Surface Water Management Plan

City of Red Wing, Minnesota

RWING 161191 | April 23, 2022

SEH

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April 23, 2022

RE: 2022 Surface Water Management Plan Amendment
City of Red Wing, Minnesota
SEH No. RWING 161191

Mr. Jerry Plein, Public Works Deputy Director
City of Red Wing
229 Tyler Rd. N
Red Wing, MN 55066

Dear Mr. Plein:

The 2022 Amendment of the City of Red Wing Surface Water Management Plan (SWMP) is provided in the report below. Updates to Table 7-8 are an important part of the amendment as it identifies critical infrastructure upgrades to reduce flood risk in the City.

As part of the 2022 Amendment, several priority projects were identified and analyzed. Planning level construction cost estimates were developed. In some cases, additional information and analysis is needed before construction cost estimates can be developed.

Sincerely,

Jeremy Walgrave

Jeremy Walgrave, PE, CFM
Sr. Water Resources Engineer

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2022 Surface Water Management Plan Amendment

City of Red Wing, Minnesota

SEH No. RWING 161191

April 23, 2022

I hereby certify that this 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.

____

Jeremy Walgrave, PE, CFM

Date: ____________________ License No.: 43131

Reviewed By: ____________________ Date: ____________________

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
St. Paul, MN 55110

Executive Summary

In 2014, the City of Red Wing developed a Surface Water Management Plan (SWMP) and citywide hydrologic and hydraulic model. Since the original plan was developed, changes to precipitation amounts and land use within the City have occurred. In addition, major precipitation events since 2014 have brought to light some problem areas in the City related to flooding and erosion. Starting in 2021, the City decided to update various elements of the SWMP in order to prioritize the development of solutions to reduce flood risk, address erosion issues, and assess climate change and resiliency. The updates to the SWMP have been analyzed and discussed in this Report – 2022 SWMP Amendment.

Precipitation intensity and frequency estimates were updated in 2014 with the release of the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. This generally increased precipitation amounts for various events in the City of Red Wing and surrounding area. The hydrologic and hydraulic model developed for the SWMP in 2014 used previous precipitation values. The hydrologic and hydraulic modeling requires updates to reflect the Atlas 14 precipitation values.

In September 2019, the City experienced a major precipitation event that caused significant flooding in the downtown area. It has been estimated that the precipitation event was greater than a 500-yr event. The Bush Street low point between W 3rd Street and W 4th Street experienced the most significant flooding. Flooding at the Bush Street low point was caused by a lack of capacity in the storm sewer system and break-out flows from other sub-watersheds.

As part of the 2022 SWMP Amendment, four priority projects were identified and analyzed:

- Cherry Street Detention and/or Cherry Street Removal
- Siewert St./Neal St. Ravine Stabilization
- Levee Park Tunnel and Downtown Flooding
- Storm Sewer Surcharge Analysis
    - 7th Street – Plum Street and Bush Street
    - Maple Street near Sunnyside Elementary School
    - Intersection of Pioneer Rd. and Brooks Ave.

The erosion related projects have relatively straightforward solutions. However, the storm sewer surcharge and flooding issues in the downtown area will require more challenging solutions that incorporate a combination of various storm sewer and inlet capacity upgrades. The modeling results and potential solutions for each area are discussed in detail in this Report.

One of the objectives of the 2022 SWMP Amendment was to update Table 7-8 from the original SWMP. Table 7-8 identifies storm water improvement projects throughout the City and prioritization of projects as well as projects that have been completed to date. The City sought clarity within the original table and has also completed some of the projects originally identified in the 2014 SWMP.

The City of Red Wing has an extensive system of storm water infrastructure that includes over 65 miles of storm sewer, 4 miles of tunnels, 250 discharge outfalls, 2,500 storm sewer inlets, 70 storm water ponds, 5 rain gardens, and many miles of conveyance ditches and drainage ravines. In order to maintain and improve this infrastructure, storm water fees are collected from property owners, based on their land use through the City's Stormwater Utility Fund. This method, called the Residential Equivalent Factor (REF), takes into account the volume of runoff the individual properties contribute to the storm water system. These fees are used directly for improving storm water quality, maintaining the system and protecting our fresh and groundwater resources, as permitted by the Minnesota Pollution Control Agency through the NPDES Municipal Separate Storm Sewer System (MS4) Permit.

The City has currently budgeted $843,000 per year to improve the storm sewer system and maintain compliance with the NPDES MS4 permit, which includes requirements related to maintenance, public education and outreach, public involvement, illicit discharge detection, construction site stormwater runoff controls, post-construction stormwater management, pollution prevention, and good housekeeping. These activities are funded entirely by the Stormwater Utility Fund. This budgeted amount does not include any Capital Improvement Plan related activities.

In response to feedback from citizens, the City is exploring options for storm water fee credits to reduce fees collected from properties that reduce or prevent storm water discharges. Storm water management facilities reduce the quantity and improve the quality of stormwater runoff, therefor reducing the need for capital investment in new infrastructure and ongoing maintenance costs. Eligible property owners would be able to apply for a storm water utility fee credit that would be applied to their monthly utility bill.

The Stormwater Utility Fund is not adequate to fund the majority of the projects discussed in the 2022 SWMP Amendment. It will be important for the Red Wing City Council to formally adopt the 2022 SWMP Amendment. By formally adopting the 2022 SWMP Amendment, the City will be well positioned to take advantage of various funding sources and ultimately implement projects that will improve storm water quality, reduce flood risk, and make the City more resilient to climate change.

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2022 Surface Water Management Plan Amendment

Prepared for City of Red Wing

1 Introduction and Background

In 2014 the City of Red Wing hired Barr Engineering to prepare a Surface Water Management Plan (SWMP), including a Citywide hydrologic and hydraulic (H&H) model. Since the development of the SWMP, the City has identified the need to investigate potential projects in further detail and prepare an amendment to the existing plan which focuses on the selected projects. The City has chosen four (4) priority projects as part of this amendment, including:

- Cherry Street stormwater treatment/retention
- Siewert Street ravine repair
- Levee Park Tunnel rehabilitation and downtown area drainage analysis
- Storm sewer surcharge drainage analysis

Conceptual design alternatives for the aforementioned projects were investigated, including planning level construction costs. Additionally, a review of the Citywide H&H model was completed along with the corresponding background information as summarized in the 2014 SWMP. This report also includes a summary of the findings of the review.

2 H&H Model Review and Updates

Four separate models were received from Barr. The models appear to be split by watershed and are all 1D models, meaning that they model the flow of water through a linear network of nodes and links. These links can represent pipe networks and surface flow. The models are broken up by the four major watersheds (Figure 1):

- Cannon River
- Hay Creek
- Mississippi River
- Spring Creek

The models are broken up because under most precipitation events the watersheds are isolated from each other and there would be no real benefit in having them in the same model. Smaller models also help to shorten computer simulation run time.

2.1 Hydrology

The models were developed utilizing the EPA runoff methodology to calculate runoff timing and volumes. This methodology requires the following inputs to calculate runoff:

- Subcatchment area

- Impervious percentage
- Subcatchment width
- Subcatchment slope

The subcatchment width and slope are used to determine the travel time of runoff within the subcatchment while the area and impervious percentage are used in part to calculate the volume of runoff generated. The runoff methodology also requires separate infiltration calcs in order to account for pervious area land coverage and soil type.

Within XPSWMM there are four infiltration methodologies that can be chosen and they all require an assumed depressional storage (inches) and Mannings “n” roughness values for both pervious and impervious areas. The impervious area also requires a “Zero Detention” percentage, which is the percentage of impervious area that would produce immediate runoff.

The models utilize the Horton infiltration method which is an empirical model that gives infiltration capacity as a function of time.

$$F_P = F_C + (F_0 - F_C)e^{-kt}$$

Where:

- F_P = infiltration rate into soil, in./hr
- F_c = minimum or asymtopic value of F_P, in./hr
- F_0 = maximum or initial value of F_P, in./hr
- t = time from beginning of storm, sec
- k = decay coefficient, 1/sec

This equation allows for the maximum infiltration capacity at the beginning of the storm (determined by landcover and soil type) and describes the exponential decay or reduction in infiltration capacity that occurs during a rain event.

Land use was taken from the National Land Cover Database (NLCD). These data can be fairly coarse and could be updated if the city has more recent or detailed land cover values.

Soils data were taken from the USDA soils data for Goodhue County. The predominant hydrologic soil group (HSG) in the study area is HSG B Sandy Loam with smaller pockets of HSG A/D and HSG B/D.

Rainfall depths are based on the “Hydrology Guide for Minnesota” published by the United States Department of Agriculture (USDA) in 1975 and utilize the 24-hr SCS type II rainfall distribution. Precipitation intensity and frequency estimates were updated in 2014 with the release of the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. This generally increased precipitation amounts for various events in the City of Red Wing and surrounding area. The rainfall depths used in the model are out of date and it is recommended that these be updated to reflect the currently accepted Atlas 14 precipitation values. It is also recommended that the rainfall distribution be updated to the 24-hr MSE 3 distribution.

2.2 Hydraulics

As previously noted, the four watershed models are all one-dimensional (1D) hydraulic models, meaning that the hydraulic portion of the model consists of nodes and links creating a linear network that represents the different flow paths of water through the watershed.

The nodes within the models can represent specific stormwater structures such as manholes or catch basins, storage areas, places where surface flow converges (i.e. a stream tributary meets the main stream), or simply arbitrary points used to break up links to prevent them from getting too long. Nodes can be classified as either a junction or a storage node. Regardless of the type of node all nodes require three basic data inputs:

- The spill crest (ground elevation) is the physical top of the junction which can be either real or conceptual (if the spill crest is representing the top of bank for instance)
- Ponding option: This tells the model what to do with the water in the model when the hydraulic grade line (HGL) reaches the spill crest. The options include:
  - None: This is the default option and any surcharged water that breaks the ground surface is lost from the model. The model will tabulate the duration and amount of water lost. The majority of nodes within the four models use this option.
  - Allowed: This option allows for the model to estimate temporary storage at the junction in the event of water surcharging above the ground elevation. This option was not used in the models.
  - Sealed: This option allows the HGL to rise above the ground elevation without losing volume from the model. Several of the nodes within the model were set to this mode and seem to correspond to the downtown tunnel area where tunnel shape changes without an actual structure reaching the surface.
  - Link Spill Crest to 2D: This option is only used in models with an active 2D grid where the node in question is located. For this option the water that would be lost from the system is linked and passed to the 2D grid for overland flow routing.
  - Link Invert to 2D: This option links culverts to the 2D grid.
- Node Invert Elevation: This is the physical bottom of the junction.

There are a number of storage nodes within the models as well, which represent areas within the model where water can be stored, such as wetlands, lakes, ponds, or underground storage tanks. In addition to the inputs above, storage nodes require:

- Measure Depth From (spill crest or node invert): This is the elevation at which the storage node becomes effective.
- Storage Method: This tells the model how the storage will be calculated. There are three options available, but the four models only used the "Stepwise Linear" option which requires each storage node to have a stage-storage curve associated with it.
- Surcharge Elevation: This is the upper limit of the storage as calculated by the Storage Method. Above this level the surface area of the node becomes the default manhole surface area.

The links within the models can be either single links or multi-links and can represent, pipes, tunnels, surface flow, weirs, orifices, pumps, or a special structure. Single links can only represent a conduit which can be either a pipe or an open channel. Conduits require the following inputs:

- Conduit Shape: examples circular, rectangular, trapezoidal, natural, custom
- Upstream invert
- Downstream invert
- Diameter/height
- Width (not needed for circular pipes)
- Length
- Manning's n
- Slope

The majority of the links within the models are multi-links, due to the ability to represent both a pipe network and surface flow. Multi-links can represent up to seven separate links and can have multiple of any of the aforementioned link types. Generally, within these models, the multi-links are representing both a storm sewer pipe and a surface channel (usually a road). This is a way to account for any volume that surcharges out of a pipe. A modeler can add a surface conduit to track the surcharged volume. This is an adequate way of representing how water flows in certain circumstances. However, surface flows can be much more complicated than a 1D model would allow. For example, in the downtown area of Red Wing, when the storm sewer surcharges, a lot of the surface flow ends up in a low spot along Bush Street. This low spot takes break out flows from two completely different watersheds. The break out flows were not adequately modeled in the original 1D model. This is an area were converting to a 2D model is desirable as it relies less on the judgement of the modeler and more on a properly created digital elevation model (DEM) surface.

Recommendations

- Update rainfall data to Atlas 14 precipitation values
- Update the rainfall distributions to the 24-hr MSE3 distribution (This distribution has been added to the model along with the Atlas 14 precipitation values, but resulted in flood loss for certain models that will need to be addressed)
- Convert sections of the models that are runoff only to include a hydraulics component. This can be done on a prioritized basis when there is potentially a land use change to happen in the area or if something in particular needs to be analyzed. In order to update the hydraulics component of the model, survey data or as-built data will be needed for the hydraulic infrastructure.
- The general hydraulic structure of the model (only modeling trunk lines and in 1D) is adequate for the scale of the model. However, if there is a particular area that needs to be analyzed in detail it is recommended that detail be added to the hydraulic network. This should only be done on a case-by-case basis.
- In areas where there is known surcharging and surface flow, the model should be updated to a 2D model. This should be done on a case-by-case basis as projects are prioritized and ready for feasibility analysis and final design.

3 Priority Projects

The City identified four priority project areas in need of additional or updated evaluation. The analysis of each priority project area included a high-level planning cost estimate. Additional effort will be needed should these projects move to final design and require the preparation of construction documents.

3.1 Cherry Street Stormwater Treatment/Retention

Cherry Street is one of the last remaining gravel roads within the developed area of Red Wing. The road is underutilized and prone to washouts of sand and gravel that directly discharge to the downstream tunnel system, located adjacent to Greenwood Street. The steep slopes in this area are a primary factor in relation to washouts and erosion. Cherry Street discharges to a tunnel system. This tunnel system ultimately travels down Plum Street, an area prone to flooding during larger or more intense rainfall events, and ultimately discharges directly to the Mississippi River. The City is planning to abandon a portion of Cherry Street. An analysis was completed to understand if removal of Cherry Street and/or stormwater detention could help relieve some of the flooding issues experienced along Plum Street. Additionally, managing flows may also impact the discharge of sand and gravel to the Mississippi River.

The Cherry Street watershed is approximately 45.6 acres and is included in a larger drainage area (23PLS) that is 79.1 acres in the model. As mentioned above, the Cherry Street watershed drains to the Plum Street tunnel, which has an overall drainage area of over 1,000 acres (Figure 2). This means that the Cherry Street drainage area makes up approximately 4.5% of the overall Plum Street watershed. As this area is relatively small compared to the overall watershed, there is negligible impact on the downstream flooding when runoff from the Cherry Street area is removed from the system. To test this, runoff node 23PLS was turned off in the model to eliminate the entire 79.1 acre drainage area from the model. The results were compared to an unmodified run and are shown in Table 1.

Table 1 – 100-Year Peak Flow Comparison

Location	100-yr Peak Flow with Cherry Street Watershed [cfs]	100-yr Peak Flow without Cherry Street Watershed [cfs]
Plum Street Outlet Tunnel	606.8	606.2
Plum Street Outlet Surface Flow	27.9	24.4
Plum Street Outlet Total	634.7	630.7

Based on the results, it is not recommended that the City pursue stormwater detention in the Cherry Street area as a solution to address downstream flooding issues. The City may still consider improvements to the stabilization of the Cherry Street area as this may be beneficial to address sediment and pollutant loading to the Mississippi River.

3.2 Neal Street Ravine Repair

Hay Creek is a MnDNR designated trout stream that runs south to north to the Mississippi River. The stream runs through the City limits, west of the downtown area. The Neal Street ravine is a tributary to Hay Creek. This approximate 2,000-foot ravine runs parallel to Siewert Street on the west and extends from Neal Street to Featherstone Road. The drainage from the ravine is conveyed to Hay Creek by the storm sewer under Featherstone Road.

The ravine has been experiencing severe erosion that has become significantly more extensive over the past few years. Sediment is discharged directly to the downstream storm sewer system, which discharges to Hay Creek. Several options have been investigated in the past, however nothing has been implemented.

Preliminary survey data was collected to capture the existing ravine profile and cross-sectional data. This survey data was used to create a digital elevation model (DEM) and the ravine area of the Hay Creek model was converted from 1D to 2D within the model to get a better idea of how water flows within the ravine. This also allowed the visualization of flow depths and localized high velocity zones.

A site visit was performed on July 23, 2021, to evaluate erosion areas in the ravine. Significant erosion was observed within the ravine. The erosion has resulted in nearly vertical channel banks ranging from three feet to twelve feet high. Near the bottom where the grade significantly flattens out a sediment delta has formed.

Site Photos: Sediment Deposition Where the Channel Slope is Flat


Site Photos: Eroded Channel Banks

The 2D model indicates average peak flow depths of five feet. Figure 3 shows the flood inundation map.

Three alternatives to stabilize the ravine were evaluated, which include armoring the channel with riprap, installing ditch checks throughout the channel, and extending storm sewer from the end of the pond outlet pipe to the point where the channel flattens out (approximately 600 feet upstream of Featherstone Road). Following the evaluation of alternatives, it is not recommended that the City pursue ditch checks or storm sewer installation.

Ditch checks are not recommended because they would trap sediment and would require regular maintenance in order to remove and dispose of the sediment. Maintenance would be expected to be time consuming and challenging, due to the overall difficult site access and anticipated frequency.

Storm sewer is not recommended due to the high cost that would be necessary for installation and to remedy the erosion issues. Maintenance costs would be relatively low. However, as the storm sewer deteriorates over time, replacement costs would be significant.

It is recommended that the City pursue armoring of the channel with riprap to alleviate the erosion issues. Appendix A contains a conceptual plan that shows the proposed rip-rap extents and a typical section. The conceptual plans are not intended for construction purposes.

There were two other issues observed during the site visit. Several draintile pipes from residential properties were found that discharge directly onto the steep slopes of the ravine, adjacent to the backyards. Although small, the discharge of water onto the steep slopes is causing localized erosion, which could cause destabilization of the slopes in the future. It is recommended that the draintile pipes be extended down the slope and discharge into the main channel.

The second issue was identified within a small storm sewer segment located off of Siewert Street, discharging towards the ravine. The last few sections of pipe have separated at the pipe joints and have ultimately caused a large void in the slope. It is recommended that the storm sewer be repaired with pipe ties at each of the joints to prevent separation. Fill will be needed to repair the slope back to the original grade.

3.2.1 RECOMMENDATIONS

- Regrade the channel and place riprap to stabilize the channel.
- Extend residential draintile pipes to the stabilized riprap channel.
- Repair storm sewer coming off of Siewert Street and restore the slope.

3.3 Levee Park Tunnel Rehabilitation and Downtown Area Drainage Analysis

3.3.1 Levee Park Tunnel Rehabilitation

The City has several tunnels used for stormwater conveyance in the downtown area that were historically used as combined sewers (sanitary and storm). The City has since separated the combined sewers but still utilize these tunnels for stormwater conveyance. The Bush Street and Plum Street historic tunnels outfall to the Mississippi River within Levee Park. A railroad, owned by Canadian Pacific (CP), divides Levee Park and the downtown area crossing approximately perpendicular to the tunnels. Several segments of the tunnels have deteriorated over time and have required repairs or replacement. The Bush Street and Plum Street tunnels have been replaced from the outfall to the right of way of the railroad tracks. However, tunnel replacements beyond the railroad are yet to be completed as CP Railroad will not approve open cut operations within their right of way.

CNA Engineers inspected the Bush Street and Plum Street tunnels and prepared a memo (Appendix B) detailing recommended repairs. According to the inspection completed and as detailed in the memo from CNA Engineers, the Bush Street tunnel is in good condition and no repair is needed at this time, though the upstream sections will need repair in the future.

The Plum Street tunnel, however, needs repair. Recommendations include:

- Replacement of timber invert with concrete which can be done now or in future
- Reinforcement of the limestone block arch section of the tunnel with a shotcrete liner. This liner should have anchors installed to the limestone blocks to assist in the bonding of the shotcrete to the limestone.
- The existing steel plate can remain in place and the steel supports should remain until the shotcrete has fully cured.

SEH updated the City's Mississippi River H&H model with a conceptual repair detail provided by CNA Engineers (see details in "*Downtown Area Drainage Analysis"* section) to verify what impact, this change in the tunnel may have on the upstream contributing area. The results indicate that the conceptual repair will not exacerbate downtown flooding issues.

CNA is currently working with the City to develop construction documents for the repair of the Plum Street tunnel under the CP Railroad tracks.

3.4 Downtown Area Drainage Analysis

The downtown area of Red Wing is fully developed and contains significant impervious area. The downtown area is known to experience significant flooding in large rainfall events, affecting both the roadway and adjacent properties. The City has also expressed a concern that past work in the stormwater tunnels to separate the storm sewer and sanitary sewer may have exacerbated these flooding issues, as the tunnel systems service as the primary discharge of the downtown area. The downtown area was analyzed using the existing H&H model to identify the source of the flooding issues and to develop conceptual scenarios to alleviate the flooding issue.

The primary area of concern within the downtown area is a localized low spot on Bush Street between W 3rd Street and W 4th Street. In large rain events, the storm sewer systems get overwhelmed and surcharges into the street where the surface runoff flows to the low spot. Modeling surface flows in this area would be very difficult and complicated in a 1D model. Therefore, this area of the model was converted to 2D. Converting the model from 1D to 2D involves removing any surface 1D conduits and instead linking the nodes in that area to a 2D grid. When water from the pipe network surcharges, it gets passed to this 2D grid and the water is able to flow as it naturally would along this 2D surface. The following updates were made to the model for analysis:

- Downtown area was converted to 2D
- Conceptual repairs for Plum St. were incorporated into the model
- Detail was added to the low spot area to better reflect surface inlets available to capture floodwater
- The Model was calibrated to the September 2019 rain event
- As-built plans showing the most current tunnel and pipe dimensions were obtained from the City and updated in the model.

The 2D analysis showed that the flooding at the Bush Street low point is caused by a combination of three different occurrences. First, the Bush Street tunnel is flowing slightly above capacity as the city has reported surcharging at Bush St. and W 4th Street. Second, the Plum Street tunnel surcharges into the street and causes a breakout flow to go northwest down Plum Street, then southwest down W 4th St and then again northwest to the low spot. Third, storm sewer systems along East and West Avenue at both W 5th and W 6th Street surcharge, again causing breakout flows to the northeast that ultimately settle at the Bush Street low point. Figure 4 illustrates the flooding extents, surcharge locations, and locations of break out flows from adjacent subwatersheds during a 100-yr event.

All three of these occurrences ultimately cause a capacity issue within the Bush Street storm sewer network, as experienced during the September 2019 event. It should be noted that the September 2019 event was equivalent to a storm greater than a 500-yr storm event and much of the analysis performed used a 100-year storm event to identify flooding issues. A typical storm-sewer system is designed to handle a 10-year event, which the existing system appears able to handle. It is the City’s intent to identify ways to mitigate the flooding issues for larger events without specifically designing to a specific design storm-event.

Identifying solutions to the downtown flooding was iterative and many different combinations were evaluated. This is because the flooding at the low point of Bush Street was not solely due to the Bush Street tunnel system being overwhelmed. Breakout flows from Plum Street as well as East and West Avenues were contributing to the flooding. The recommended solution involves increasing hydraulic capacity at several locations. The final conceptual design incorporates several different approaches that lead to a fairly complicated solution. Recommendations are listed below and shown on Figure 5.

- Adding surface inlets within the Bush Street low point to allow flooding to draw down quicker.
- Adding a second trunk line and outlet to Bush Street starting at about W 4^{th} Street
- Adding a bypass pipe along Bush Street to bypass a constriction and flat portion of the Bush Street trunk line near W 3^{rd} Street.
- Diverting flows from the Plum Street system at W 4^{th} Street to both the Bush Street and Bluff Street systems
- Adding a second trunk line down West Avenue from West 6^{th} St to the Mississippi River
- Adding a storm sewer connection on W 4^{th} Street between East Avenue and West Avenue
- Adding a second trunk line down East Avenue from W 7^{th} Street to W 4^{th} Street where it connects into the West Avenue system
- Adding a second barrel along W 5^{th} St from East Avenue to Bush Street.

While the recommended storm sewer capacity upgrades will reduce flood risk in the downtown area, minor surface flooding is still expected during major storm events as shown in Figure 5.

Due to the complicated solution, a phased approach is recommended, and projects should be prioritized based on cost and benefit given. It is additionally advised to align storm sewer projects with planned Street projects in order to save money on construction.

As far as prioritization, the added surface inlets and pipes along Bush Street that bypass a natural choke point in that system (a relatively flat spot as well as a constricted section of the tunnel) should be the first projects undertaken as they will provide the most flood risk reduction for the least amount of money.

The highest priority projects and planning level costs are included in Table 2 below. The costs shown include storm sewer and concrete street replacement.

Table 2 – Planning Level Construction Cost Estimate

Project Description	Planning Level Construction Cost
Bush Street Low Point - Install 7 new inlets - Reconstruct pavement	$800,000
Bush Street – low point to Main St. - Install 550 LF 60” RCP - Reconstruct pavement	$5,100,000
Bush Street – Main St. to Levee Rd. - Install 400 LF 60” RCP - Reconstruct pavement	$3,400,000
Bush Street – W 4th St. to low point - 155 LF 60” RCP - Reconstruct pavement	$1,500,000

3.5 Storm Sewer Surcharge Drainage Analysis

In addition to the downtown area, there are other areas of the City where there have been reports of storm sewers experiencing surcharge conditions above manhole rim elevations, leading to dislodged manhole covers and exacerbated surface flow conditions during large rainfall events. Three of these areas were idented by the City as priority and evaluated by SEH using the City’s H&H model.

3.5.1 The 7th Street Area of Plum and Bush Streets

This area was ultimately analyzed in conjunction with the downtown flooding analysis, as surcharging from this area was an ultimate contributor to the downtown flooding issue. Recommendations were also incorporated in the downtown flooding analysis. See Figures 4 and 5.

3.5.2 Maple Street, near Sunny Side Elementary School

The Maple Street Storm sewer system near Sunnyside Elementary collects drainage from approximately 140 acres of residential land use. The storm sewer mostly consists of the trunk line running down Maple Street running east to west from Vera Avenue to Southwood Avenue where it enters into a 3.5’ diameter pipe running underneath the Red Wing Golf Course. See Figure 6. This section of the Hay Creek model is not very detailed and is fairly coarse, but some initial options were looked at regarding increasing capacity. Ultimately it was found that increasing capacity along Maple Street has minimal benefit without increasing pipe capacity downstream. The difficulty with this is that downstream is approximately 3,500 linear feet of pipe running underneath a golf course which may be challenging to replace.

Adding stormwater detention was also conceptually investigated by completely removing the Southwood watershed from the model. This drainage area accounts for approximately 65 acres or nearly 50% of the overall contributing area. Despite this, the model still indicated surcharge conditions with this removal. This area will require further study and a more detailed analysis, which would include adding detail to the H&H model to be able to refine drainage characteristics of the contributing area.

3.5.3 The Intersection of Pioneer Road and Brooks Avenue

The Pioneer Road storm sewer system at the intersection with Brooks Avenue takes drainage from approximately 190 acres of residential landuse. The storm sewer is fairly simple consisting mostly of trunk line with the occasional lateral structure or cluster of surface inlets as shown in Figure 7. The Hay Creek model is not very detailed in this area and combines several stretches of storm sewer pipe into a single link but did allow for a big picture analysis of the issue. Increasing capacity along Pioneer Road does alleviate the issue at the intersection of Brooks Avenue and Pioneer Road. However, this does propagate a capacity issue downstream and would ultimately require additional improvement downstream, including increasing capacity for a significant length of the storm sewer, possibly to the system outfall.

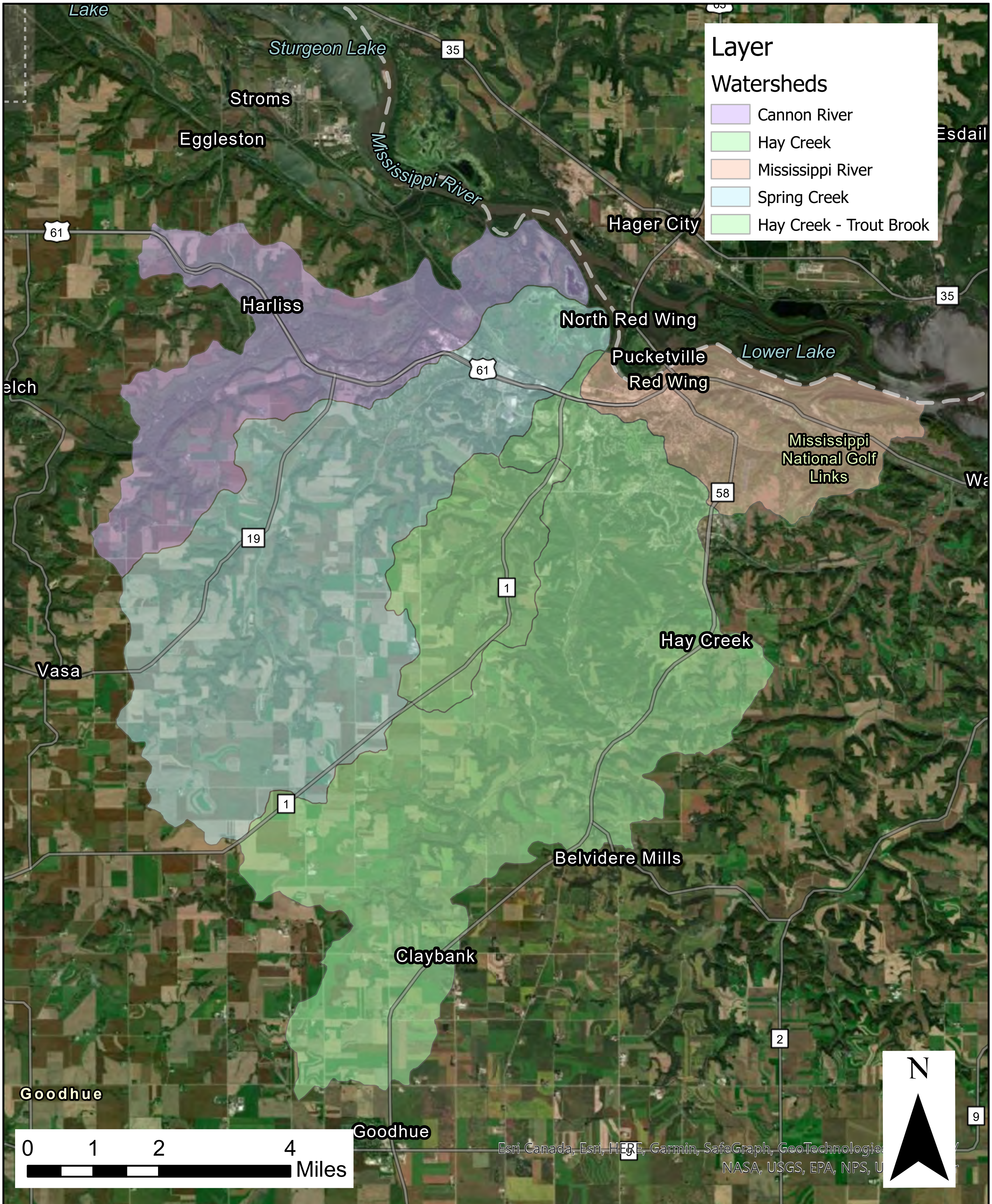
Unlike the Maple Street area, it does seem that adding detention could be a viable option. Due to the coarseness of the model in this area, a more detailed analysis would be required in order to properly identify areas where this could occur and would have the biggest impact.

4 2022 Surface Water Management Plan Amendment – Table 7-8

Table 7-8 of the 2014 SWMP identifies storm water improvement projects throughout the City as well as prioritization of projects. The City sought clarity within the original table including updates reflecting projects completed since 2014 and additional information as identified within this report. Table 7-8 from the original 2014 SWMP has been updated to reflect this information. Table 7-8 is shown in Appendix C. The next steps for the high and medium priority projects are to complete feasibility studies to get a better understanding of the total design and construction costs.

Tables

Figures



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Project: RWING - 161191
Print Date: 4/1/2022

Map by: mchristenson
Projection: UTM Zone 15N
Source: State of MN, City of Red Wing, Barr

Citywide Model Watersheds

Red Wing SWMP Amendment
City of Red Wing, MN

Figure 01

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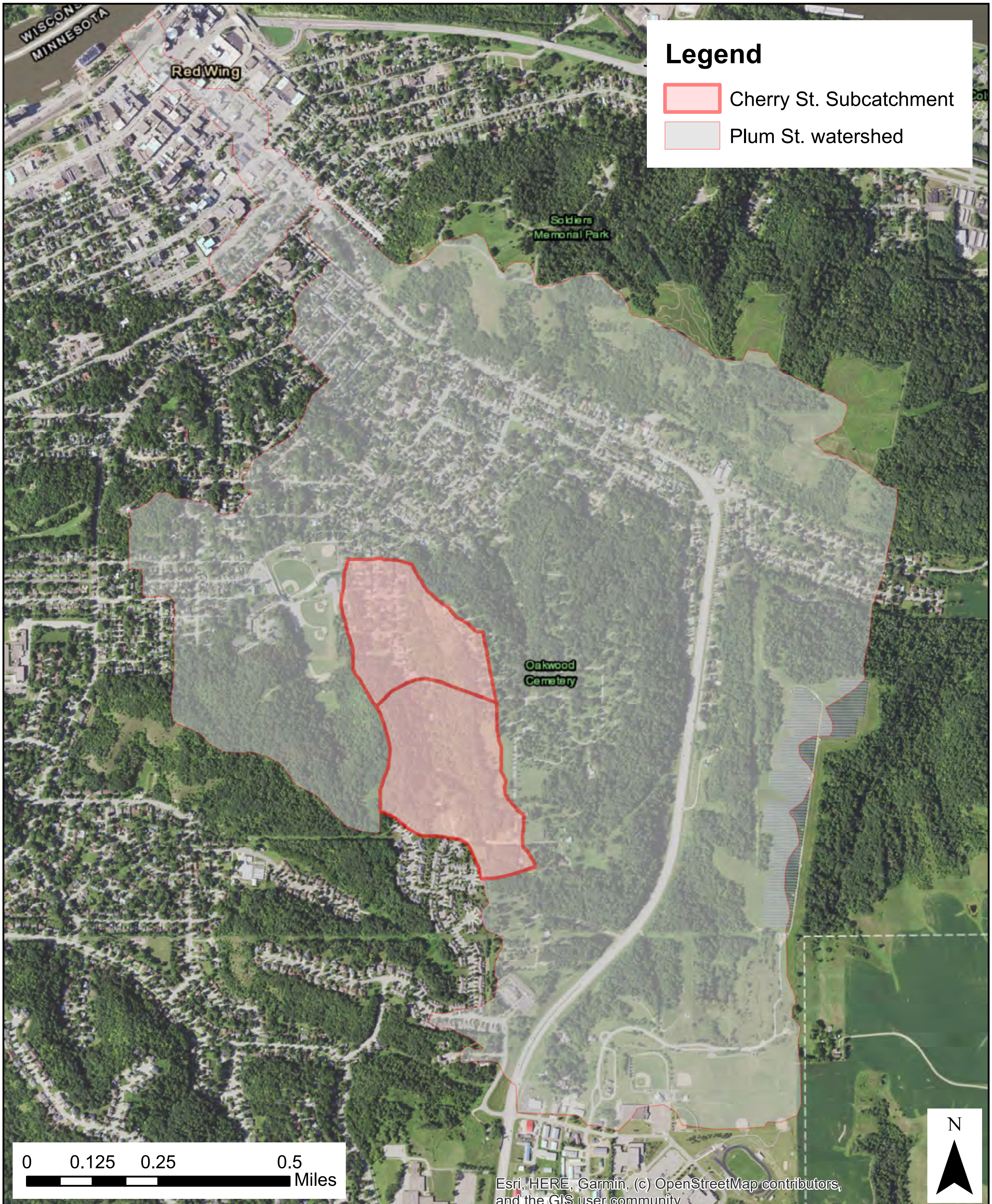

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SEH

3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (888) 908-8166
TF: (800) 325-2055
www.sehinc.com

Project: RWING 161191
Print Date: 4/8/2022

Map by: mchristenson
Projection: UTM Zone 15N
Source: City of Red Wing, ESRI, State of MN

Cherry St. Watershed
Red Wing SWMP Updates
Red Wing, MN

Figure
02

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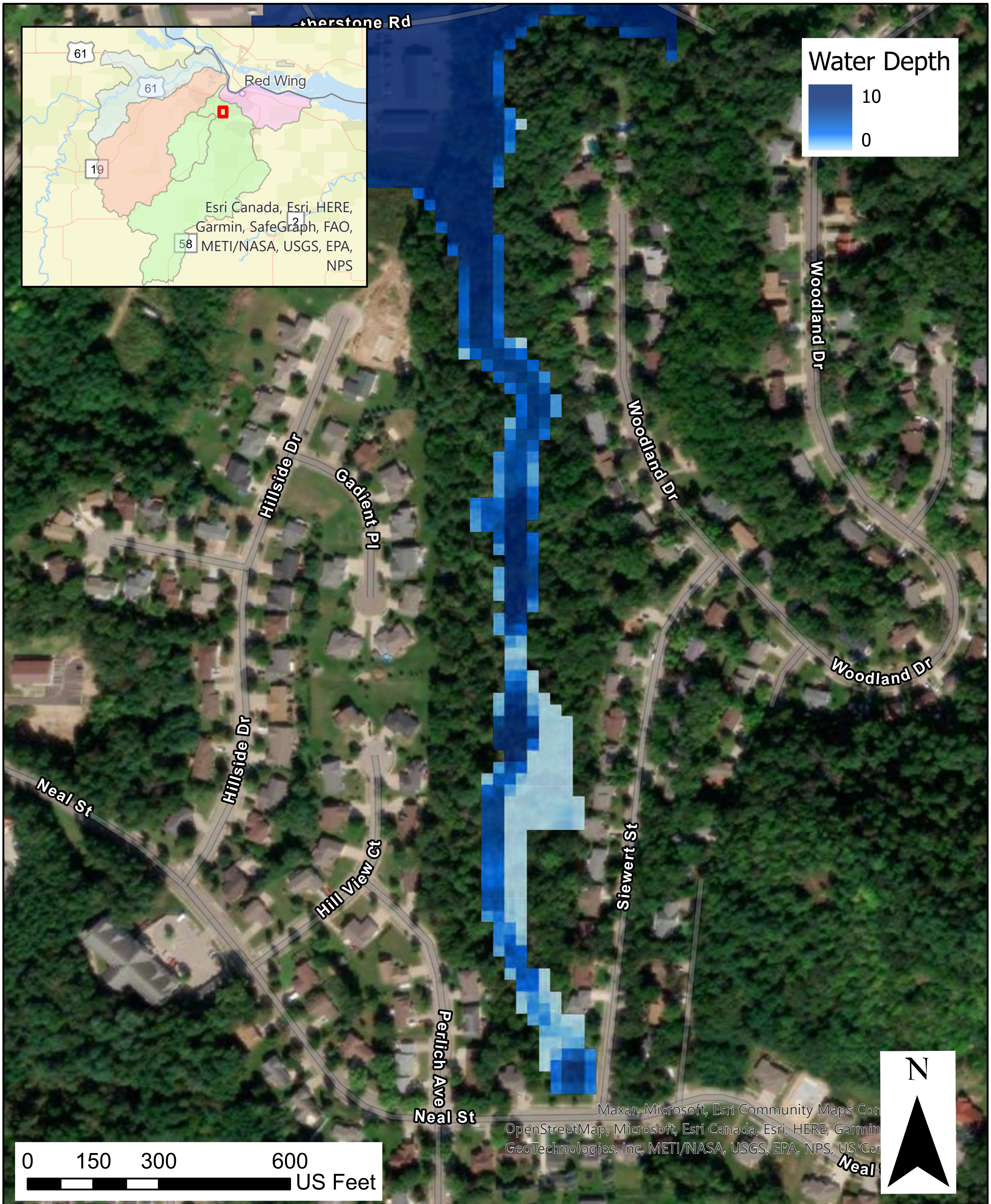

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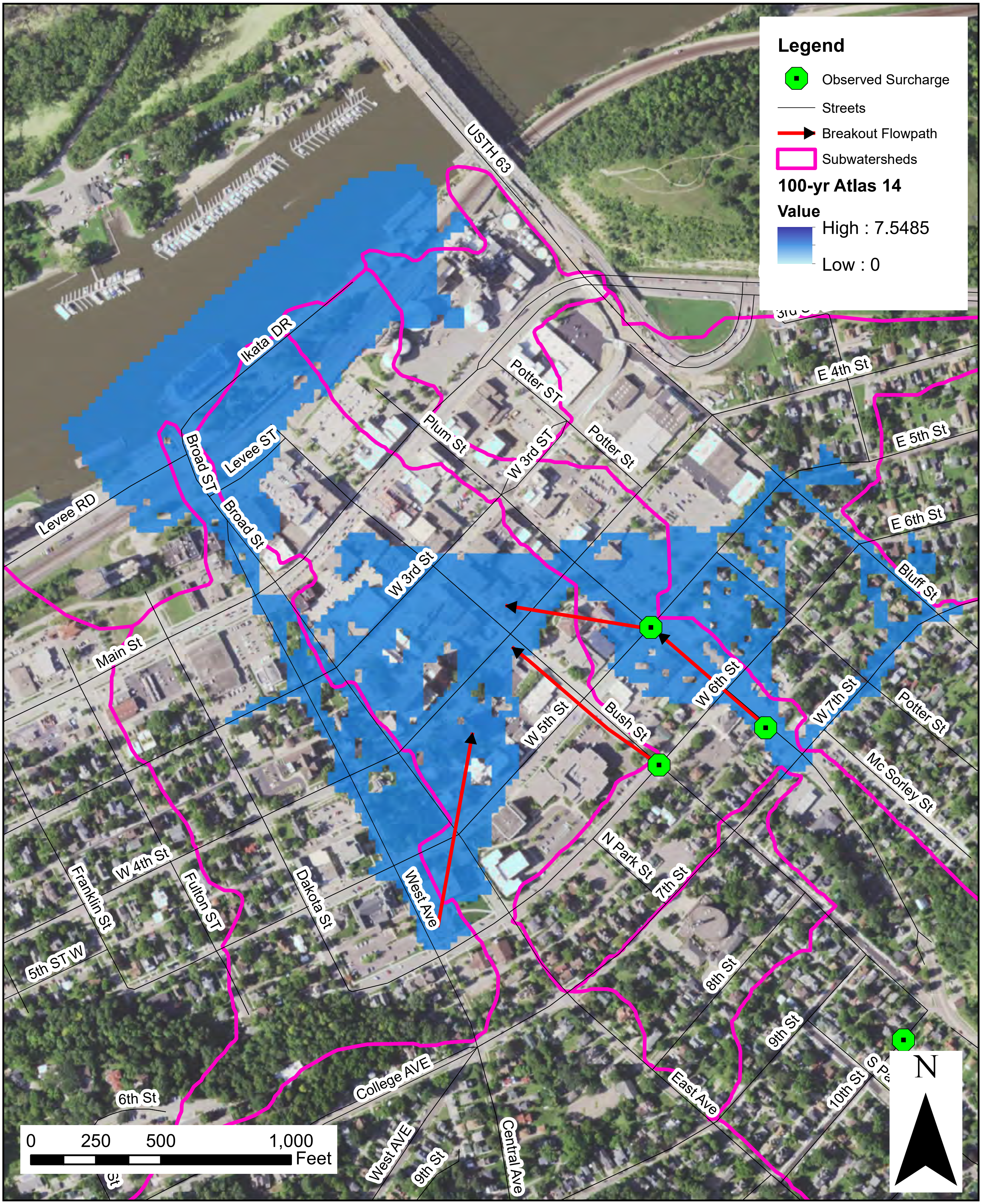

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Project: RWING-161191
Print Date: 4/8/2022

Map by: mchristenson
Projection:NAD 1983 UTM Zone 15N
Source: City of Red Wing, MnDOT

Existing Conditions 100-yr Event Inundation

Red Wing SWMP Update
Red Wing, MN

Figure 4

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SEH	3535 VADNAIS CENTER DR. ST. PAUL, MN 55110 PHONE: (651) 490-2000 FAX: (888) 908-8166 TF: (800) 325-2055 www.sehinc.com	Project: RWING-161191 Print Date: 4/20/2022 Map by: mchristenson Projection:NAD 1983 UTM Zone 15N Source: City of Red Wing, MnDOT	***Proposed Conditions 100-yr Atlas 14 Event Inundation*** Red Wing SWMP Update Red Wing, MN	Figure 5

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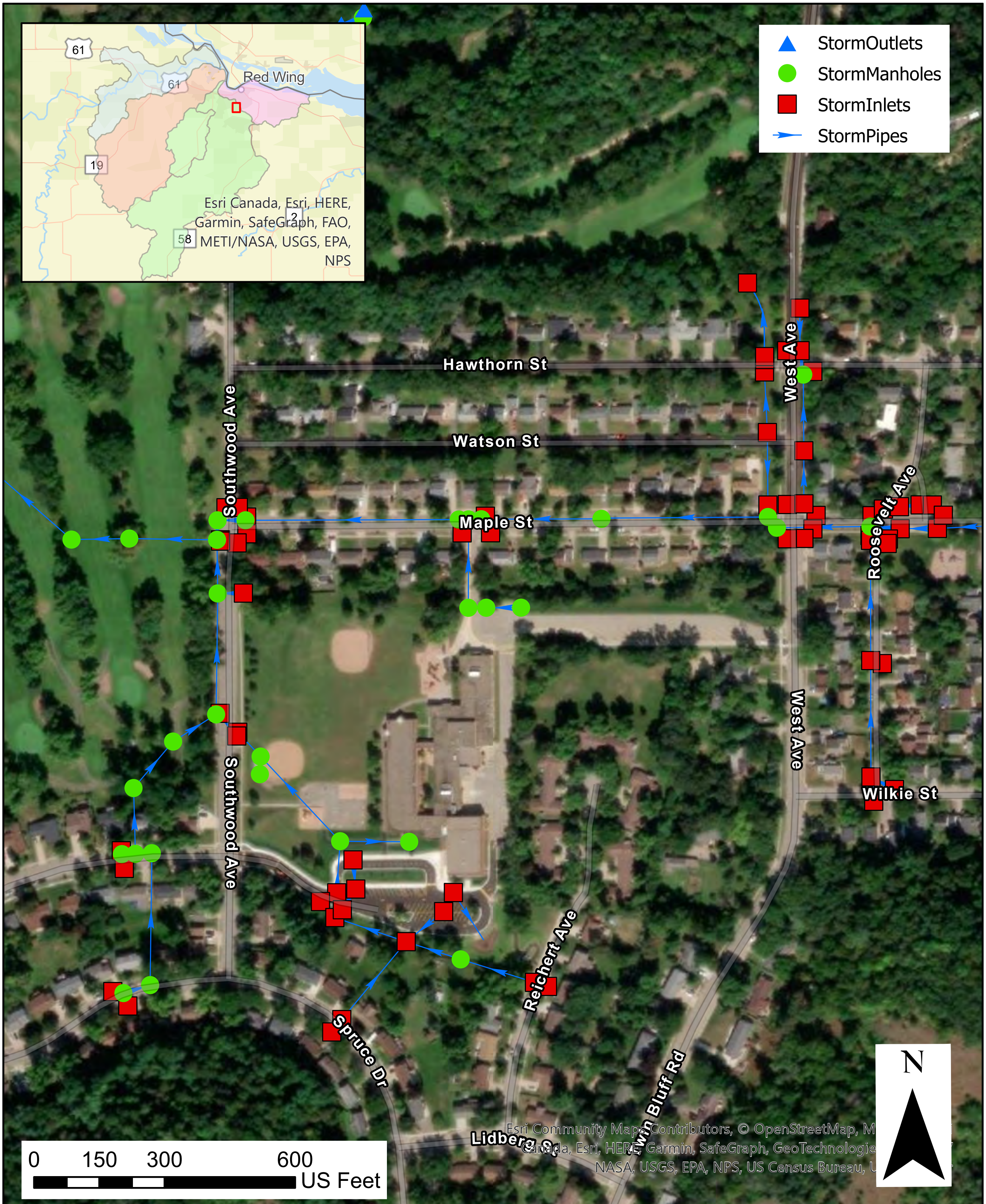

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SEH	3535 VADNAIS CENTER DR. ST. PAUL, MN 55110 PHONE: (651) 490-2000 FAX: (888) 908-8166 TF: (800) 325-2055 www.sehinc.com	Project: RWING - 161191 Print Date: 4/1/2022 Map by: mchristenson Projection: UTM Zone 15N Source: State of MN, City of Red Wing, Barr	***Maple Street*** Red Wing SWMP Amendment City of Red Wing, MN	Figure 06

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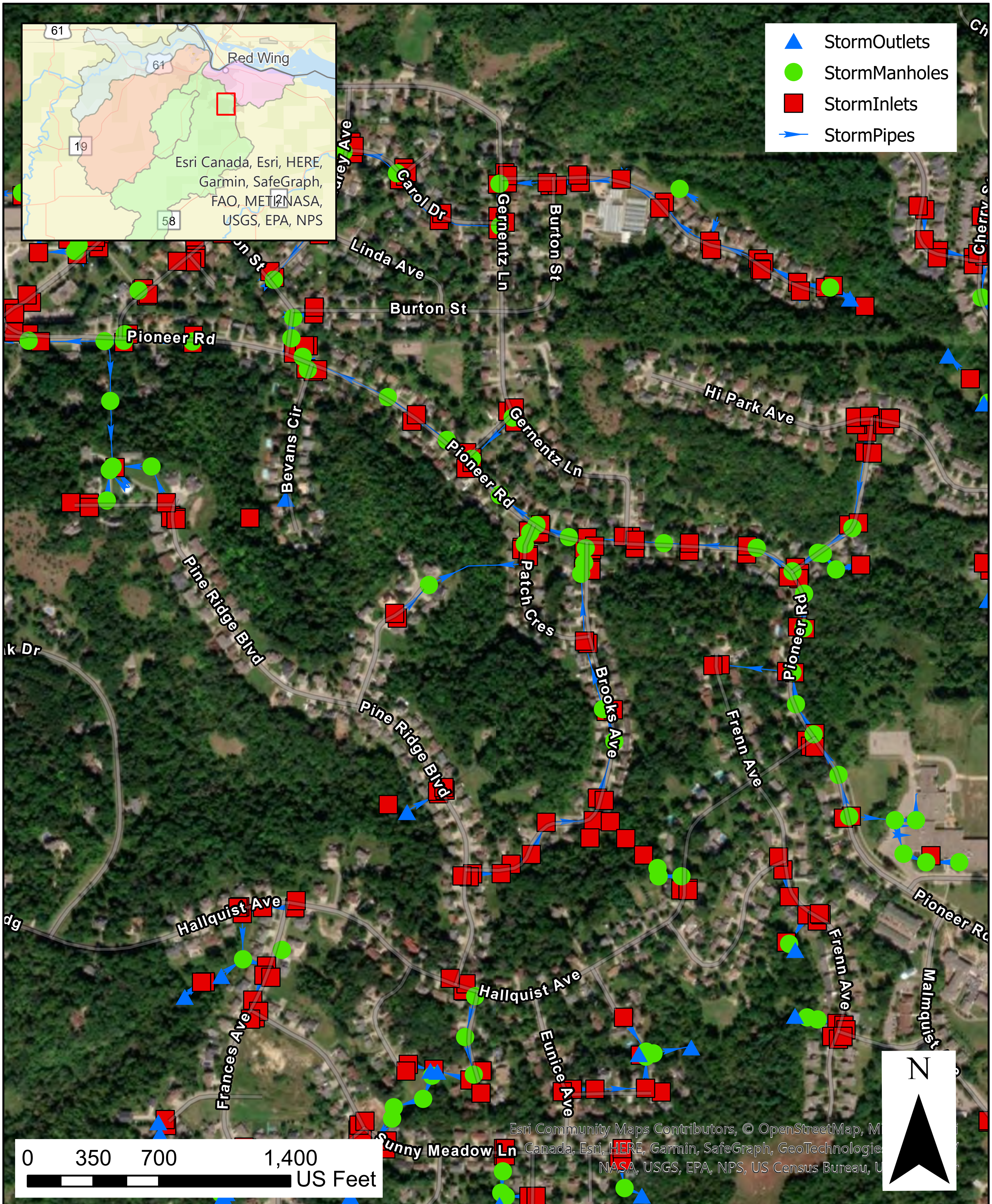

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Project: RWING - 161191
Print Date: 4/23/2022

Map by: mchristenson
Projection: UTM Zone 15N
Source: State of MN, City of Red Wing, Barr

Pioneer Rd. and Brooks Avenue

Red Wing SWMP Amendment
City of Red Wing, MN

Figure 07

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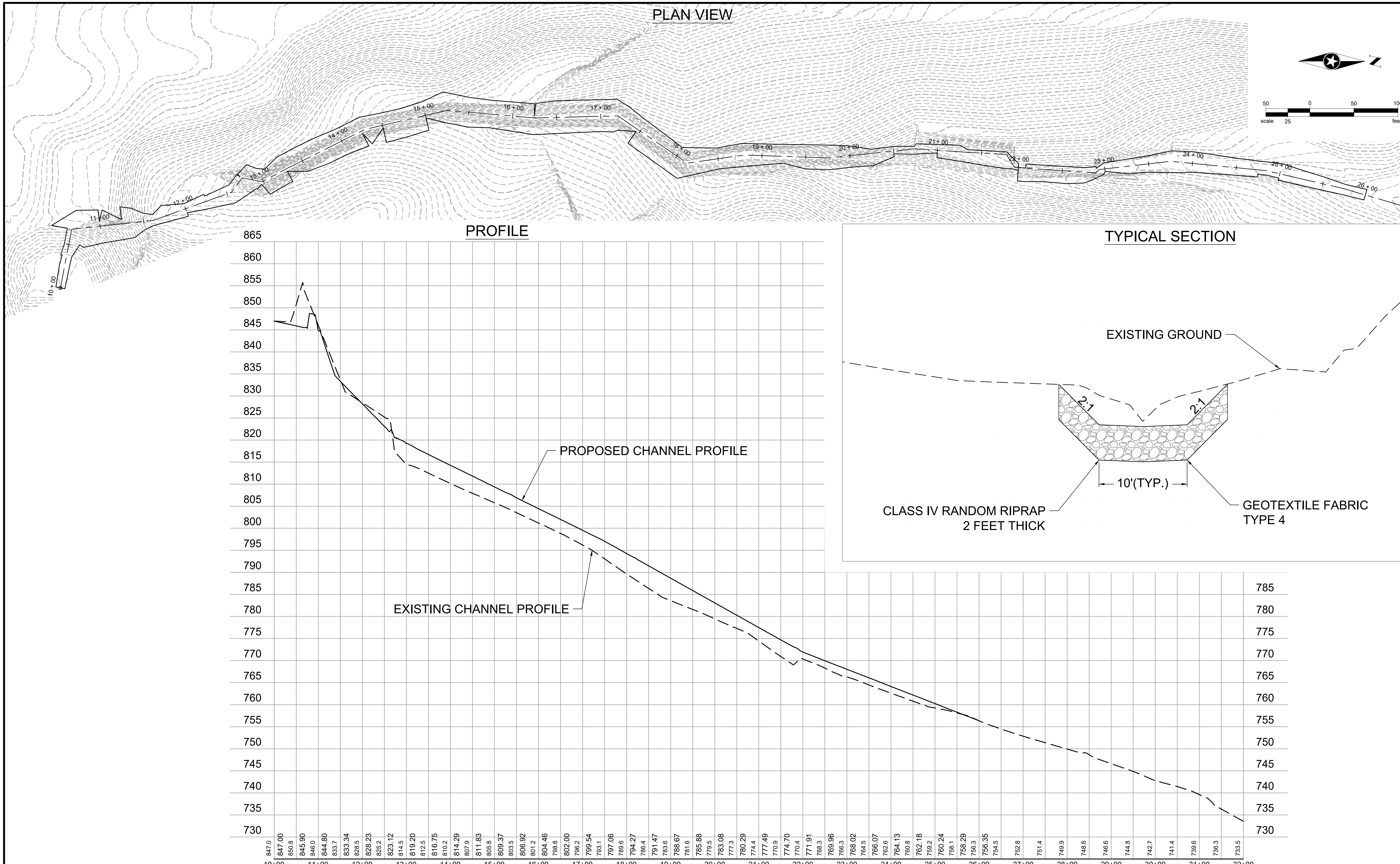
Appendix A

Neal Street Ravine Conceptual Plans



SEH Project	######	Rev.#	Revision Issue Description	Date	Rev.#	Revision Issue Description	Date
Drawn By							
Designed By							
Checked By							

SEH

I HEREBY CERTIFY THAT THIS PLAN 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 LICENSE STATE.

LICENSED NAME

DATE LICENSE SIGN DATE LICENSE NO. LICENSE NO

NEAL STREET RAVINE

REDWING, MINNESOTA

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of ---

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Appendix B

Plum Street Tunnel Assessment – CNA Engineers

CNA CONSULTING ENGINEERS

3433 Broadway Street NE, Suite 130
Minneapolis MN 55413
(612) 379-8805

July 12, 2021

Jeremy Walgrave
Short Elliott Hendrickson, Inc.
3535 Vadnais Center Dr
St. Paul, MN 55110

RE: Plum St Tunnel Repairs in Red Wing, MN

Dear Mr. Walgrave:

CNA Consulting Engineers (CNA) was retained to evaluate the condition and provide a conceptual repair for the Plum Street Storm Tunnel underneath the railroad tracks.

Inspections of the tunnels were performed on July 1, 2021, by Craig Eckdahl and Hayden Christensen of CNA with assistance from the City of Red Wing Public Works Department (City). We also did a quick observation of the Bush Street Storm Tunnel. Each of the tunnels were observed visually from the outlet to approximately 600 feet upstream. The observations was compared to the Storm Tunnel System Assessment Report and Management Plan, dated July 2013 prepared by CNA. The following sections provide the observations that were noted during the observations and any differences from the 2013 report.

Plum Street Tunnel

The first 80 feet of the tunnel was demolished and replaced with a 8-foot by 6-foot box culverts in 2019. Each of the box culvert joints have been tied together and no infiltration was observed. A cast-in-place concrete transition is located between the box culverts and the upstream tunnel section between Sta 0+80 to 0+84. The remaining cross-sections have not changed from the 2013 report. The stations have been updated to match the current tunnel stationing, stations from the 2013 report need to have 70 feet added to match current stationing:

- 0+84 to 1+12: 8 foot wide by 5.5 foot high limestone block crown and walls with a timber invert
- 1+12 to 1+28: 8 foot wide by 6 foot high cast in place concrete box
- 1+28 to 3+39: 8 foot wide by 4.5 to 5.5 foot high limestone block crown and walls with a cast in place concrete invert
- 3+39 to 3+59: 8 foot wide by 4.5 foot high brick crown and walls with a brick invert covered with cement plaster
- 3+59 to 5+99: 5 foot wide by 7 foot high concrete crown and limestone block walls with a brick invert covered with cement plaster
- 5+99 to 6+13: 6 foot wide by 7 foot high brick crown and limestone block walls with a concrete invert

- 6+13 to 6+74: 6 foot wide by 6 foot high brick crown and limestone block walls with a concrete invert

The railroad tracks are located above the tunnel from approximately Station 1+50 to 2+90. The tunnel is a limestone brick arch with a concrete invert. This section is in poor condition. See photos attached.

An area from approximate Station 1+70 to 2+00 has had some repair work performed. From approximate Station 1+80 to 1+86, a steel plate has been installed and supported by steel angles bars. On either side plywood was bolted to the crown and grout pumped behind it. Some of the plywood has rotted away from the crown.

The limestone block arch also has longitudinal cracks/fractures located in the crown. Most of the mortar for the blocks has started to erode. Some of the limestone blocks have also started to erode. See photos attached.

Bush Street Tunnel

The first 138 feet of the tunnel was demolished and replaced with 6-foot by 6-foot box culverts in 2019. Each of the box culvert joints have been tied together and no infiltration was observed. The remaining cross-sections have not changed from the 2013 report:

- 1+38 to 1+65: 5 foot wide by 7-foot-high limestone block crown and walls with a timber invert
- 1+65 to 1+79: 4.5 foot wide by 6-foot-high cast in place concrete junction box
- 1+79 to 1+96: 4 foot wide by 6.25-foot-high limestone block crown and walls tunnel with a cast in place concrete invert
- 1+96 to 2+68: 3.33 foot wide by 5.67-foot-high shotcrete crown, walls and concrete invert
- 2+68 to 4+03: 4.5 foot wide by 5-foot-high limestone block crown and walls with a concrete invert
- 4+03 to 5+40: 4.5 foot wide by 5.5-foot-high stone block crown and walls with a brick invert covered with cement plaster.

The railroad tracks are located above the tunnel from approximately Station 2+00 to 2+60. This section of the tunnel has a shotcrete liner that was probably placed on to the limestone walls and crown. This section of the tunnel is in good condition with no evidence of cracks in the shotcrete. See photos attached.

Upstream of the railroad tracks the tunnel has stone block crown and walls, observations were made of crown limestone blocks that had longitudinal cracks. These blocks should be observed and monitored on a regular basis to prevent them from propagating and potentially failing and falling into the tunnel. See photos attached.

At approximately Station 4+03 a hole was noticed in the crown that will allow material to enter the tunnel. This is also upstream of a catch basin that City personal said had settled. See photos attached.

Recommendations:

Plum Street Tunnel

The section of Plum Street that has a timber invert can be replaced with concrete and can be done now or in the future.

The limestone block arch section of the tunnel should have a reinforced shotcrete liner placed inside of it. The liner should have anchors installed to the limestone blocks to assist in the bonding of the shotcrete and limestone blocks. The existing steel plate can remain in place and the steel supports should remain until the shotcrete has reached maturity.

Bush Street Tunnel

The area under the railroad tracks is in good condition and no repair is needed at this time. The upstream sections should be repaired in the future.

Cost Estimate:

Tunnel Repair Section	Repair Length	Unit Cost	Total Cost
Plum Street			
Shotcrete Limestone Arch – Sta. 1+50 to 2+90, under railroad	140 feet	$1,500/LF	$210,000
Timber Invert Replacement, Sta 0+84 to 1+12	30 feet	$700/LF	$21,000
Shotcrete Limestone Arch – Sta 1+28 to 1+50, 2+90 to 3+28, adjacent to railroad	60 feet	$1,500/LF	$90,000
		Plum St Total	**$321,000**
		15% Contingency	**$48,150**
		Total	**$369,150**

Closure

CNA's observations, opinions, and recommendations have been conducted according to generally accepted engineering practices at this time and location. We recognize additional data, field testing, design background, and other considerations may exist but have not yet been incorporated into our considerations. We would be pleased to review additional data should such information be made available to us, and if appropriate to revise our conclusions and recommendations if they are affected by the additional information. Please contact us if you have any questions or need additional services.

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.

Signature: Craig Eckdahl

Name: Craig Eckdahl, PE

Date: 7/12/2021 License Number: 53544

Reviewed by: Brent K Nelson

Name: Brent K Nelson, PE

Tunnel	Plum Street
Description	Station 1+50, Crack in Crown

Tunnel	Plum Street
Description	Station 1+80, Steel Plate and Supports

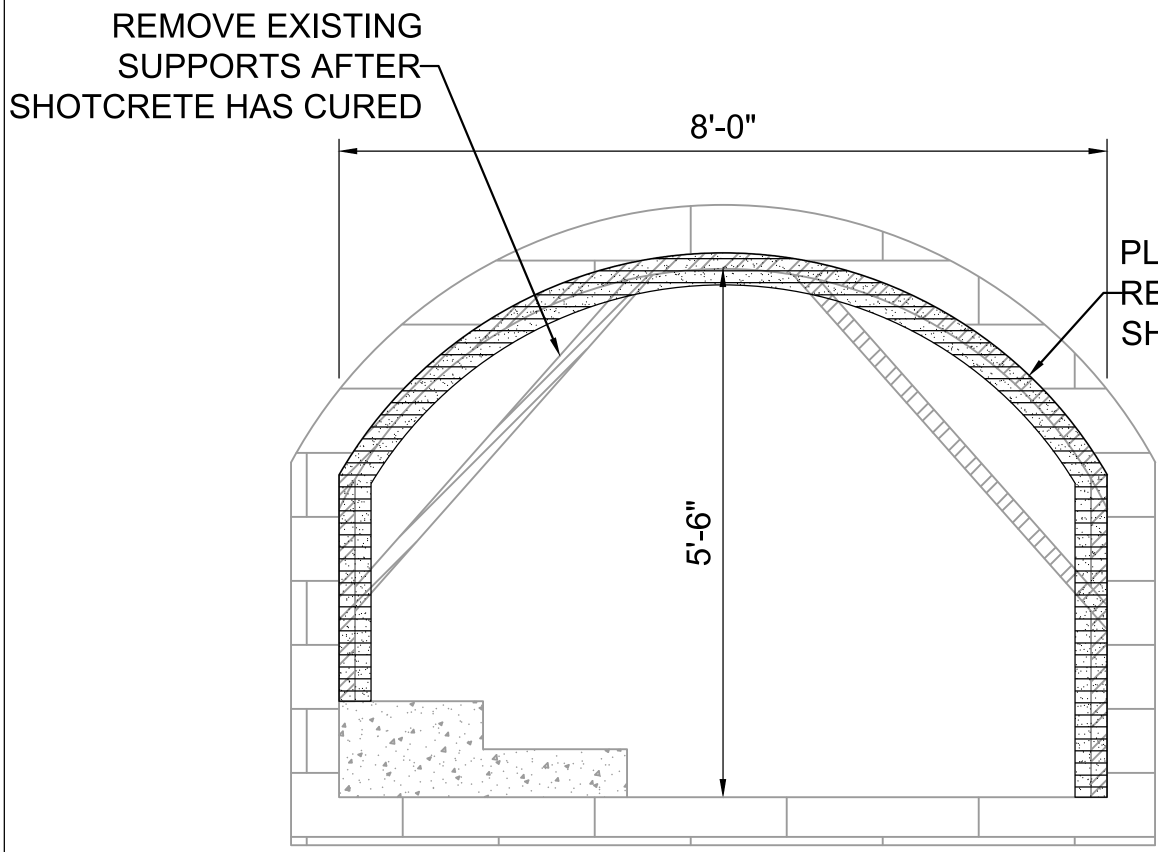
Tunnel	Plum Street
Description	Station 1+00, Timber Floor

Tunnel	Bush Street
Description	Station 2+25, Shotcrete walls and crown

Tunnel	Bush Street
Description	Station 2+45, Tunnel Junction

Tunnel	Bush Street
Description	Station 4+01, Hole in Crown

Tunnel	Bush Street
Description	Longitudinal Crack in Crown Block



CNA CONSULTING ENGINEERS	RED WING STORM TUNNEL REPAIR	DESIGNED CRE	DATE 07/12/2021
		DRAWN SML	PROJECT NO
	PLUM ST TUNNEL REPAIR		DRAWING FIG 1

S:\Red Wing\Red Wing 21-01 SEH\design phase\dwgs\Project#-Project Name\report drawings\FIG 1 - Plum.dwg

Appendix C

Table 7-8 [2022 Amendment]

Table 7-8-2. City of Red Wing Surface Water Implementation Program
Improvements to address Flooding Problems

ID #	Planned Activity	Location	Priority	Comments	SEH Modeling Comments
21	Construct 31.9 acre-foot stormwater basin	BA-16	Development Driven	Basin area = 10 ac	This is along the fairway of one of the holes of the golf course. There is unlikely any room for a basin this size here.
22	Construct 8.4 acre-foot extended detention basin	HC4 Hay Creek Detention Basins	Development Driven	Basin area = 2 ac	Not an issue for flooding. These nodes within the Hay Creek Model are all runoff nodes and would require addition of conveyance (ditches, culverts, storm sewer) to understand the hydraulic effects. Information on the conveyance elements will be needed for the model and could come from survey and/or as-built plans.
23	Construct 5.6 acre-foot extended detention basin	HC5 Hay Creek Detention Basins	Development Driven	Basin area = 1 ac	
24	Construct 32.3 acre-foot extended detention basin	HC9 Hay Creek Detention Basins	Development Driven	Basin area = 6 ac	
25	Construct 14.6 acre-foot extended detention basin	HC10	Development Driven	Basin area = 3 ac	
26	Construct 27.8 acre-foot extended detention basin	HC11	Development Driven	Basin area = 4 ac	
27	Construct 8.3 acre-foot extended detention basin	HCVR2, 3 and 4	Development Driven	Basin area = 4 ac	
28	Construct 1.9 acre-foot extended detention basin	FSR and HCVR 1	Development Driven	Basin area = 4 ac	
29	Construct 4.4 acre-foot extended detnetion basin	HCVR5 and 6	Development Driven	Basin area = 4 ac	
30	Construct 12.6 acre-foot extended detention basin	SC7	Development Driven	Basin area = 4 ac	These nodes within the Hay Creek Model are all runoff nodes and would require addition of conveyance (ditches, culverts, storm sewer) to understand the hydraulic effects. Information on the conveyance elements will be needed for the model and could come from survey and/or as-built plans.
31	Construct 59.1 acre-foot extended detention basin	SC1	Development Driven	Basin area = 12 ac	
32	Constuct 19.6 acre-foot extended detention basin	SC4	Development Driven	Basin area = 5 ac	
33	Construct 56.4 acre-foot extended detention basin	SC3	Development Driven	Basin area = 12 ac	
34	Construct 39.1 acre-foot extended detention basin	CSC11	Development Driven	Basin area = 9 ac	
35	Construct 14.3 acre-foot extended detention basin	SC9	Development Driven	Basin area = 4 ac	
36	Construct 80.6 acre-foot extended detention basin	SC6	Development Driven	Basin area = 22 ac	
37	Construct 68.1 acre-foot extended detention basin	SC8	Development Driven	Basin area = 13 ac	
38	Construct 3.5 acre-foot extended detention basin	SC2-1	Development Driven	Basin area = 1 ac	
39	Construct 31.0 acre-foot stormwater basin	SC5	Development Driven	Basin area = 6 ac	
40	Construct 36.1 acre-foot stormwater basin	CR1	Development Driven	Basin area = 6 ac	These nodes within the Hay Creek Model are all runoff nodes and would require addition of conveyance (ditches, culverts, storm sewer) to understand the hydraulic effects. Information on the conveyance elements will be needed for the model and could come from survey and/or as-built plans.
41	Construct 29.3 acre-foot extended detention basin	1-PR	Development Driven	Basin area = 3 ac	
42	Construct 18.7 acre-foot stormwater basin	CR2	Development Driven	Basin area = 4 ac	
43	Construct 50.4 acre-foot stormwater basin	CR3	Development Driven	Basin area = 10 ac	

Table 7-8-2. City of Red Wing Surface Water Implementation Program
Improvements to address Flooding Problems

ID #	Planned Activity	Location	Priority	Comments	SEH Modeling Comments
45a	Storm sewer upgrade	Bush St (Mississippi River Watershed)	High	Feasibility Study, Final Design, Construction - Bush St. low point - install 7 new inlets	This project was incorporated into the model as part of this 2022 SWMP amendment.
45b	Storm sewer upgrade	Bush St (Mississippi River Watershed)	Medium High	Feasibility Study, Final Design, Construction - low point to Main St. - 550 LF of 60" RCP	This project was incorporated into the model as part of this 2022 SWMP amendment.
45c	Storm sewer upgrade	Bush St (Mississippi River Watershed)	Medium High	Feasibility Study, Final Design, Construction - Main St. to Levee Rd. - 400 LF of 60" RCP	
45d	Storm sewer upgrade	Bush St (Mississippi River Watershed)	Medium High	Feasibility Study, Final Design, Construction - W 4th St to low point - 155 LF of 60" RCP	This project was incorporated into the model as part of this 2022 SWMP amendment.
45e	Storm sewer upgrade	W 4th St (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - Bluff St. to Plum St. - 768 LF of 48" RCP	This project was incorporated into the model as part of this 2022 SWMP amendment.
45f	Storm sewer upgrade	W 4th St (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - Plum St. to Bush St. - 385 LF of 42" RCP	This project was incorporated into the model as part of this 2022 SWMP amendment.
46a	Storm sewer upgrade	West Ave. (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - W 4th St. to River - 1540 LF of 42" RCP	Some improvements have already occurred but may be able to reconstruct road and add new storm.
46b	Storm sewer upgrade	W 4th St (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - East Ave. to West Ave. - 400 LF of 24" RCP (2 parralel pipes)	This project was incorporated into the model as part of this 2022 SWMP amendment.
46c	Storm sewer upgrade	East Ave. (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - W 5th St. to W 4th St. - 740 LF of 24" RCP (2 parralel pipes)	Some improvements have already occurred but may be able to reconstruct road and add new storm.
46d	Storm sewer upgrade	W 5th St (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - East Ave. to Bush St. - 700 LF of 30" RCP (additional parralel pipe)	This project was incorporated into the model as part of this 2022 SWMP amendment.
46e	Storm sewer upgrade	East Ave. (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - W 7th St. to W 5th St. - 790 LF of 30" RCP (additional parralel pipe)	Some improvements have already occurred but may be able to reconstruct road and add new storm.
46f	Storm sewer upgrade	West Ave. (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - W 5th St. to W 4th St. - 425 LF of 30" RCP (additional parralel pipe)	Some improvements have already occurred but may be able to reconstruct road and add new storm.
46g	Storm sewer upgrade	West Ave. (Mississippi River Watershed)	Medium	Feasibility Study, Final Design, Construction - W 6th St. to W 5th St. - 290 LF of 18" RCP (additional parralel pipe)	Some improvements have already occurred but may be able to reconstruct road and add new storm.

Table 7-8-2. City of Red Wing Surface Water Implementation Program

Improvements to address Flooding Problems

ID #	Planned Activity	Location	Priority	Comments	SEH Modeling Comments
54a	Maple Street and Watson Street Area near Sunnyside Elementary School Flooding	Maple St. (Hay Creek watershed)	Medium Low	Update model with hydraulic infrastructure data and complete feasibility study.	Model updates are needed to reflect the correct watershed areas and conveyance. Information for the conveyance updates could be obtained from survey and/or as-built plans.
54b	Pioneer Road and Brooks Avenue Flooding	Pioneer Rd. and Brooks Ave. (Hay Creek watershed)	Medium Low	Update model with hydraulic infrastructure data and complete feasibility study.	Model updates are needed to reflect the correct watershed areas and conveyance. Information for the conveyance updates could be obtained from survey and/or as-built plans.
56	Tunnel Rehabilitation	Citywide	Medium	First phase of annual tunnel rehabilitation planned for 6th Street and East Avenue	Plum Street rehabilitation project under the railroad tracks at Levee Park is underway.
57	Revise Zoning Ordninance Division 52	Citywide	On Going	Revise to update minimum building elevations. Revisit most current floodplain maps.	
58	Update Hydrologic/Hydraulic Modeling	Citywide	Medium	Model updates to include recently-updated precipitation, soil, and land-use data	
60	Promote stormwater retention through infiltration practices and demonstration projects	Citywide	On Going	Promotion of stormwater retention would be achieved by providing incentives to developers	
61	Administer Red Wing Storm Water Utility	Citywide	N/A	Completed	Completed

Table 7-8-3 City of Red wIng Surface Water Implementation Program

Infrastructure Improvements to address water quality problems

ID #	Planned Activity	Location	Priority	Comments
62	Pond maintenance -- sediment removal 6 ponds	Citywide	On Going	Inspect 20% of ponds each year on a 5-year cycle. Ponds are cleaned out when they reach 50% capacity loss.
63	Replace street sweeper/vacuum at 10 years old	Citywide	On Going	See the City Capital Improvement Program
64	Partner with county, adjacent townships, and upstream landowners outside City's jurisdiction to reduce pollutant/sediment loadings and volume	Citywide	On Going	This task includes projects, meetings, and/or agreements.
65	Tyler Road North outlet trash collectors	Spring Creek watershed	Medium Low	From City Staff
66	Ponding at Featherstone and Hay Creek	Hay Creek Watershed	Medium Low	From City Staff
67	Pond at Pioneer Road (near County facility)	Hay Creek Watershed	Medium Low	From City Staff
68	Levee Rd. -- multiple outflows	Mississippi watershed	Medium	Sumps, SAFL Baffle, etc.
69	Siewert/Neal Street ravine repair	Hay Creek Watershed	High	Final design is underway. Construction documents will be prepared in 2022.

Table 7-8-4. City of Red Wing Surface Water Implementation Program

Cannon River Turbidity Impairment Implementation Tasks

ID #	Planned Activity	Location	Priority	Comments
70	Provide long-term maintenance for detention basins to reduce sedimentation in local streams	Cannon River Watershed	On Going	Cannon River Turbidity Impairment Implementation Task F-1
71	Provide general stormwater education to residents, especially in urban areas	Cannon River Watershed	On Going	Cannon River Turbidity Impairment Implementation Task F-2
72	Provide education, design, installation assistance, and cost-share funding for stormwater practices	Cannon River Watershed	On Going	Cannon River Turbidity Impairment Implementation Task F-3
73	Prepare and adopt local erosion-control standards and ordinances for construction sites	Cannon River Watershed	Done	Cannon River Turbidity Impairment Implementation Task F-4
74	Identify and repair erosion-prone land areas owned by the City of Red Wing	Cannon River Watershed	Done	Cannon River Turbidity Impairment Implementation Task F-5
75	Train city staff regarding pollution caused by park and fleet/building maintenance and construction, and outfall inspection and system maintenance	Cannon River Watershed	On Going	Cannon River Turbidity Impairment Implementation Task F-6
76	Develop and implement street sweeping practices to reduce sediment especially in areas close to waters	Cannon River Watershed	On Going	Cannon River Turbidity Impairment Implementation Task F-7

Table 7-8-5. City of Red Wing Surface Water Implementation Program

South Metro Mississippi River Turbidity Impairment Implementation Task

ID #	Planned Activity	Location	Priority	Comments
77	Develop BMPs to achieve an estimated 25% reduction in sediment load in existing urban areas and apply these BMPs to developing areas; in conjuntion with the construction stormwater permit and minimum control measures, this will bring Red Wing into compliance with the TMDL.	Citywide	On Going	City of Red Wing is meeting the WLA. Continue to maintain BMPs and compliance with the WLA.

Table 7-8-6. City of Red Wing Surface Water Implementation Program

Mississippi and Vermillion River Turbidity Impairment Implementation Tasks

ID #	Planned Activity	Location	Priority	Comments
78	Erosion control along Cherry St. from Oakwood Cemetery	Mississippi River watershed	Low	Development Driven with Upper Cherry St. connection
79	Erosion control from Cannonview Dr. to the Cannon River bottoms	Cannon River watershed	Medium	
80	Relocate city sand/salt storage from Upper Harbor and cover and maintain	Mississippi River watershed	Done	
81	Upper Harbor Stormwater Demonstration Project	Mississippi River watershed	Medium	
82	Addition of stormwater management projects as Upper Harbor re-develops	Mississippi River watershed	Medium	

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