition of the sanitary sewer system is documented by videotapes showing the sewer main. The televising reveals the pipe is in good condition with no physical defects.

All of the water on Burlington Path flows east toward the low point on Burlington Path. The storm sewer in the area ranges from 15" to 18" RCP. Three separate storm sewer systems pass through Burlington Path. Two systems start in the backyards of the lots on the north side of Burlington Path. These systems head south crossing Burlington Path. The third system starts near the east end of Burlington Path and flows south along Butternut Trail.

See Figure 5 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.9.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for Burlington Path is a full depth reclamation. The proposed roadway width is to stay at 34' from back of curb to back of curb. The horizontal and vertical profile are expected to remain similar to the existing roadway.

2.9.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.9.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, it was determined no improvements are necessary for the existing sanitary sewer along the reclamation project area. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.9.6 Proposed Storm Sewer Improvements

Based on the storm sewer pipe age, it was determined no improvements are necessary for the existing storm sewer along the reclamation project area.

2.10 CABRILLA WAY

2.10.1 Background

Option 2 proposes improvements to Cabrilla Way. The roadway is not proposed for improvements under Option 1.

Cabrilla Way, from Butternut Trail to Butternut Trail, is a local residential road in Empire Township. The road runs north/south and east/west in the southwestern part of the Township and serves the residential single family and multi-family homes on and around it.

Cabrilla Way is a 34' wide back of curb to back of curb bituminous roadway with concrete curb and gutter on both sides. There are no existing sidewalks or trails located along the roadway corridor. Township records show that the road was constructed in 2002.

2.10.2 Existing Conditions

The geotechnical investigation included four pavement cores, two soil borings, and GPR testing along Cabrilla Way. The data indicates that the bituminous thickness ranges between 2 inches and 5.5 inches with an average of 4 inches and the aggregate base thickness ranges between 2 inches and 12 inches with an average of 6 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, longitudinal cracking, alligator cracking, shrinkage cracking, polished aggregates, and deficient drainage.

A pavement condition survey of Cabrilla Way was completed in 2013 and 2018. From the survey, the following PCI results were generated:

Table 10 – Cabrilla Way PCI			
From	To	2013 PCI	2018 PCI
Butternut Trail	200 th Street	83	71
200 th Street	Burlington Path	83	66
Burlington Path	Cabrilla Court	83	66
Cabrilla Court	Butternut Trail	83	66

Cabrilla Way has an existing 8-inch diameter ductile iron watermain. Between Cabrilla Court and Butternut Trail the watermain increases to 10 inches in diameter. Township records show that watermain improvements were constructed in 2002.

Cabrilla Way has an existing sanitary sewer main that runs along centerline. The main is 8-inch diameter pipe made of PVC. A 10-inch diameter stretch flows south and west from Butternut

Trail to connect to the MCES Interceptor. The rest of the sanitary sewer flows south along Cabrilla Way until it connects to the 10-inch diameter segment. The existing condition of the sanitary sewer system is documented by videotapes showing the sewer main. The televising reveals the pipe is in good condition with no physical defects. Township records show that the sanitary sewer was constructed in 2002.

Cabrilla Way has multiple storm sewer systems. The pipe ranges in size from 12" RCP to 30" RCP. Along the southern loop of Cabrilla Way, 4 separate sets of catch basins collect water and convey it to a pond. One other storm sewer system transports water from the pond to the Vermillion River to the south. Water is collected at multiple catch basins and flows south to a pond on the western portion of Cabrilla Way. A series of catch basins collect water on the northern portion of Cabrilla Way. The water flows south through easements between the yards towards Burlington Path.

See Figure 5 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.10.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for Cabrilla Way is a full depth reclamation. The proposed roadway width is to stay at 34' from back of curb to back of curb. The horizontal and vertical profile are expected to remain similar to the existing roadway.

2.10.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.10.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, improvements to the sanitary sewer main are not being proposed at this time. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.10.6 Proposed Storm Sewer Improvements

Based on the storm sewer pipe age, it was determined no improvements are necessary for the existing storm sewer along the reclamation project area.

2.11 CABRILLA COURT

2.11.1 Background

Option 2 proposes improvements to Cabrilla Court. The roadway is not proposed for improvements under Option 1.

Cabrilla Court, from Cabrilla Way to the cul-de-sac, is a local residential road in Empire Township. The road runs north/south in the southwestern part of the Township and serves the residential single family homes on it.

Cabrilla Court is a 34' back of curb to back of curb bituminous roadway with concrete curb and gutter on both sides. There are no existing sidewalks or trails located along the roadway corridor. Township records show that the road was constructed in 2002.

2.11.2 Existing Conditions

The geotechnical investigation included one pavement core and GPR testing along Cabrilla Court. The data indicates that the bituminous thickness ranges between 3 inches and 6.5 inches with an average of 4.5 inches and the aggregate base thickness ranges between 5.5 inches and 13 inches with an average of 8 inches.

The bituminous pavement within the study area shows wear and distress due to traffic loading as well as typical weathering effects experienced with aged bituminous pavement. The existing pavement shows transverse cracking, alligator cracking, shrinkage cracking, polished aggregates, and deficient drainage.

A pavement condition survey of Cabrilla Court was completed in 2013 and 2018. From the survey, the following PCI results were generated:

Table 11 – Cabrilla Court PCI			
From	To	2013 PCI	2018 PCI
Cabrilla Way	Cul-De-Sac	83	74

Cabrilla Court has an existing 10-inch diameter ductile iron watermain which runs the entire length of Cabrilla Court and connects to watermain coming from 197th Street. Township records show that watermain improvements were constructed in 2002.

Cabrilla Court has one segment of sanitary sewer that runs along the centerline. The pipe is 8-inch diameter PVC. The existing condition of the sanitary sewer system is documented by videotapes showing the sewer main. The televising reveals the pipe is in good condition with no physical defects. Township Records show the sanitary sewer was constructed in 2002.

Cabrilla Court does not have a storm sewer system. All of Cabrilla Court flows south to Cabrilla Way.

See Figure 5 for a depiction of the existing watermain, sanitary sewer, and storm sewer.

2.11.3 Proposed Street Improvements

Based on the roadway age, pavement distresses, PCI rating, and sub-soils, the proposed improvement for Cabrilla Court is a full depth reclamation. The proposed roadway width is to stay at 34' from back of curb to back of curb. The horizontal and vertical profile are expected to remain similar to the existing roadway.

2.11.4 Proposed Watermain Improvements

Based on the watermain pipe age, material type, and lack of break history, it was determined no improvements are necessary for the existing watermain along the reclamation project area.

2.11.5 Proposed Sanitary Sewer Improvements

Based on the sanitary sewer pipe age, material type, and televising results, improvements to the sanitary sewer main are not being proposed at this time. All existing sanitary sewer manhole castings are proposed for replacement with new concrete adjustment rings and new castings.

2.11.6 Proposed Storm Sewer Improvements

No improvements are recommended as a part of the proposed project.

3.0 ESTIMATED COSTS/FINANCING

The estimated project cost to complete the improvements proposed herein are presented below for each of the two options. These costs include estimated construction costs, a 10% contingency, and 15% indirect cost (financial, legal, administrative, and engineering).

These cost estimates are based upon public construction cost information. Since the consultant has no control over the cost of labor, materials, competitive bidding process, weather conditions, and other factors affecting the cost of construction, all cost estimates are opinions for general information of the client and no warranty or guarantee as to the accuracy of construction cost estimates is made. It is recommended that costs for project financing should be based upon actual, competitive bid prices with reasonable contingencies.

The costs for both options are broken down based off of different streets and different parts of the project.

Table 12 – Estimated Cost Summary Option 1 (See Appendix B for Detailed Cost Estimate)			
Location	Construction Cost (Includes 10% Contingency)	Indirect Cost (15%)	Total Estimated Cost
170 th Street	\$312,100	\$46,800	\$358,900
200 th Street (TH 3 to California Avenue)	\$381,600	\$57,200	\$438,800
200 th Street (California to Cabrilla Way)	\$156,500	\$23,500	\$180,000
Chili Avenue	\$243,100	\$36,500	\$279,600
Chevelle Avenue	\$237,200	\$35,600	\$272,800
Cascade Avenue	\$37,400	\$5,600	\$43,000
201 st Street	\$182,700	\$27,400	\$210,100
Chesterfield Way	\$302,300	\$45,300	\$347,600
203 rd Street	\$78,800	\$11,800	\$90,600
Butternut Trail	\$242,500	\$36,400	\$278,900
TOTALS	\$2,174,200	\$326,100	\$2,500,300

Table 13 – Funding Summary Option 1		
Item	Total Estimated Cost	Township Share
Streets	\$2,288,000	\$2,288,000
Sanitary Sewer	\$49,100	\$49,100
Watermain	\$8,500	\$8,500
Storm Sewer	\$154,700	\$154,700
TOTALS	\$2,500,300	\$2,500,300

**Table 14 – Estimated Cost Summary Option 2
(See Appendix B for Detailed Cost Estimate)**

Location	Construction Cost (Includes 10% Contingency)	Overhead Cost (15%)	Total Estimated Cost
170 th Street	\$295,000	\$44,300	\$339,300
200 TH Street	\$95,200	\$14,300	\$109,500
Cascade Avenue	\$34,000	\$5,100	\$39,100
201 st Street	\$101,500	\$15,200	\$116,700
Chesterfield Way	\$113,400	\$17,000	\$130,400
203 rd Street	\$69,000	\$10,400	\$79,400
Butternut Trail	\$209,400	\$31,400	\$240,800
Burlington Path	\$130,000	\$19,500	\$149,500
Cabrilla Way	\$357,000	\$53,600	\$410,600
Cabrilla Court	\$34,200	\$5,100	\$39,300
TOTALS	\$1,438,700	\$215,900	\$1,654,600

Table 15 – Funding Summary Option 2

Item	Total Estimated Cost	Township Share
Streets	\$1,572,800	\$1,572,800
Sanitary Sewer	\$68,300	\$68,300
Watermain	\$10,700	\$10,700
Storm Sewer	\$2,800	\$2,800
TOTALS	\$1,654,600	\$1,654,600

The Township will finance the project costs through money collected via bonds and also through the mining tax fund.

It is recommended that Option 1 be selected for improvements. Installing curb and gutter and storm sewer on roadways that do not currently have these improvements will improve drainage on these roadways. Curb and gutter helps support the pavement structure, leading to less deterioration along the pavement edges. Ultimately, the addition of curb and gutter and storm sewer is expected to increase the lifespan and improve the ride quality of the pavement.

4.0 PROJECT SCHEDULE

The proposed project schedule is shown below:

Receive Feasibility (Preliminary Engineering) Report*	October 9, 2018
Order Project & Preparation of Plans*	December 11, 2018
Send Public Hearing Meeting Notice to Residents	January 8, 2019
Hold Public Hearing Meeting	January 22, 2019
Approve Plans & Specs; Authorize Ad for Bids*	February 26, 2019
Get Ad for Bid to Quest CDN & Farmington Independent	February 26, 2019
Advertise Farmington Independent (Repeat publication on 3/11/19)	March 4, 2019
Open Bids at 11am	March 21, 2019
Award Bid*	March 26, 2019
Preconstruction Meeting	May 9, 2019
Construction Start	May 13, 2019

* Town Board Meeting

5.0 EASEMENTS AND PERMITS

All of the proposed improvements are anticipated to be limited to the existing street right-of-way and easements.

Permits and approvals may be required from the following:

- Union Pacific Railroad – work within right-of-way permit at the railroad crossing along 170th Street.
- Minnesota Pollution Control Agency (MPCA) – General Storm Water Permit for Construction Activities under the National Pollutant Elimination System (NPDES) program
- Minnesota Department of Transportation (MnDOT) – work within right-of-way permit at Chippendale Avenue (TH 3) for 170th Street, 200th Street, and Chesterfield Way work.

6.0 CONCLUSION

From an engineering standpoint, this project, as proposed, is feasible, cost effective, and necessary. It can best be accomplished by letting competitive bids for the work under one contract in order to complete the work in an orderly and efficient manner. The Township and its financial consultant will have to determine the economic feasibility of the proposed improvements.

Appendix A: Figures

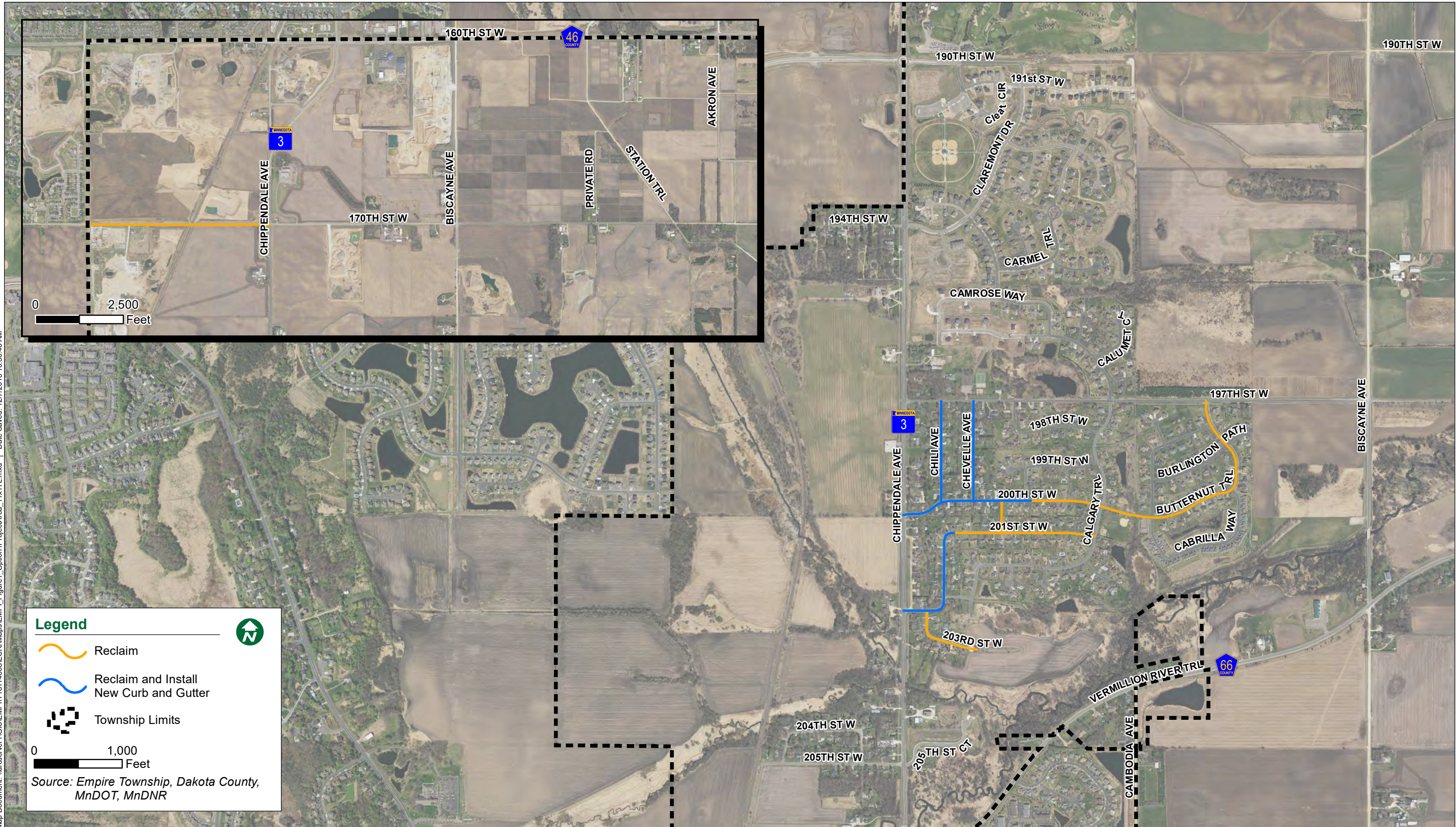


2019 Street Improvements Project

Empire Township, MN

Figure 1 - Option 1 Project Area

December 2018

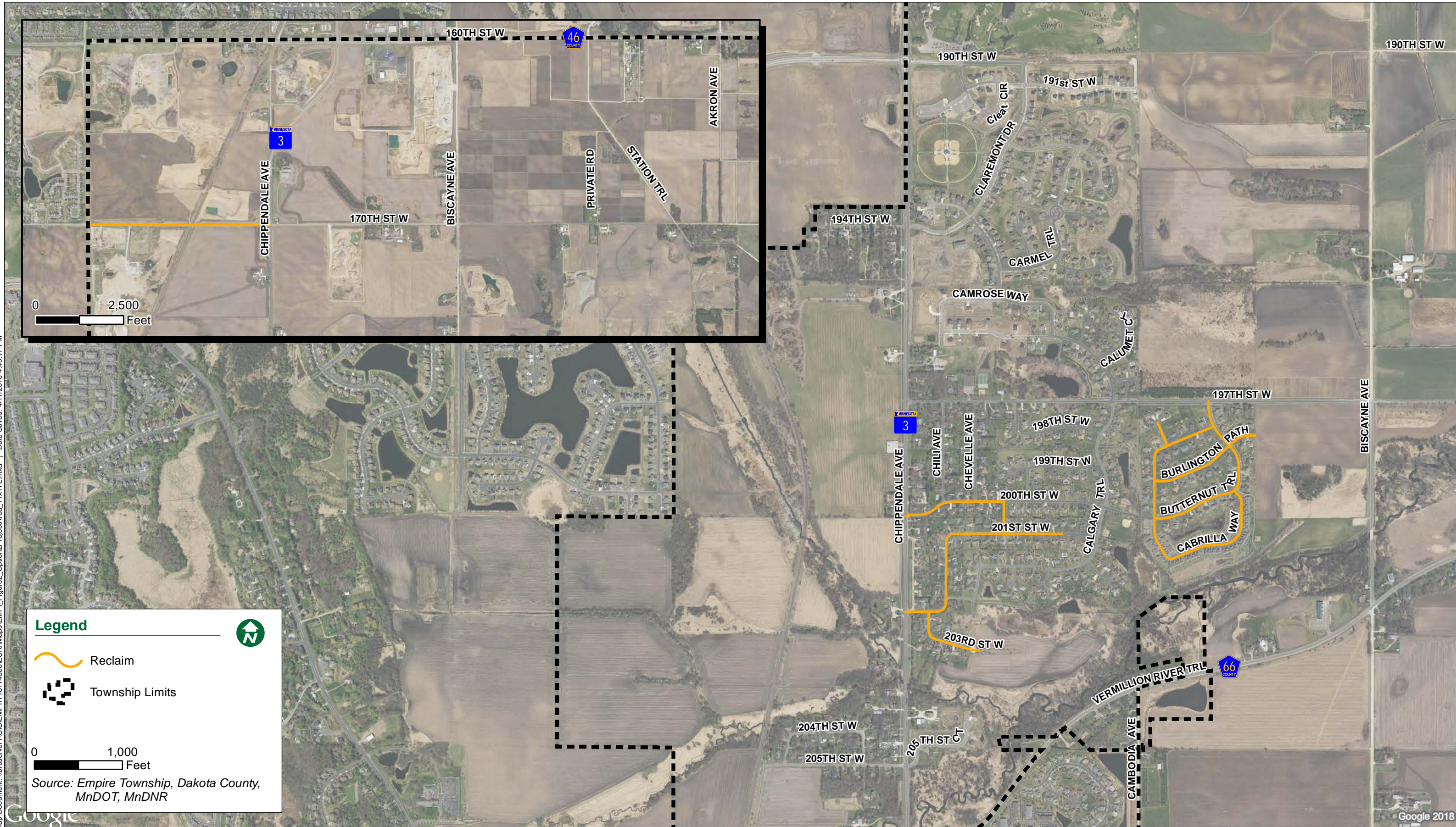


Legend

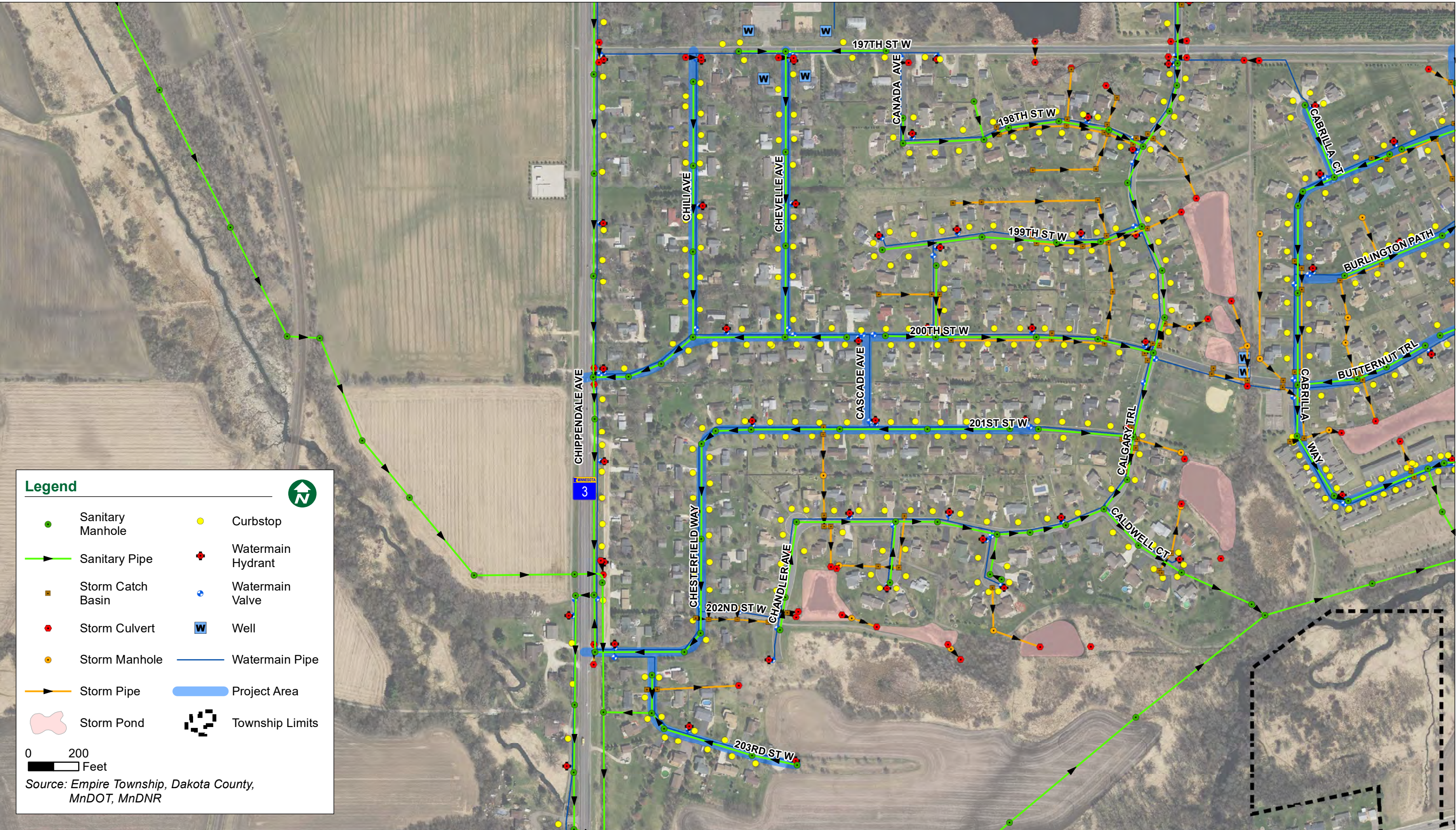
- Reclaim
- Reclaim and Install New Curb and Gutter
- Township Limits

0 1,000 Feet

Source: Empire Township, Dakota County, MnDOT, MnDNR







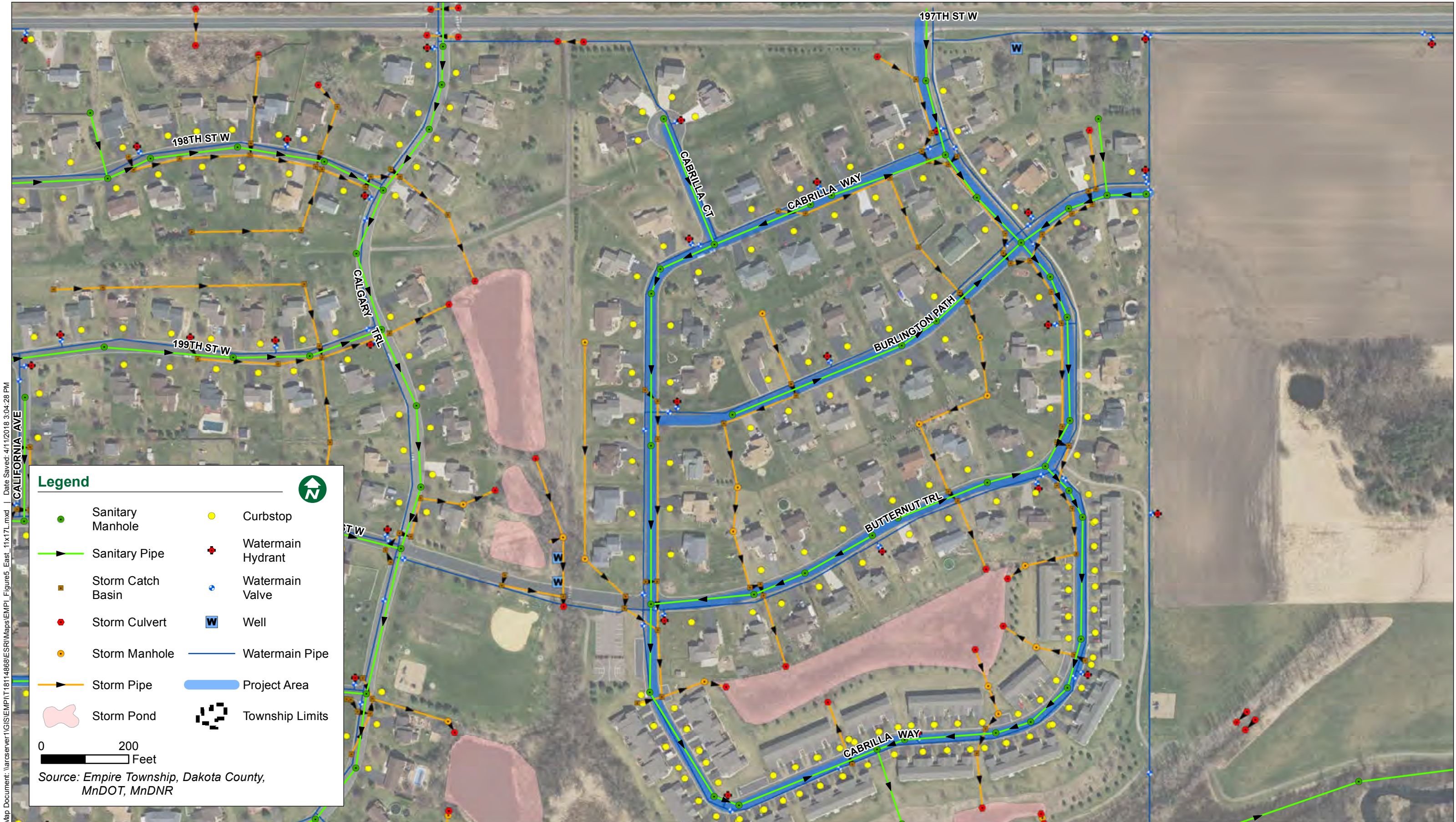


2019 Street Improvements Project

Empire Township, MN

Figure 5 - East Area

April 2018



Map Document: \\arcserver1\GIS\EMPT\18114868\ESRI\Map\EMPT_Figure5_East_11x17L.mxd | Date Saved: 4/11/2018 3:04:28 PM

Appendix B: Preliminary Cost Estimate

PRELIMINARY ENGINEER'S ESTIMATE
2019 STREET IMPROVEMENTS PROJECT
EMPIRE TOWNSHIP, MINNESOTA
OPTION 1
BMI PROJECT NO. T18.115336

SCHEDULE "A" - STREETS (TOTAL PROJECT)

ITEM NO.	SPEC NO.	ITEM DESCRIPTION	PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET - TH 3 TO CALIFORNIA RECLAMATION		200TH STREET - CALIFORNIA TO BUTTERNUT RECLAMATION		CHILI AVENUE RECLAMATION		CHEVELLE AVENUE RECLAMATION		CASCADE AVENUE RECLAMATION		201ST STREET RECLAMATION		CHESTERFIELD WAY RECLAMATION		203RD STREET RECLAMATION		BUTTERNUT TRAIL RECLAMATION	
			UNIT	QUANTITY	UNIT PRICE	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS
1	2021.501	MOBILIZATION	LUMP SUM	1.00	\$ 90,000.00	\$ 90,000.00	0.14	\$ 12,600.00	0.18	\$ 16,200.00	0.07	\$ 6,300.00	0.11	\$ 9,900.00	0.11	\$ 9,900.00	0.02	\$ 1,800.00	0.08	\$ 7,200.00	0.14	\$ 12,600.00	0.04	\$ 3,600.00	0.11	\$ 9,900.00
2	2104.501	REMOVE CURB & GUTTER	LF	620	\$ 6.00	\$ 3,720.00	0	\$ -	620	\$ 3,720.00	0	\$ -	0	\$ -	\$ -	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
3	2104.501	REMOVE CURB & GUTTER (SPOT REPLACEMENT)	LF	1817	\$ 8.00	\$ 14,536.00	0	\$ -	0	\$ -	435	\$ 3,480.00	0	\$ -	\$ -	\$ -	105	\$ 840.00	452	\$ 3,616.00	0	\$ -	219	\$ 1,752.00	606	\$ 4,848.00
4	2104.503	REMOVE BITUMINOUS CURB	LF	2990	\$ 3.00	\$ 8,970.00	0	\$ -	70	\$ 210.00	0	\$ -	0	\$ -	\$ -	\$ -	0	\$ -	240	\$ 720.00	2680	\$ 8,040.00	0	\$ -	0	\$ -
5	2104.505	REMOVE BITUMINOUS DRIVEWAY PAVEMENT	SF	11120	\$ 1.00	\$ 11,120.00	900	\$ 900.00	3300	\$ 3,300.00	0	\$ -	1600	\$ 1,600.00	\$ 1,760.00	\$ 1,760.00	0	\$ -	160	\$ 160.00	3400	\$ 3,400.00	0	\$ -	0	\$ -
6	2104.505	REMOVE CONCRETE PAVEMENT (VALLEY GUTTER)	SY	15	\$ 10.00	\$ 150.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	\$ -	\$ -	15	\$ 150.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -
7	2104.505	REMOVE CONCRETE DRIVEWAY PAVEMENT	SY	222	\$ 7.00	\$ 1,554.00	0	\$ -	67	\$ 469.00	0	\$ -	111	\$ 777.00	\$ 22.00	\$ 154.00	0	\$ -	0	\$ -	22	\$ 154.00	0	\$ -	0	\$ -
8	2104.509	REMOVE SIGN POST	EACH	17	\$ 50.00	\$ 850.00	0	\$ -	8	\$ 400.00	0	\$ -	2	\$ 100.00	\$ 1.00	\$ 50.00	0	\$ -	0	\$ -	6	\$ 300.00	0	\$ -	0	\$ -
9	2104.511	SAWING CONCRETE PAVEMENT (FULL DEPTH)	LF	220	\$ 5.00	\$ 1,100.00	0	\$ -	75	\$ 375.00	0	\$ -	100	\$ 500.00	\$ 25.00	\$ 125.00	0	\$ -	0	\$ -	20	\$ 100.00	0	\$ -	0	\$ -
10	2104.513	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	LF	1775	\$ 4.00	\$ 7,100.00	170	\$ 680.00	375	\$ 1,500.00	70	\$ 280.00	225	\$ 900.00	\$ 245.00	\$ 980.00	0	\$ -	55	\$ 220.00	390	\$ 1,560.00	0	\$ -	245	\$ 980.00
11	2104.521	SALVAGE & REINSTALL SPRINKLER SYSTEM	LF	1103	\$ 16.00	\$ 17,648.00	0	\$ -	321	\$ 5,136.00	0	\$ -	224	\$ 3,584.00	\$ 221.00	\$ 3,536.00	0	\$ -	69	\$ 1,104.00	268	\$ 4,288.00	0	\$ -	0	\$ -
12	2104.523	SALVAGE & REINSTALL MAILBOX	EACH	75	\$ 80.00	\$ 6,000.00	0	\$ -	17	\$ 1,360.00	12	\$ 960.00	15	\$ 1,200.00	\$ 12.00	\$ 960.00	0	\$ -	1	\$ 80.00	18	\$ 1,440.00	0	\$ -	0	\$ -
13	2105.501	COMMON EXCAVATION	CY	8334	\$ 10.00	\$ 83,340.00	0	\$ -	2244	\$ 22,440.00	0	\$ -	1902	\$ 19,020.00	\$ 1,877.00	\$ 18,770.00	0	\$ -	104	\$ 1,040.00	2207	\$ 22,070.00	0	\$ -	0	\$ -
14	2105.507	SUBGRADE EXCAVATION	CY	2049	\$ 14.00	\$ 28,686.00	462	\$ 6,468.00	251	\$ 3,514.00	166	\$ 2,324.00	193	\$ 2,702.00	\$ 190.00	\$ 2,660.00	35	\$ 490.00	191	\$ 2,674.00	223	\$ 3,122.00	84	\$ 1,176.00	254	\$ 3,556.00
15	2105.526	SELECT TOPSOIL BORROW	CY	1910	\$ 30.00	\$ 57,300.00	0	\$ -	495	\$ 14,850.00	67	\$ 2,010.00	345	\$ 10,350.00	\$ 340.00	\$ 10,200.00	16	\$ 480.00	107	\$ 3,210.00	413	\$ 12,390.00	34	\$ 1,020.00	93	\$ 2,790.00
16	2105.607	SALVAGE AND REINSTALL RECLAIMED MATERIAL	CY	3894	\$ 11.00	\$ 42,834.00	0	\$ -	1118	\$ 12,298.00	0	\$ -	857	\$ 9,427.00	\$ 846.00	\$ 9,306.00	0	\$ -	80	\$ 880.00	993	\$ 10,923.00	0	\$ -	0	\$ -
17	2105.609	SELECT GRANULAR BORROW	TON	13673	\$ 9.00	\$ 123,057.00	0	\$ -	1767	\$ 15,903.00	1755	\$ 15,795.00	1355	\$ 12,195.00	\$ 1,337.00	\$ 12,033.00	372	\$ 3,348.00	1966	\$ 17,694.00	1572	\$ 14,148.00	883	\$ 7,947.00	2666	\$ 23,994.00
18	2105.609	AGGREGATE BACKFILL	CY	2049	\$ 14.00	\$ 28,686.00	462	\$ 6,468.00	251	\$ 3,514.00	166	\$ 2,324.00	193	\$ 2,702.00	\$ 190.00	\$ 2,660.00	35	\$ 490.00	191	\$ 2,674.00	223	\$ 3,122.00	84	\$ 1,176.00	254	\$ 3,556.00
19	2123.610	STREET SWEEPER (WITH PICKUP BROOM)	HOURL	52	\$ 80.00	\$ 4,160.00	5	\$ 400.00	4	\$ 320.00	6	\$ 480.00	6	\$ 480.00	\$ 6.00	\$ 480.00	3	\$ 240.00	8	\$ 640.00	6	\$ 480.00	3	\$ 240.00	5	\$ 400.00
20	2130.501	WATER DUST CONTROL	MG	130	\$ 50.00	\$ 6,500.00	10	\$ 500.00	10	\$ 500.00	30	\$ 1,500.00	10	\$ 500.00	\$ 10.00	\$ 500.00	10	\$ 500.00	20	\$ 1,000.00	10	\$ 500.00	10	\$ 500.00	10	\$ 500.00
21	2211.501	AGGREGATE BASE CLASS 5 MOD. (100% CRUSHED)	TON	2259	\$ 14.50	\$ 32,755.50	0	\$ -	646	\$ 9,367.00	0	\$ -	496	\$ 7,192.00	\$ 489.00	\$ 7,090.50	0	\$ -	53	\$ 768.50	575	\$ 8,337.50	0	\$ -	0	\$ -
22	2215.501	FULL DEPTH RECLAMATION (8")	SY	52760	\$ 2.50	\$ 131,900.00	13867	\$ 34,667.50	5029	\$ 12,572.50	4994	\$ 12,485.00	3858	\$ 9,645.00	\$ 3,806.00	\$ 9,515.00	1050	\$ 2,625.00	5544	\$ 13,860.00	4467	\$ 11,167.50	2514	\$ 6,285.00	7631	\$ 19,077.50
23	2221.501	AGGREGATE SHOULDERING CLASS 2	TON	122	\$ 23.00	\$ 2,806.00	122	\$ 2,806.00	0	\$ -	0	\$ -	0	\$ -	\$ -	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
24	2357.502	BITUMINOUS MATERIAL FOR TACK COAT	GAL	3169	\$ 2.50	\$ 7,922.50	832	\$ 2,080.00	302	\$ 755.00	300	\$ 750.00	231	\$ 577.50	\$ 228.00	\$ 570.00	63	\$ 157.50	336	\$ 840.00	268	\$ 670.00	151	\$ 377.50	458	\$ 1,145.00
25	2360.501	TYPE SP 9.5 WEARING COURSE MIXTURE (3,B) 2"	TON	6680	\$ 58.00	\$ 387,440.00	1754	\$101,732.00	636	\$ 36,888.00	632	\$ 36,656.00	488	\$ 28,304.00	\$ 481.00	\$ 27,898.00	133	\$ 7,714.00	708	\$ 41,064.00	565	\$ 32,770.00	318	\$18,444.00	965	\$ 55,970.00
26	2360.502	TYPE SP 12.5 NON-WEARING COURSE MIXTURE (3,B) 2"	TON	6680	\$ 55.00	\$ 367,400.00	1754	\$ 96,470.00	636	\$ 34,980.00	632	\$ 34,760.00	488	\$ 26,840.00	\$ 481.00	\$ 26,455.00	133	\$ 7,315.00	708	\$ 38,940.00	565	\$ 31,075.00	318	\$17,490.00	965	\$ 53,075.00
27	2360.503	TYPE SP 9.5 WEAR CRS MIX (3,B) 3" THICK DRIVEWAY PAVEMENT	SY	1360	\$ 20.00	\$ 27,200.00	110	\$ 2,200.00	403	\$ 8,060.00	0	\$ -	196	\$ 3,920.00	\$ 215.00	\$ 4,300.00	0	\$ -	20	\$ 400.00	416	\$ 8,320.00	0	\$ -	0	\$ -
28	2531.507	6" CONCRETE DRIVEWAY PAVEMENT	SY	244	\$ 58.00	\$ 14,152.00	0	\$ -	74	\$ 4,292.00	0	\$ -	122	\$ 7,076.00	\$ 24.00	\$ 1,392.00	0	\$ -	0	\$ -	24	\$ 1,392.00	0	\$ -	0	\$ -
29	2531.501	CONCRETE CURB AND GUTTER D412	LF	10582	\$ 12.50	\$ 132,275.00	0	\$ -	3212	\$ 40,150.00	0	\$ -	2240	\$ 28,000.00	\$ 2,210.00	\$ 27,625.00	0	\$ -	240	\$ 3,000.00	2680	\$ 33,500.00	0	\$ -	0	\$ -
30	2531.501	CONCRETE CURB AND GUTTER D412 (SPOT REPAIR)	LF	1817	\$ 25.00	\$ 45,425.00	0	\$ -	0	\$ -	435	\$ 10,875.00	0	\$ -	\$ -	\$ -	105	\$ 2,625.00	452	\$ 11,300.00	0	\$ -	219	\$ 5,475.00	606	\$ 15,150.00
31	2531.604	7" CONCRETE VALLEY GUTTER	SY	15	\$ 85.00	\$ 1,275.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	\$ -	\$ -	15	\$ 1,275.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -
32	2540.601	TEMPORARY MAILBOXES	LUMP SUM	0	\$ 3,000.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	\$ -	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
33	2563.601	TRAFFIC CONTROL	LUMP SUM	1	\$ 5,000.00	\$ 5,000.00	0.14	\$ 700.00	0.18	\$ 900.00	0.07	\$ 350.00	0	\$ 550.00	\$ 0.11	\$ 550.00	0.02	\$ 100.00	0.08	\$ 400.00	0.14	\$ 700.00	0.04	\$ 200.00	0.11	\$ 550.00
34	2573.502	SILT FENCE, TYPE HEAVY DUTY	LF	1641	\$ 3.00	\$ 4,923.00	520	\$ 1,560.00	146	\$ 438.00	145	\$ 435.00	112	\$ 336.00	\$ 111.00	\$ 333.00	35	\$ 105.00	163	\$ 489.00	134	\$ 402.00	73	\$ 219.00	202	\$ 606.00
35	2573.530	STORM DRAIN INLET PROTECTION	EACH	60	\$ 350.00	\$ 21,000.00	0	\$ -	12	\$ 4,200.00	14	\$ 4,900.00	2	\$ 700.00	\$ 2.00	\$ 700.00	2	\$ 700.00	5	\$ 1,750.00	5	\$ 1,750.00	2	\$ 700.00	16	\$ 5,600.00
36	2573.540	FILTER LOG TYPE WOOD FIBER BIOROLL	LF	821	\$ 4.00	\$ 3,284.00	260	\$ 1,040.00	73	\$ 292.00	73	\$ 292.00	56	\$ 224.00	\$ 55.00	\$ 220.00	18	\$ 72.00	81	\$ 324.00	67	\$ 268.00	37	\$ 148.00	101	\$ 404.00
37	2573.602	TEMPORARY ROCK CONSTRUCTION ENTRANCE	EACH	12	\$ 1,000.00	\$ 12,000.00	2	\$ 2,000.00	2	\$ 2,000.00	0	\$ -	1	\$ 1,000.00	\$ 1.00	\$ 1,000.00	2	\$ 2,000.00	1	\$ 1,000.00	1	\$ 1,000.00	0	\$ -	2	\$ 2,000.00
38	2575.505	SODDING TYPE LAWN	SY	14878	\$ 4.50	\$ 66,951.00	0	\$ -	3854	\$ 17,343.00	522	\$ 2,349.00	2688	\$ 12,096.00	\$ 2,652.00	\$ 11,934.00	126	\$ 567.00	830	\$ 3,735.00	3216	\$ 14,472.00	263	\$ 1,183.50	727	\$ 3,271.50
39	2582.502	4" SOLID LINE EPOXY (WHITE)	LF	10400	\$ 0.40	\$ 4,160.00	10400	\$ 4,160.00	0	\$ -	0	\$ -	0	\$ -	\$ -	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
40	2582.502	4" DOUBLE SOLID LINE EPOXY (YELLOW)	LF	5200	\$ 0.60	\$ 3,120.00	5200	\$ 3,120.00	0	\$ -	0	\$ -	0	\$ -	\$ -	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
SCHEDULE "A" - STREETS (TOTAL PROJECT)						\$1,808,300.00		\$280,600.00		\$278,300.00		\$ 139,400.00		\$202,400.00		\$193,700.00		\$33,600.00		\$160,800.00		\$244,500.00		\$68,000.00		\$207,400.00
10% CONTINGENCY						\$ 180,800.00		\$ 28,100.00		\$ 27,800.00		\$ 13,900.00		\$ 20,200.00		\$ 19,400.00		\$ 3,400.00		\$ 16,100.00		\$ 24,500.00		\$ 6,800.00		\$ 20,700.00
SCHEDULE "A" - STREETS (TOTAL PROJECT)						PROJECT TOTAL		\$308,700.00		\$306,100.00		\$ 153,300.00		\$222,600.00		\$213,100.00		\$37,000.00		\$176,900.00		\$269,000.00		\$74,800.00		\$228,100.00

SCHEDULE "B" - SANITARY SEWER (TOTAL PROJECT)

ITEM NO.	SPEC NO.	ITEM DESCRIPTION	PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET - TH 3 TO CALIFORNIA RECLAMATION		200TH STREET - CALIFORNIA TO BUTTERNUT RECLAMATION		CHILI AVENUE RECLAMATION		CHEVELLE AVENUE RECLAMATION		CASCADE AVENUE RECLAMATION	
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SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)

			PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET - TH 3 TO CALIFORNIA RECLAMATION		200TH STREET - CALIFORNIA TO BUTTERNUT RECLAMATION		CHILI AVENUE RECLAMATION		CHEVELLE AVENUE RECLAMATION		CASCADE AVENUE RECLAMATION		201ST STREET RECLAMATION		CHESTERFIELD WAY RECLAMATION		203RD STREET RECLAMATION		BUTTERNUT TRAIL RECLAMATION	
ITEM NO.	SPEC NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS
42	2504.602	ADJUST VALVE BOX	EACH	19	\$ 350.00	\$ 6,650.00	0	\$ -	4	\$ 1,400.00	\$ 3.00	\$ 1,050.00	2.00	\$ 700.00	2.00	\$ 700.00	1	\$ 350.00	2	\$ 700.00	1	\$ 350.00	0	\$ -	4	\$ 1,400.00
SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)						TOTAL	\$ 6,700.00	\$ -	\$ 1,400.00	\$ 1,100.00	\$ 700.00	\$ 700.00	\$ 400.00	\$ 700.00	\$ 400.00	\$ 400.00	\$ -	\$ 100.00	\$ 400.00	\$ 700.00	\$ 400.00	\$ -	\$ 1,400.00			
10% CONTINGENCY							\$ 700.00	\$ -	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ -	\$ 100.00	\$ -	\$ 100.00	\$ -	\$ 100.00	\$ 800.00	\$ 400.00	\$ 800.00	\$ -	\$ 100.00			
SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)						PROJECT TOTAL	\$ 7,400.00	\$ -	\$ 1,500.00	\$ 1,200.00	\$ 800.00	\$ 800.00	\$ 400.00	\$ 800.00	\$ 400.00	\$ 400.00	\$ 800.00	\$ 400.00	\$ 800.00	\$ 400.00	\$ 800.00	\$ -	\$ 1,500.00			

SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)

			PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET - TH 3 TO CALIFORNIA RECLAMATION		200TH STREET - CALIFORNIA TO BUTTERNUT RECLAMATION		CHILI AVENUE RECLAMATION		CHEVELLE AVENUE RECLAMATION		CASCADE AVENUE RECLAMATION		201ST STREET RECLAMATION		CHESTERFIELD WAY RECLAMATION		203RD STREET RECLAMATION		BUTTERNUT TRAIL RECLAMATION	
ITEM NO.	SPEC NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS
43	2503.541	18" RC PIPE SEWER CL V DESIGN 3006 (STORM)	LF	2455	\$ 38.00	\$ 93,290.00	80	\$ 3,040.00	1170	\$ 44,460.00	0	\$ -	310.00	\$ 11,780.00	420.00	\$ 15,960.00	0	\$ -	0	\$ -	475	\$ 18,050.00	0	\$ -	0	\$ -
44	2503.602	CONNECT TO EXISTING STORM SEWER	EACH	2	\$ 800.00	\$ 1,600.00	0	\$ -	1	\$ 800.00	0	\$ -	\$ -	\$ -	\$ -	\$ -	0	\$ -	0	\$ -	1	\$ 800.00	0	\$ -	0	\$ -
45	2506.502	CONST DRAINAGE STRUCTURE DES (2'X3') (PLATE#301)	EACH	8	\$ 1,200.00	\$ 9,600.00	0	\$ -	5	\$ 6,000.00	0	\$ -	\$ 1.00	\$ 1,200.00	\$ 1.00	\$ 1,200.00	0	\$ -	0	\$ -	1	\$ 1,200.00	0	\$ -	0	\$ -
46	2506.502	CONST DRAINAGE STRUCTURE DES 48-4022 (PLATE#300)	EACH	8	\$ 2,200.00	\$ 17,600.00	0	\$ -	4	\$ 8,800.00	0	\$ -	\$ 1.00	\$ 2,200.00	\$ 1.00	\$ 2,200.00	0	\$ -	0	\$ -	2	\$ 4,400.00	0	\$ -	0	\$ -
SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)						TOTAL		\$ 122,100.00		\$ 3,100.00		\$ 60,100.00		\$ -		\$ 15,200.00		\$ 19,400.00		\$ -		\$ 24,500.00		\$ -		\$ -
10% CONTINGENCY								\$ 12,200.00		\$ 300.00		\$ 6,000.00		\$ -		\$ 1,500.00		\$ 1,900.00		\$ -		\$ 2,500.00		\$ -		\$ -
SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)						PROJECT TOTAL		\$ 134,300.00		\$ 3,400.00		\$ 66,100.00		\$ -		\$ 16,700.00		\$ 21,300.00		\$ -		\$ 27,000.00		\$ -		\$ -

SCHEDULE "A" - STREETS (TOTAL PROJECT)						\$1,989,600.00		\$308,700.00		\$306,100.00		\$ 153,300.00		\$222,600.00		\$213,100.00		\$37,000.00		\$176,900.00		\$269,000.00		\$74,800.00		\$228,100.00
SCHEDULE "B" - SANITARY SEWER (TOTAL PROJECT)						\$ 42,700.00		\$ -		\$ 7,900.00		\$ 2,000.00		\$ 3,000.00		\$ 2,000.00		\$ -		\$ 5,000.00		\$ 5,900.00		\$ 4,000.00		\$ 12,900.00
SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)						\$ 7,400.00		\$ -		\$ 1,500.00		\$ 1,200.00		\$ 800.00		\$ 800.00		\$ 400.00		\$ 800.00		\$ 400.00		\$ -		\$ 1,500.00
SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)						\$ 134,500.00		\$ 3,400.00		\$ 66,100.00		\$ -		\$ 16,700.00		\$ 21,300.00		\$ -		\$ -		\$ 27,000.00		\$ -		\$ -
PROJECT SUBTOTAL - W/ 10% CONTINGENCY						\$2,174,200.00		\$312,100.00		\$381,600.00		\$ 156,500.00		\$243,100.00		\$237,200.00		\$37,400.00		\$182,700.00		\$302,300.00		\$78,800.00		\$242,500.00
CL LENGTH						16400		5200		1460		1450		1120		1105		350		1625		1340		730		2020
CONSTRUCTION COSTS/ FT						\$ 132.57		\$ 60.02		\$ 261.37		\$ 107.93		\$ 217.05		\$ 214.66		\$ 106.86		\$ 112.43		\$ 225.60		\$ 107.95		\$ 120.05
15% OVERHEAD						\$ 326,100.00		\$ 46,800.00		\$ 57,200.00		\$ 23,500.00		\$ 36,500.00		\$ 35,600.00		\$ 5,600.00		\$ 27,400.00		\$ 45,300.00		\$11,800.00		\$ 36,400.00
ESTIMATED PROJECT GRAND TOTAL						\$2,500,300.00		\$358,900.00		\$438,800.00		\$ 180,000.00		\$279,600.00		\$272,800.00		\$43,000.00		\$210,100.00		\$347,600.00		\$90,600.00		\$278,900.00

BMI PROJECT NO. T18.115336

ITEM NO.	SPEC NO.	ITEM DESCRIPTION	PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET RECLAMATION		CASCADE AVENUE RECLAMATION		201ST STREET RECLAMATION		CHESTERFIELD WAY RECLAMATION		203RD STREET RECLAMATION		BUTTERNUT TRAIL RECLAMATION		BURLINGTON PATH RECLAMATION		CABRILLA WAY RECLAMATION		CABRILLA COURT RECLAMATION		
			UNIT	QUANTITY	UNIT PRICE	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY
	1	2021.501	MOBILIZATION	LUMP SUM	1	\$ 65,000.00	\$ 65,000.00	0.2	\$ 13,000.00	0.07	\$ 4,550.00	0.02	\$ 1,300.00	0.07	\$ 4,550.00	0.08	\$ 5,200.00	0.05	\$ 3,250.00	0.15	\$ 9,750.00	0.09	\$ 5,850.00	0.25	\$ 16,250.00	0.02	\$ 1,300.00
	2	2104.501	REMOVE CURB & GUTTER	LF	0	\$ 6.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	3	2104.501	REMOVE CURB & GUTTER (SPOT REPLACEMENT)	LF	2769	\$ 8.00	\$ 22,152.00	0	\$ -	0	\$ -	105	\$ 840.00	327	\$ 2,616.00	0	\$ -	219	\$ 1,752.00	606	\$ 4,848.00	383	\$ 3,064.00	1005	\$ 8,040.00	124	\$ 992.00
	4	2104.503	REMOVE BITUMINOUS CURB	LF	2990	\$ 3.00	\$ 8,970.00	0	\$ -	70	\$ 210.00	0	\$ -	240	\$ 720.00	2680	\$ 8,040.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	5	2104.505	REMOVE BITUMINOUS DRIVEWAY PAVEMENT	SF	900	\$ 1.00	\$ 900.00	900	\$ 900.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	6	2104.505	REMOVE CONCRETE PAVEMENT (VALLEY GUTTER)	SY	115	\$ 10.00	\$ 1,150.00	0	\$ -	0	\$ -	15	\$ 150.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	100	\$ 1,000.00	0	\$ -
	7	2104.505	REMOVE CONCRETE DRIVEWAY PAVEMENT	SY	128	\$ 7.00	\$ 896.00	0	\$ -	22	\$ 154.00	0	\$ -	18	\$ 126.00	0	\$ -	22	\$ 154.00	22	\$ 154.00	22	\$ 154.00	0	\$ -	22	\$ 154.00
	8	2104.509	REMOVE SIGN POST	EACH	0	\$ 50.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	9	2104.511	SAWING CONCRETE PAVEMENT (FULL DEPTH)	LF	290	\$ 5.00	\$ 1,450.00	0	\$ -	75	\$ 375.00	75	\$ 375.00	20	\$ 100.00	20	\$ 100.00	25	\$ 125.00	25	\$ 125.00	25	\$ 125.00	0	\$ -	25	\$ 125.00
	10	2104.513	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	LF	1253	\$ 4.00	\$ 5,012.00	140	\$ 560.00	300	\$ 1,200.00	325	\$ 1,300.00	30	\$ 120.00	390	\$ 1,560.00	0	\$ -	68	\$ 272.00	0	\$ -	0	\$ -	0	\$ -
	11	2104.521	SALVAGE & REINSTALL SPRINKLER SYSTEM	LF	0	\$ 16.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	12	2104.523	SALVAGE & REINSTALL MAILBOX	EACH	0	\$ 80.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	13	2105.501	COMMON EXCAVATION	CY	0	\$ 10.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	14	2105.507	SUBGRADE EXCAVATION	CY	0	\$ 14.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	15	2105.526	SELECT TOPSOIL BORROW	CY	426	\$ 30.00	\$ 12,780.00	0	\$ -	0	\$ -	16	\$ 480.00	50	\$ 1,500.00	0	\$ -	34	\$ 1,020.00	93	\$ 2,790.00	59	\$ 1,770.00	155	\$ 4,650.00	19	\$ 570.00
	16	2105.607	SALVAGE AND REINSTALL RECLAIMED MATERIAL	CY	0	\$ 11.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	17	2105.609	AGGREGATE BACKFILL	CY	0	\$ 14.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0													

ITEM NO.	SPEC NO.	ITEM DESCRIPTION	PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET RECLAMATION		CASCADE AVENUE RECLAMATION		201ST STREET RECLAMATION		CHESTERFIELD WAY RECLAMATION		203RD STREET RECLAMATION		BUTTERNUT TRAIL RECLAMATION		BURLINGTON PATH RECLAMATION		CABRILLA WAY RECLAMATION		CABRILLA COURT RECLAMATION	
			UNIT	QUANTITY	UNIT PRICE	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS
40	2506.502	CASTING ASSEMBLY (SANITARY)	EACH	60	\$ 900.00	\$ 54,000.00	0	\$ -	6	\$ 5,400.00	0	\$ -	5	\$ 4,500.00	6	\$ 5,400.00	4	\$ 3,600.00	13	\$ 11,700.00	6	\$ 5,400.00	19	\$ 17,100.00	1	\$ 900.00
SCHEDULE "B" - SANITARY SEWER (TOTAL PROJECT)				SUBTOTAL		\$ 54,000.00		\$ -		\$ 5,400.00		\$ -		\$ 4,500.00		\$ 5,400.00		\$ 3,600.00		\$ 11,700.00		\$ 5,400.00		\$ 17,100.00		\$ 900.00
10% CONTINGENCY						\$ 5,400.00		\$ -		\$ 500.00		\$ -		\$ 500.00		\$ 500.00		\$ 400.00		\$ 1,200.00		\$ 500.00		\$ 1,700.00		\$ 100.00
SCHEDULE "B" - SANITARY SEWER (TOTAL PROJECT)				PROJECT TOTAL		\$ 59,400.00		\$ -		\$ 5,900.00		\$ -		\$ 5,000.00		\$ 5,900.00		\$ 4,000.00		\$ 12,900.00		\$ 5,900.00		\$ 18,800.00		\$ 1,000.00

SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)

ITEM NO.	SPEC NO.	ITEM DESCRIPTION	PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET RECLAMATION		CASCADE AVENUE RECLAMATION		201ST STREET RECLAMATION		CHESTERFIELD WAY RECLAMATION		203RD STREET RECLAMATION		BUTTERNUT TRAIL RECLAMATION		BURLINGTON PATH RECLAMATION		CABRILLA WAY RECLAMATION		CABRILLA COURT RECLAMATION				
			UNIT	QUANTITY	UNIT PRICE	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS			
41	2504.602	ADJUST VALVE BOX	EACH	24	\$ 350.00	\$ 8,400.00	0	\$ -	4	\$ 1,400.00	1	\$ 350.00	2	\$ 700.00	1	\$ 350.00	0	\$ -	4	\$ 1,400.00	3	\$ 1,050.00	9	\$ 3,150.00	0	\$ -			
SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)						SUBTOTAL		\$ 8,400.00		\$ -		\$ 1,400.00		\$ 400.00		\$ 700.00		\$ 400.00		\$ -		\$ 1,400.00		\$ 1,100.00		\$ 3,200.00		\$ -	
10% CONTINGENCY								\$ 800.00		\$ -		\$ 100.00		\$ -		\$ 100.00		\$ -		\$ 100.00		\$ 100.00		\$ 300.00		\$ -			
SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)						PROJECT TOTAL		\$ 9,200.00		\$ -		\$ 1,500.00		\$ 400.00		\$ 800.00		\$ -		\$ 1,500.00		\$ 1,200.00		\$ 3,500.00		\$ -			

SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)

ITEM NO.	SPEC NO.	ITEM DESCRIPTION	PROJECT TOTALS				170TH STREET RECLAMATION		200TH STREET RECLAMATION		CASCADE AVENUE RECLAMATION		201ST STREET RECLAMATION		CHESTERFIELD WAY RECLAMATION		203RD STREET RECLAMATION		BUTTERNUT TRAIL RECLAMATION		BURLINGTON PATH RECLAMATION		CABRILLA WAY RECLAMATION		CABRILLA COURT RECLAMATION	
			UNIT	QUANTITY	UNIT PRICE	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS	QUANTITY	TOTAL COSTS
42	2503.541	18" RC PIPE SEWER CL V DESIGN 3006 (STORM)	LF	25	\$ 38.00	\$ 950.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	25	\$ 950.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
43	2503.602	CONNECT TO EXISTING STORM SEWER	EACH	0	\$ 800.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
44	2506.502	CONST DRAINAGE STRUCTURE DES (2'X3') (PLATE#301)	EACH	1	\$ 1,200.00	\$ 1,200.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	1	\$ 1,200.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
45	2506.502	CONST DRAINAGE STRUCTURE DES 48-4022 (PLATE#300)	EACH	0	\$ 2,200.00	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)						SUBTOTAL		\$ 2,200.00		\$ -		\$ -		\$ -		\$ 2,200.00		\$ -		\$ -		\$ -		\$ -		
10% CONTINGENCY								\$ 200.00		\$ -		\$ -		\$ -		\$ 200.00		\$ -		\$ -		\$ -		\$ -		
SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)						PROJECT TOTAL		\$ 2,400.00		\$ -		\$ -		\$ -		\$ 2,400.00		\$ -		\$ -		\$ -		\$ -		

SCHEDULE "A" - STREETS (TOTAL PROJECT)						\$1,367,600.00	\$295,000.00	\$ 87,800.00	\$33,600.00	\$ 95,700.00	\$104,700.00	\$65,000.00	\$195,000.00	\$122,900.00	\$334,700.00	\$ 33,200.00
SCHEDULE "B" - SANITARY SEWER (TOTAL PROJECT)						\$ 59,400.00	\$ -	\$ 5,900.00	\$ -	\$ 5,000.00	\$ 5,900.00	\$ 4,000.00	\$ 12,900.00	\$ 5,900.00	\$ 18,800.00	\$ 1,000.00
SCHEDULE "C" - WATERMAIN (TOTAL PROJECT)						\$ 9,300.00	\$ -	\$ 1,500.00	\$ 400.00	\$ 800.00	\$ 400.00	\$ -	\$ 1,500.00	\$ 1,200.00	\$ 3,500.00	\$ -
SCHEDULE "D" - STORM SEWER (TOTAL PROJECT)						\$ 2,400.00	\$ -	\$ -	\$ -	\$ -	\$ 2,400.00	\$ -	\$ -	\$ -	\$ -	\$ -
PROJECT SUBTOTAL - W/ 10% CONTINGENCY						\$1,438,700.00	\$295,000.00	\$ 95,200.00	\$34,000.00	\$101,500.00	\$113,400.00	\$69,000.00	\$209,400.00	\$130,000.00	\$357,000.00	\$ 34,200.00
15% OVERHEAD						\$ 215,900.00	\$ 44,300.00	\$ 14,300.00	\$ 5,100.00	\$ 15,200.00	\$ 17,000.00	\$10,400.00	\$ 31,400.00	\$ 19,500.00	\$ 53,600.00	\$ 5,100.00
ESTIMATED PROJECT GRAND TOTAL						\$1,654,600.00	\$339,300.00	\$109,500.00	\$39,100.00	\$116,700.00	\$130,400.00	\$79,400.00	\$240,800.00	\$149,500.00	\$410,600.00	\$ 39,300.00

Appendix C: Soil Boring & Pavement Core Locations & Logs

October 18, 2018

Project B1805248

Mr. Eric Hauser
Bolton & Menk, Inc.
12224 Nicollet Avenue
Burnsville, MN 55337

Re: Pavement Evaluation
2019 Street Improvements Project
Various Streets
Empire Township, Minnesota

Dear Mr. Hauser:

This letter summarizes our ground penetrating radar (GPR) testing, cores, and soil borings performed for the 2019 Street Improvements Project in Empire Township, Minnesota. The purpose of this pavement evaluation was to evaluate the pavement thicknesses of the streets in Empire Township using GPR, coring, and hand auger borings, and use this information to provide general recommendations for pavement reclamation.

We performed our work in general accordance with our proposal submitted to you on May 7, 2018.

GPR Results

We performed GPR testing on June 21, 2018 in a single direction on each of the streets highlighted on the attached Soil Boring Location Sketch. The GPR data collection density was approximately one scan per linear foot and was tied to both GPS and linear distance measurements. We organized the collected data to proceed in predominantly the eastbound or northbound directions, which may not necessarily reflect the original direction of data collection.

The results tables below (Tables 1 and 2) provide statistical summaries of the bituminous (BIT) and aggregate base (AGG) thicknesses based on our analysis of the GPR data using the RADAN software program. Please see the accompanying notes in our electronic attachments for additional discussion of observations, anomalies, and limitations.

Table 1. GPR Analysis Summary Statistics (BIT layer)

Street	Dir	From	To	GPR Picked Length (ft)	Bituminous layer thickness statistics (inches)				
					Avg.	15th Pctle	5th Pctle	Min	Max
170th St W	EB	West Twp Line	TH 3	5050	3.5	3.0	2.7	1.7	5.9
200th St W	EB	TH 3	Cascade Ave	1078	4.3	3.5	3.1	2.6	7.1
201st St W	EB	Chesterfield Way	End	1366	3.0	2.5	2.1	1.7	5.2
203rd St W	EB	Chesterfield Way	End	696	2.9	2.5	2.2	0.0*	4.0
Burlington Path	EB	Cabrilla Way	End	1218	3.9	3.4	3.1	1.9	5.4
Butternut Trail	EB	Cabrilla Way	End	1957	4.0	3.7	3.5	2.6	5.5
Cabrilla Ct	NB	Cabrilla Way	End	258	4.4	3.7	3.4	3.0	6.6
Cabrilla Way	All	Butternut Trail	Butternut Trail	3299	4.1	3.7	3.4	2.9	6.1
Cascade Ave	NB	201st St W	200th St W	298	2.4	2.0	1.9	1.7	4.9
Chesterfield Way	EB/NB	TH 3	201st St W	1206	3.6	3.1	3.0	2.3	6.2
Chevelle Ave	NB	200th St W	197th St W	1025	4.3	3.9	3.5	2.8	5.7
Chili Ave	NB	200th St W	197th St W	1059	3.8	3.4	3.1	2.7	5.4

*A minimum thickness of 0 inches can sometimes result from anomalous readings caused by signal noise. Refer to the data submitted electronically with this report for detailed thickness information.

Table 2. GPR Analysis Summary Statistics (AGG layer) (where present)

Street	Dir	From	To	GPR Picked Length (ft)	Aggregate layer thickness statistics (inches)				
					Avg.	15th Pctle	5th Pctle	Min	Max
170th St W	EB	West Twp Line	TH 3	5050	--	--	--	--	--
200th St W	EB	TH 3	Cascade Ave	1078	--	--	--	--	--
201st St W	EB	Chesterfield Way	End	1366	--	--	--	--	--
203rd St W	EB	Chesterfield Way	End	696	--	--	--	--	--
Burlington Path	EB	Cabrilla Wayy	End	1218	--	--	--	--	--
Butternut Trail	EB	Cabrilla Way	End	1957	6.2	5.4	5.0	4.1	9.1
Cabrilla Ct	NB	Cabrilla Way	End	258	8.2	6.7	6.2	5.5	13.1
Cabrilla Way	All	Butternut Trail	Butternut Trail	3299	6.0	3.5	2.9	1.8	11.7
Cascade Ave	NB	201st St W	200th St W	298	--	--	--	--	--
Chesterfield Way	EB/NB	TH 3	201st St W	1206	--	--	--	--	--
Chevelle Ave	NB	200th St W	197th St W	1025	5.6	4.5	2.8	1.4	8.6
Chili Ave	NB	200th St W	197th St W	1059	5.1	2.6	2.0	1.1	10.0

Figures provided electronically with this letter include interpreted layer depth along the street by linear measurement. The figures should be consulted for variation in the pavement thickness not directly reflected in our statistical summaries. We also suggest cross-checking the locations shown on the attached charts with the locations of any known features (culverts, intersections, maintenance and utility patches, etc.) that may result in local changes to the paved section.

Information from the cores and auger borings, described in the next section, was used to obtain bituminous and aggregate base layer thicknesses (where present) for comparison to GPR data.

As suggested by the summary shown in Table 2 and shown on the attached figures, a second layer (probable aggregate base) was not always visible in the GPR scan. This can often be the result of ambient/electromagnetic signal noise; however, our samples of the materials suggest the “aggregate base” and underlying soils were often very similar in character and would generally not be differentiable by GPR method. The lack of a visible second layer in the GPR scan does not necessarily imply an absence of one within the pavement section. We provide additional information on the aggregate base in the following sections.

Cores and Soil Borings

At your request, we performed 24 cores and shallow hand auger borings approximately in locations selected by Bolton & Menk, Inc. as shown on the sketch attached to this letter. We ultimately identified the field locations based on a preliminary review of the GPR and the accompanying GPS data.

Table 3 describes the core and aggregate base thicknesses and core material conditions. Due to the gravelly nature of the penetrated soils, we met refusal of our hand auger in the majority of the 24 locations; the thicknesses represent the total penetration of the hand auger, which may not have reached subgrade soil layers. To supplement the subgrade soil information, we performed additional borings with a truck-mounted drill rig as discussed below.

Photos of the cores are attached to this letter.

Table 3. Pavement Core and Hand Auger Summary

Core	Street	Core Thickness (inches)	Aggregate Base Thickness (inches)*	Notes
C-1	170 th St W	3 1/4	12 3/4	Refusal of hand auger
C-2		3	7	Refusal of hand auger
C-3		3 3/4	3 1/4	Refusal of hand auger
C-4		3 3/4	8 1/4	Refusal of hand auger
C-5		3 1/4	4 3/4	Refusal of hand auger
C-6	203 rd St W	3	7	Refusal of hand auger. High-severity stripping throughout core; debonded top layer.
C-7	Chesterfield Way	3 3/4	13 1/4	Refusal of hand auger. Moderate-severity stripping near top of core. Debonding of top layer.
C-8		4 1/2	7 1/2	Refusal of hand auger
C-9	201 st St W	2 1/4	5 3/4	Refusal of hand auger
C-10		3	5	Refusal of hand auger
C-11	200 th St W	2 3/4	7 1/4	Refusal of hand auger
C-12		4 1/4	8 3/4	Refusal of hand auger. Moderate-severity stripping near top of core. Debonding of top layer.
C-13		5	10	Refusal of hand auger on clayey layer
C-14	Cascade Ave	3	5	Refusal of hand auger
C-15	Chili Ave W	3 1/2	8 1/2	Low-severity stripping at core bottom
C-16	Chevelle Ave	4	14	Refusal of hand auger on clayey layer
C-17	Cabrilla Way	4 1/2		Unable to obtain aggregate/soil samples
C-18	Butternut Trail	4	1	Refusal of hand auger
C-19	Cabrilla Way	4	3	Refusal of hand auger
C-20		4	3	Refusal of hand auger
C-21	Burlington Path	3 3/4	3 1/4	Refusal of hand auger
C-22	Butternut Trail	3 3/4	3 1/4	Refusal of hand auger
C-23	Cabrilla Ct	4	3	Refusal of hand auger
C-24	Cabrilla Way	4 1/4	3 3/4	Refusal of hand auger. Layer debonding.

*"Aggregate base" was identified by the coring crew in the field and does not imply the material meets a particular gradation or specification (e.g. Class 5).

In order to supplement the soils and aggregate thickness information that was limited by our hand auger refusals, we initially performed power auger borings in five locations to depths of 5 feet each in locations shown on the attached sketch (B-1 to B-5). Bolton & Menk, Inc. later requested borings in another nine locations (B-6 to B-14). Prior to drilling, we staked the borings based on GPS locations from the GPR data and cleared public utilities via Gopher State One Call.

The borings are summarized in Table 4. Please consult the attached boring logs and Descriptive Terminology of Soil sheet for complete information.

Table 4. Soil Boring Summary

Boring	Street	Bituminous Thickness (inches)	Aggregate Base Thickness* (inches)	Soils Notes
B-1	Chevelle Avenue	4 ¾	8	Silty sand with gravel (SM)
B-2	Chesterfield Way	5	5	Silty sand (SM)
B-3	201st Street	4	7	Poorly graded sand with silt and gravel (SP-SM)
B-4	Burlington Path	4	7	Silty sand with gravel (SM)
B-5	Cabrilla Way	4	7 1/2	Silty sand with gravel (SM)
B-6	170th St W	4	10	Silty sand with gravel (SM) over clayey sand (SC)
B-7	170th St W	4	8	Silty sand with gravel (SM)
B-8	Chili Ave	4	8	Silty sand with gravel (SM)
B-9	200th St	5	--	(distinct aggregate base not noted) Silty sand with gravel (SM)
B-10	Cascade Ave	4	7	Silty sand with gravel (SM)
B-11	203rd St	4	6	Silty sand (SM)
B-12	Cabrilla Way	4	6	Silty sand with gravel (SM)
B-13	Cabrilla Way	5	8	Silty sand with gravel (SM)
B-14	Butternut Tr	5	8	Silty sand (SM)

*"Aggregate base" was identified by the drillers in the field and does not imply the material meets a particular gradation or specification (e.g. Class 5). As noted previously, the "aggregate base" was often very similar in character to the underlying soils, including poorly graded sand with silt (SP-SM) and gravel and silty sand (SM) with gravel.

We did not encounter water during drilling, and it is unlikely our boring depth was sufficient to penetrate the static groundwater table. Seasonal and annual fluctuations of the water table should be anticipated.

Discussion and Recommendations

The cores and GPR show an average thickness just over 3 1/2 inches and 6 1/2 inches for bituminous pavement and aggregate base, respectively, in the Empire Township 2019 project area. These thicknesses vary, particularly for aggregate base due to its intermittent visibility in the GPR data and the refusal of our hand augers in the majority of locations; we recommend consulting our electronic submissions of the GPR results for thickness by location and street.

The aggregate base sampled by the coring crew and drillers was generally a poorly graded sand with silt and gravel or silty sand with gravel. This material appeared to lack the angular material typical of a base derived from crushed quarry rock, which is part of what made it difficult to separate from the subgrade soils both visually and in the GPR scan. Nonetheless, it appears the materials underlying the base generally consist of granular materials with some proportion of gravel. Exceptions included Cores C-13 and C-16, where our hand augers met refusal on what appeared to be clayey soils at depths of 15 to 18 inches, which will be beyond the depths reached by most reclaim operations.

Subgrades encountered across the large project area in the borings appeared to consist mostly of sandy soils including poorly graded sand (SP), poorly graded sand with silt (SP-SM), and silty sand (SM), often with gravel. We therefore recommend an R-value of 40 for pavement thickness design. Note that, due to our inability to penetrate the identified “aggregate base” in many of our hand auger borings, this conclusion is based on somewhat limited information.

Based strictly on core/boring and GPR thickness, it appears generally that the pavements can be reclaimed in order to reuse the materials as aggregate base, with some considerations:

- The apparent composition of the aggregate base may produce a relatively sandy material that may have somewhat poorer structural characteristics than a material that is more angular and well-graded; a greater the proportion of bituminous pavement in the reclaimed material will improve these characteristics.
- The drillers also encountered cobbles in many of our power auger borings (often suggested on the boring logs as “auger chatter”), and the refusal of most of the hand auger borings also suggests that coarse material is commonly present in the upper portions of the pavement section. Excessive coarse rock can complicate and reduce the effectiveness of the reclaim process. The risk will increase as additional aggregate base and/or subgrade is incorporated with increasing reclaim depth.
- Removal of some reclaim material, or temporary stockpiling/windrowing of reclaim to allow for subgrade removal, will be necessary to accommodate the pavement sections recommended below if grades are fixed (such as where curb and gutter is present).

We recommend the following minimum pavement sections for the 2019 Empire Township Street Improvements Project:

Residential streets

3 1/2 inches SPWEA240C (2 lifts)

6 inches aggregate base/reclaim

170th Street (assumes fewer than 150,000 lifetime ESALs)

4 inches SPWEA240C (2 lifts)

6 inches aggregate base/reclaim

We recommend using the MnDOT penetration index method (MnDOT Specification 2211.3D.2.c) for testing compaction of reclaim/aggregate base and any granular embankment material (MnDOT Specification 2106.3F.3) placed as part of the project. Bituminous pavements should be specified, placed and tested as described in MnDOT Specification 2360.

Remarks

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please call Neil Lund at 952.995.2284.

Sincerely,

BRAUN INTERTEC CORPORATION

Professional Certification:

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



Neil G. Lund, PE
Senior Engineer
License Number: 46212
October 18, 2018

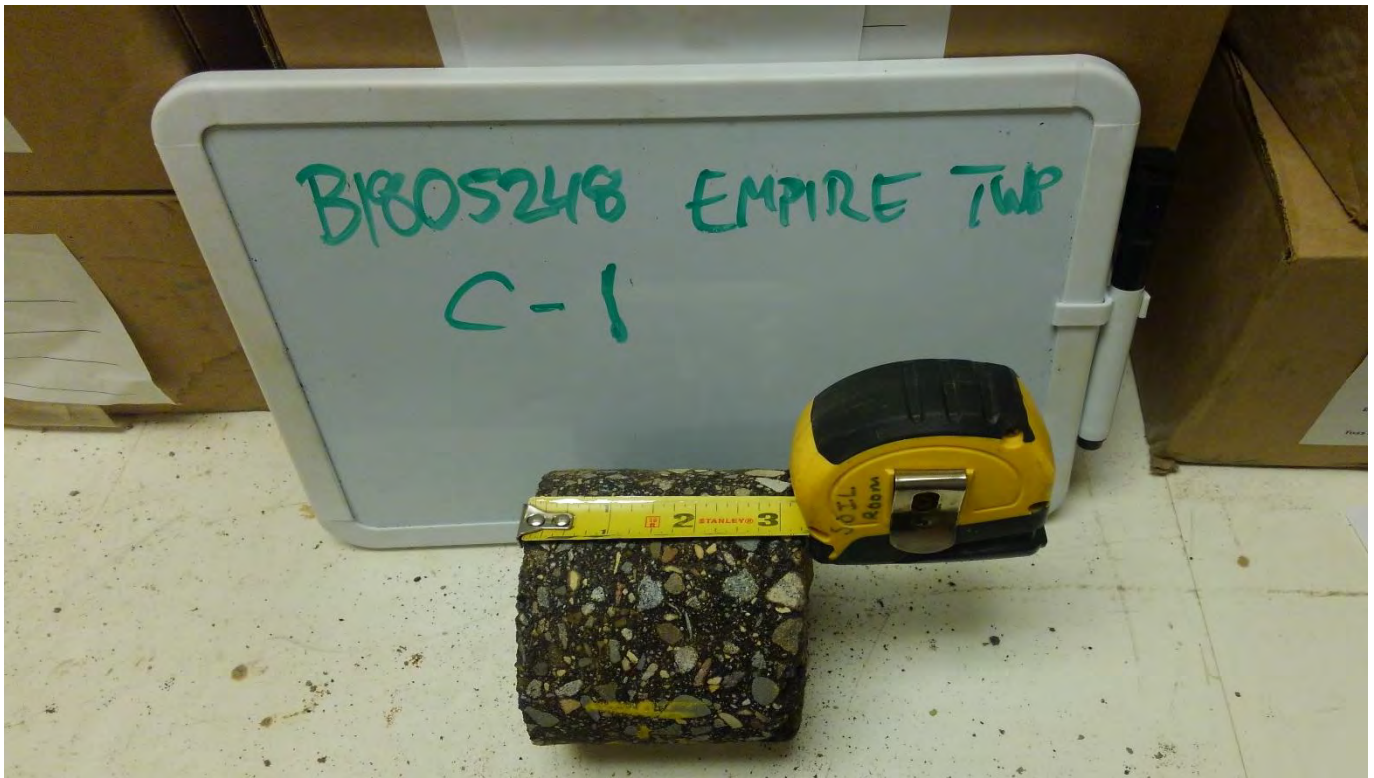


Cotette Brandenburg for:

Matthew S. Oman, PE
Principal – Principal Engineer

Attachments:

GPR Thickness Results (submitted electronically)
Core Photos
Core and Soil Boring Location Sketch (2 pages)
Boring Logs B-1 to B-14
Descriptive Terminology of Soil



Core #: C-1
 Pavement thickness: 3.25 inches Agg base thickness: 12.75 inches
 Roadway : 170th St W
 Date: 8/2/2018

Project: B1805248

BRAUN
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Core #: C-2
 Pavement thickness: 3 inches Agg base thickness: 7 inches
 Roadway : 170th St W
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-3
 Pavement thickness: 3.75 inches Agg base thickness: 3.25 inches
 Roadway : 170th St W
 Date: 8/2/2018

Project: B1805248

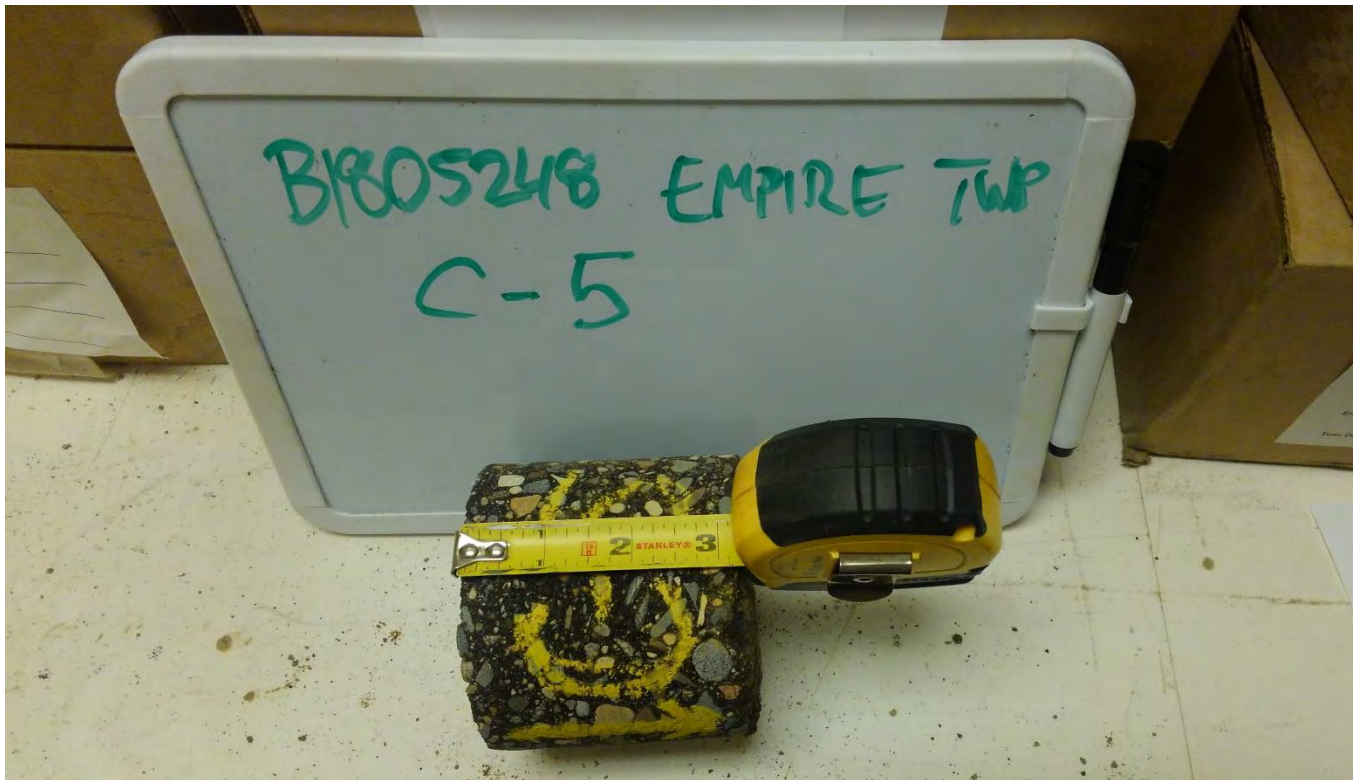
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Core #: C-4
 Pavement thickness: 3.75 inches Agg base thickness: 8.25 inches
 Roadway : 170th St W
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-5
Pavement thickness: 3.25 inches Agg base thickness: 4.75 inches
Roadway : 170th St W
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-6
Pavement thickness: 3 inches Agg base thickness: 7 inches
Roadway : 203rd St W
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-7
Pavement thickness: 3.75 inches Agg base thickness: 13.25 inches
Roadway : Chesterfield Way
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-8
Pavement thickness: 4.5 inches Agg base thickness: 7.5 inches
Roadway : Chesterfield Way
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-9
Pavement thickness: 2.25 inches Agg base thickness: 5.75 inches
Roadway : 201st St W
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-10
Pavement thickness: 3 inches Agg base thickness: 5 inches
Roadway : 201st St W
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-11
Pavement thickness: 2.75 inches Agg base thickness: 7.25 inches
Roadway : 200th St W
Date: 8/2/2018

Project: B1805248

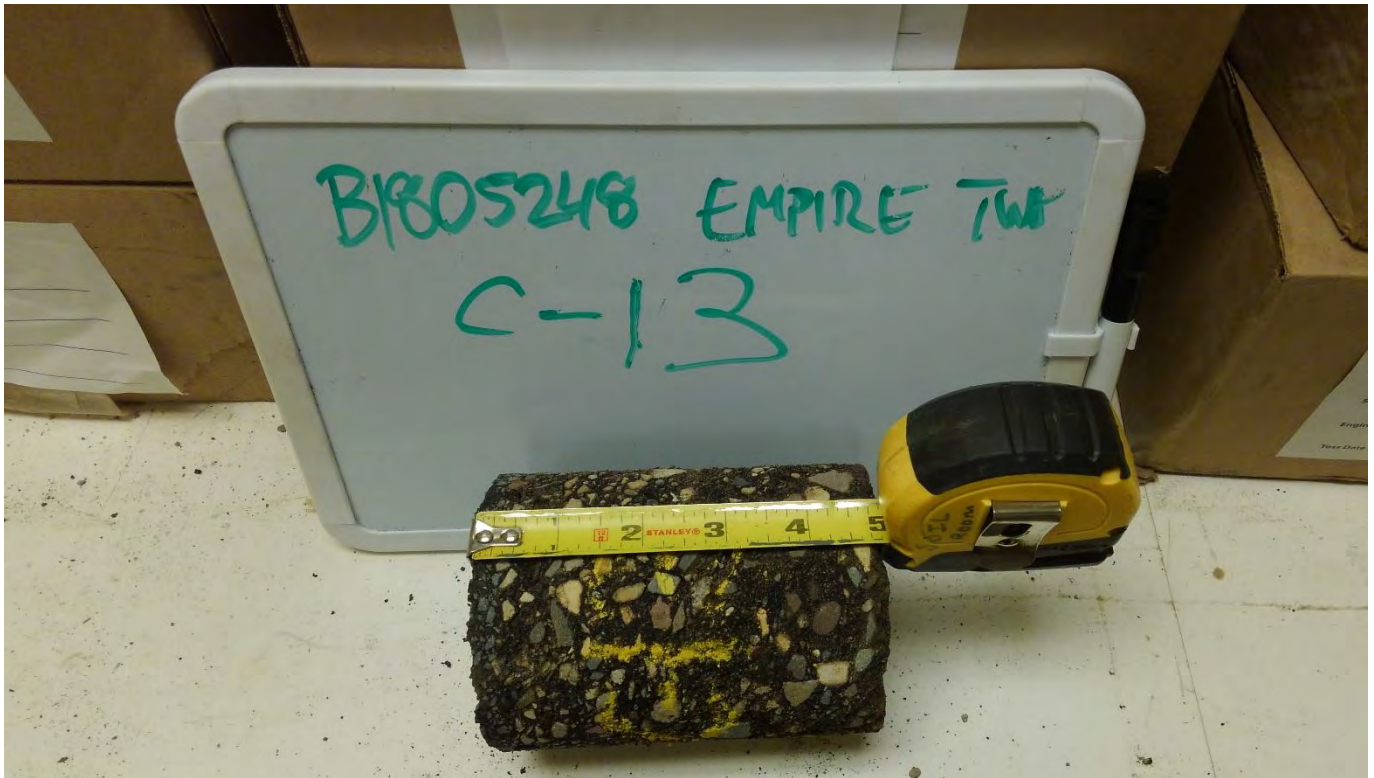
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INTERTEC



Core #: C-12
Pavement thickness: 4.25 inches Agg base thickness: 8.75 inches
Roadway : 200th St W
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-13
Pavement thickness: 5 inches Agg base thickness: 10 inches
Roadway : 200th St W
Date: 8/2/2018

Project: B1805248

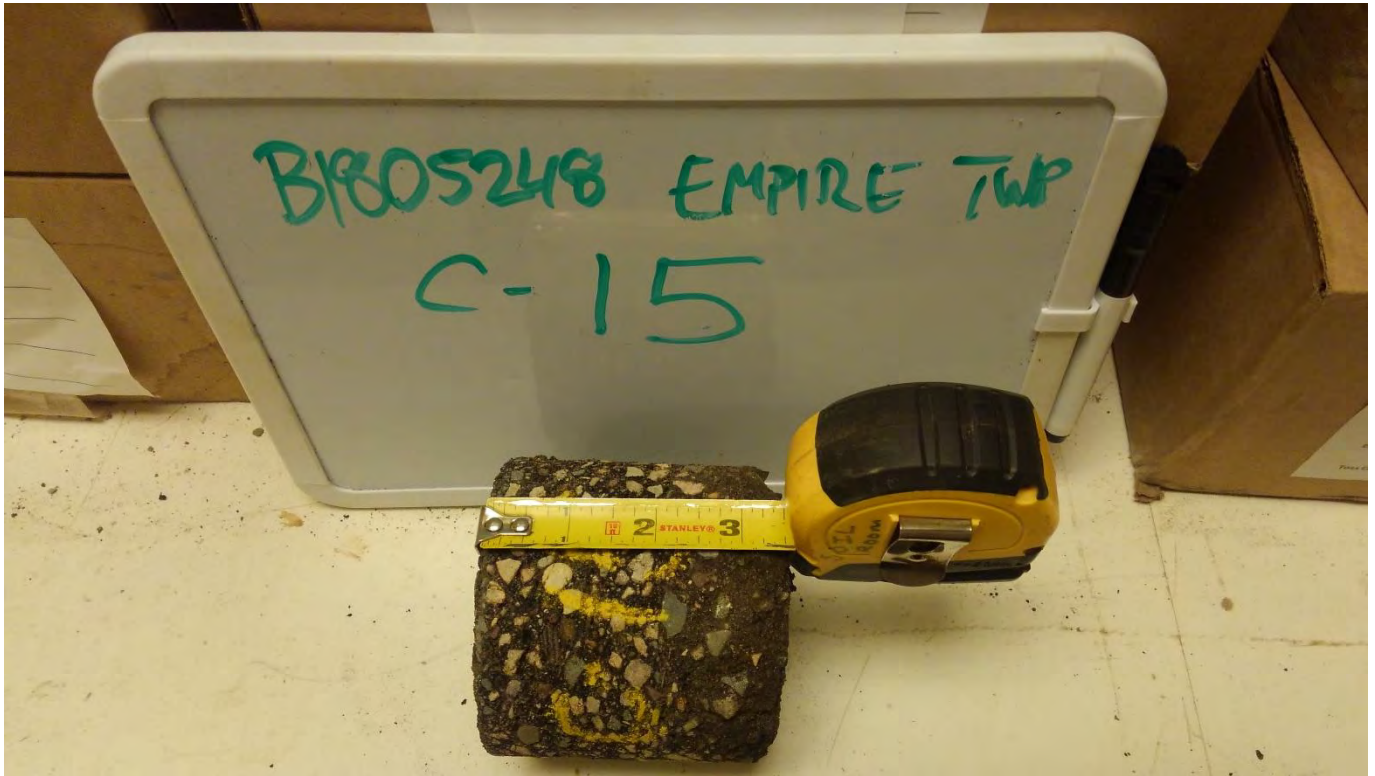
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INTERTEC



Core #: C-14
Pavement thickness: 3 inches Agg base thickness: 5 inches
Roadway : Cascade Ave
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-15
Pavement thickness: 3.5 inches Agg base thickness: 8.5 inches
Roadway : Chili Ave W
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-16
Pavement thickness: 4 inches Agg base thickness: 14 inches
Roadway : Chevelle Ave
Date: 8/2/2018

Project: B1805248

BRAUN
INTERTEC



Core #: C-17
 Pavement thickness: 4.5 inches Agg base thickness: Unable to obtain
 Roadway : Cabrilla Way
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-18
 Pavement thickness: 4 inches Agg base thickness: 1 inch
 Roadway : Butternut Trail
 Date: 8/2/2018

Project: B1805248

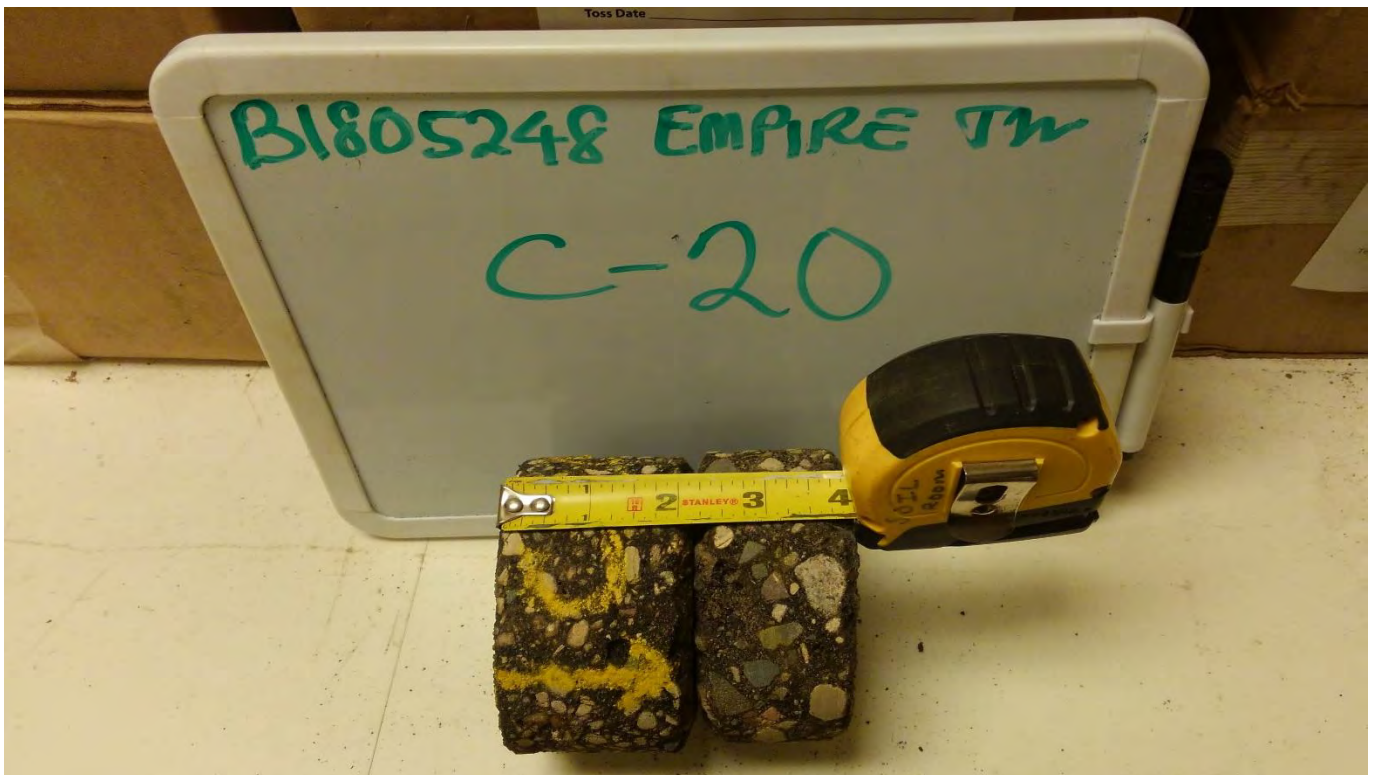
BRAUN
 INTERTEC



Core #: C-19
 Pavement thickness: 4 inches Agg base thickness: 3 inches
 Roadway : Cabrilla Way
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-20
 Pavement thickness: 4 inches Agg base thickness: 3 inches
 Roadway : Cabrilla Way
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-21
 Pavement thickness: 3.75 inches Agg base thickness: 3.25 inches
 Roadway : Burlington Path
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-22
 Pavement thickness: 3.75 inches Agg base thickness: 3.25 inches
 Roadway: Butternut Trail
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-23
 Pavement thickness: 4 inches Agg base thickness: 3 inches
 Roadway : Cabrilla Ct
 Date: 8/2/2018

Project: B1805248

BRAUN
 INTERTEC



Core #: C-24
 Pavement thickness: 4.25 inches Agg base thickness: 3.75 inches
 Roadway : Cabrilla Way
 Date: 8/2/2018

Project: B1805248

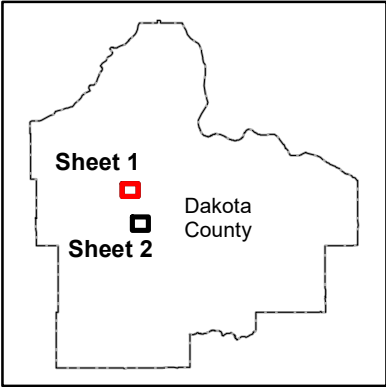
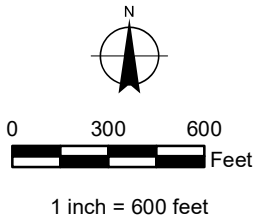
BRAUN
 INTERTEC



F:\2018\B1805248\GIS\B1805248_LocSketch.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- Approximate Pavement Core & Hand Auger Boring Location
- Approximate Power Auger Boring Location
- GPR Testing Completed



Drawing Information

Project No:
B1805248

Drawing No:
B1805248_LocSketch

Drawn By: CMF
Date Drawn: 7/25/2018
Checked By: NGL
Last Modified: 10/11/2018

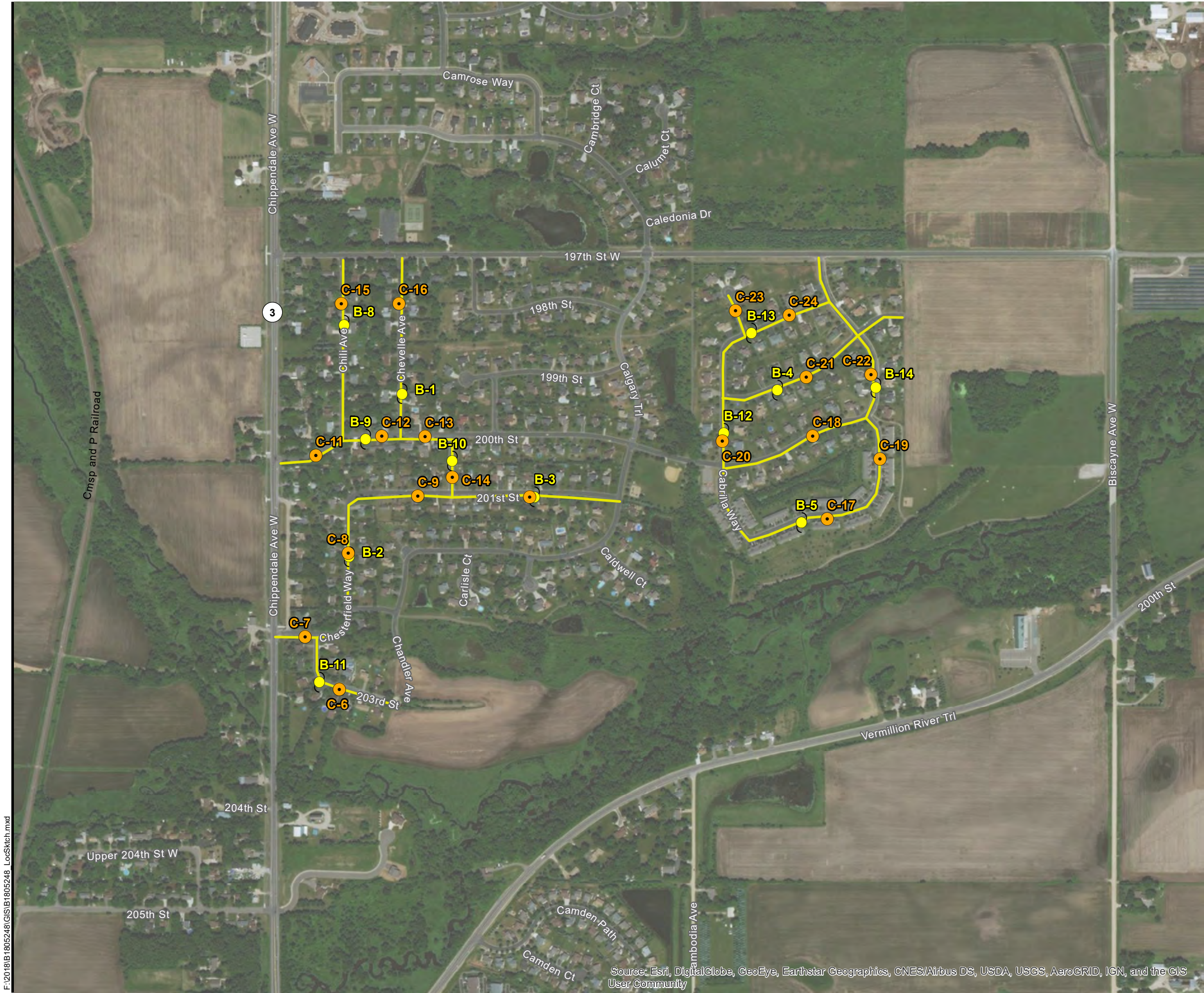
Project Information

Pavement Evaluation
Empire Township

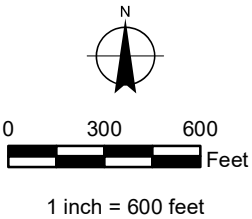
2019 Street
Improvement
Project

Empire Township,
Minnesota

**Boring, Coring,
Hand Auger &
GPR Location
Sketch**



- Approximate Pavement Core & Hand Auger Boring Location
- Approximate Power Auger Boring Location
- GPR Testing Completed



Drawing Information

Project No:

B1805248

Drawing No:

B1805248_LocSketch

Drawn By: CMF

Date Drawn: 7/25/2018

Checked By: NGL

Last Modified: 10/11/2018

Project Information

Pavement Evaluation
Empire Township

2019 Street
Improvement
Project

Empire Township,
Minnesota

**Boring, Coring,
Hand Auger &
GPR Location
Sketch**

Sheet:
2 of 2

Figure 1

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-1 LOCATION: N: 168929.024 E: 547647.268. See attached sketch.		
DRILLER: J. Chermak		METHOD: Power Auger		DATE: 8/21/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
906.7	0.0						
906.3	0.3	BIT	4 3/4 inches of bituminous.				
905.6	1.1	AGG	8 inches of aggregate base.				
		SM	SILTY SAND, fine-grained, with Gravel, Cobbles, brown, moist.				
901.7	5.0		END OF BORING.				
			Water not observed to cave-in depth of 5 feet immediately after withdrawal of auger.				
			Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-2 LOCATION: N: 167902.704 E: 547313.218. See attached sketch.		
DRILLER: J. Chermak		METHOD: Power Auger		DATE: 8/21/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
895.2	0.0						
894.7	0.4	BIT	5 inches of bituminous.				
894.3	0.8	AGG	5 inches of aggregate base.				
		SM	SILTY SAND, fine-grained, Lean Clay lumps, light brown, moist.				
890.2	5.0		END OF BORING.				
			Water not observed to cave-in depth of 5 feet immediately after withdrawal of auger.				
			Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-3 LOCATION: N: 168279.058 E: 548481.945. See attached sketch.		
DRILLER: J. Chermak		METHOD: Power Auger		DATE: 8/21/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes	
906.0	0.0						
905.6	0.3	BIT	4 inches of bituminous.				
905.1	0.9	AGG	7 inches of aggregate base.				
		SP-SM	POORLY GRADED SAND with SILT, with Gravel, brown, moist.				
901.0	5.0		END OF BORING.				
			Water not observed to cave-in depth of 5 feet immediately after withdrawal of auger.				
			Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-4 LOCATION: N: 168950.566 E: 550012.498. See attached sketch.		
DRILLER: J. Chermak		METHOD: Power Auger		DATE: 8/21/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes	
902.4	0.0						
902.1	0.3	BIT	4 inches of bituminous.				
901.5	0.9	AGG	7 inches of aggregate base.				
		SM	SILTY SAND, fine-grained, with Gravel, Cobbles, brown, moist.				
897.4	5.0		END OF BORING.				
			Water not observed to cave-in depth of 5 feet immediately after withdrawal of auger.				
			Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-5 LOCATION: N: 168116.717 E: 550164.485. See attached sketch.		
DRILLER: J. Chermak		METHOD: Power Auger		DATE: 8/21/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
892.2	0.0						
891.9	0.3	BIT	4 inches of bituminous.				
891.2	1.0	AGG	7 1/2 inches of aggregate base.				
		SM	SILTY SAND, fine-grained, with Gravel, Cobbles, brown, moist.				
887.2	5.0		END OF BORING.				
			Water not observed to cave-in depth of 5 feet immediately after withdrawal of auger.				
			Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-6 LOCATION: N: 184249.307 E: 542876.151. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes	
956.4	0.0						
956.1	0.3	BIT	4 inches of bituminous.				
955.2	1.2	AGG	10 inches of aggregate base.				
954.4	2.0	SM	SILTY SAND, fine- to medium-grained, with Gravel, brown, moist.				
		SC	CLAYEY SAND, dark brown, moist.				
951.4	5.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-7 LOCATION: N: 184249.241 E: 545589.560. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes	
958.6	0.0						
958.3	0.3	BIT	4 inches of bituminous.				
957.6	1.0	AGG	8 inches of aggregate base.				
		SM	SILTY SAND, fine- to medium-grained, with Gravel, brown, moist.				
953.6	5.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-8 LOCATION: N: 169360.153 E: 547282.086. Offset 5 feet west of stake. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
912.6	0.0						
912.3	0.3	BIT	4 inches of bituminous.				
911.6	1.0	AGG	8 inches of aggregate base.				
		SM	SILTY SAND, fine- to medium-grained, with Gravel, brown, moist.				
907.6	5.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-9 LOCATION: N: 168642.252 E: 547313.219. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes	
908.0	0.0						
907.6	0.4	BIT	5 inches of bituminous.			Auger chatter at 4 1/2 feet.	
		SM	SILTY SAND, fine-grained, with Gravel, brown then light brown, moist.				
903.0	5.0		END OF BORING. Water not observed while drilling. Boring then backfilled.				

Braun Project B1805248
GEOTECHNICAL EVALUATION
Empire Township 2019 Street Improvement Project
Various Streets
Empire Township, Minnesota

BORING: **B-10**

LOCATION: N: 168504.161 E: 547963.415. See attached sketch.

DRILLER: C. McClain

METHOD: Power Auger

DATE: **9/19/18**

SCALE: 1" = 4'

[illegible]

(See Descriptive Terminology sheet for explanation of abbreviations)

_LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-11 LOCATION: N: 167112.751 E: 547125.853. Offset 3 feet northeast of stake. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials <small>(Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)</small>	BPF	WL	Tests or Notes	
895.9	0.0						
895.6	0.3	BIT	4 inches of bituminous.			Auger chatter at 2 feet.	
895.1	0.8	AGG	6 inches of aggregate base.				
		SM	SILTY SAND, fine- to medium-grained, trace Gravel, dark brown, moist.				
890.9	5.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-12 LOCATION: N: 168679.960 E: 549676.105. Offset 4 feet southwest of stake. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
901.8	0.0						
901.5	0.3	BIT	4 inches of bituminous.			Auger chatter from 6 inches to 5 feet.	
901.0	0.8	AGG	6 inches of aggregate base.				
		SM	SILTY SAND, fine-grained, with Gravel, light brown, moist.				
896.8	5.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-13 LOCATION: N: 169310.881 E: 549849.878. Offset 3 feet north of stake. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
910.0	0.0						
909.6	0.4	BIT	5 inches of bituminous.			Auger chatter from 2 1/2 to 4 feet.	
908.9	1.1	AGG	8 inches of aggregate base.				
		SM	SILTY SAND, fine-grained, with Gravel, light brown, moist.				
			Poorly Graded Sand seam at 3 1/2 feet.				
905.0	5.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

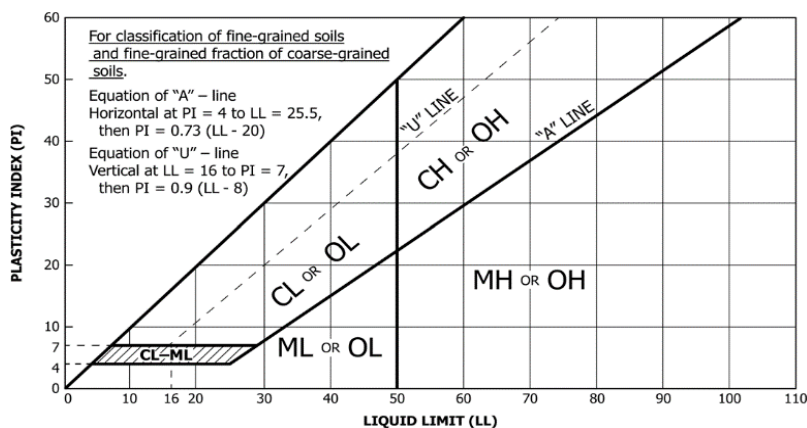
(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\05248.GPJ BRAUN_V8_CURRENT.GDT 10/18/18 13:03

Braun Project B1805248 GEOTECHNICAL EVALUATION Empire Township 2019 Street Improvement Project Various Streets Empire Township, Minnesota					BORING: B-14 LOCATION: N: 168967.999 E: 550633.296. Offset 5 feet southwest of stake. See attached sketch.		
DRILLER: C. McClain		METHOD: Power Auger		DATE: 9/19/18		SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes	
894.7	0.0						
894.3	0.4	BIT	5 inches of bituminous.			Auger chatter at 2 feet.	
893.6	1.1	AGG	8 inches of aggregate base.				
		SM	SILTY SAND, fine-grained, trace Gravel, brown, moist.				
889.7	5.0		END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines ^C)	$C_u \geq 4$ and $1 \leq C_c \leq 3^D$	GW	Well-graded gravel ^E	
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$) ^D	GP	Poorly graded gravel ^E	
		Gravels with Fines (More than 12% fines ^C)	Fines classify as ML or MH	GM	Silty gravel ^{EFG}	
			Fines Classify as CL or CH	GC	Clayey gravel ^{EFG}	
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines ^H)	$C_u \geq 6$ and $1 \leq C_c \leq 3^D$	SW	Well-graded sand ^I	
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$) ^D	SP	Poorly graded sand ^I	
		Sands with Fines (More than 12% fines ^H)	Fines classify as ML or MH	SM	Silty sand ^{FGI}	
			Fines classify as CL or CH	SC	Clayey sand ^{FGI}	
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line ^J	CL	Lean clay ^{KLM}	
			PI < 4 or plots below "A" line ^J	ML	Silt ^{KLM}	
		Organic	Liquid Limit – oven dried Liquid Limit – not dried < 0.75	OL	Organic clay ^{KLMN} Organic silt ^{KLMQ}	
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay ^{KLM}	
			PI plots below "A" line	MH	Elastic silt ^{KLM}	
		Organic	Liquid Limit – oven dried Liquid Limit – not dried < 0.75	OH	Organic clay ^{KLMP} Organic silt ^{KLMQ}	
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor			PT	Peat

- A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
E. If soil contains $\geq 15\%$ sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
I. If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains $\geq 30\%$ plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line.



DD Dry Density, pcf
WD Wet Density, pcf
P200 % Passing #200 sieve

Laboratory Tests
OC Organic content, %
q_p Pocket penetrometer strength, tsf
MC Moisture content, %

PL Plastic limit
LL Liquid limit
PI Plasticity Index

Particle Size Identification

Boulders..... over 12"
Cobbles..... 3" to 12"
Gravel
Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)
Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)
Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)
Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt..... No. 200 (0.075 mm) to .005 mm
Clay..... < .005 mm

Relative Proportions^{L, M}

trace..... 0 to 5%
little..... 6 to 14%
with..... $\geq 15\%$

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 1"

Apparent Relative Density of Cohesionless Soils

Very loose 0 to 4 BPF
Loose 5 to 10 BPF
Medium dense..... 11 to 30 BPF
Dense..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft.....	0 to 1 BPF.....	< 1/4 tsf
Soft.....	2 to 4 BPF.....	1/4 to 1/2 tsf
Medium.....	5 to 8 BPF.....	1/2 to 1 tsf
Stiff.....	9 to 15 BPF.....	1 to 2 tsf
Very Stiff.....	16 to 30 BPF.....	2 to 4 tsf
Hard.....	over 30 BPF.....	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6 inches into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6-inch increments, and added to get BPF.

Partial Penetration: If the sampler cannot be driven the full 12 inches beyond the initial 6-inch set, the number of blows for that partial penetration is shown as "No./X" (i.e., 50/2"). If the sampler cannot be advanced beyond the initial 6-inch set, the depth of penetration will be recorded in the Notes column as "No. to set X" (i.e., 50 to set 4").

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

WL: WL indicates the water level measured by the drillers either while drilling or following drilling.