2021 GULLY INVENTORY AND CONDITION ASSESSMENT, VOLUME 2

July 15, 2022

PREPARED FOR:
Lower Minnesota River Watershed District
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LOWER MINNESOTA RIVER
WATERSHED DISTRICT

Young Environmental Consulting
Group, LLC

2021 Gully Inventory and Condition Assessment

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Lower Minnesota River Watershed District
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Chaska, Minnesota

Revision 0
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prepared by

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
BEHI	Bank erosion hazard index
DEM	Digital elevation model
GIS	Geographic information system
2020 Project	2020 Gully Inventory and Condition Assessment Project, Volume 1
2021 Project	2021 Gully Inventory and Condition Assessment Project, Volume 2
HPR	High-priority region
HVRA	High value resource area
LiDAR	Light detection and radar
LMRWD	Lower Minnesota River Watershed District
MGS	Minnesota Geological Survey
MnDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
NRCS	Natural Resources Conservation Service
SSOD	Steep Slopes Overlay District
VHR	Very high-risk

EXECUTIVE SUMMARY

This report is the second volume of the Lower Minnesota River Watershed District's (LMRWD or District) *Gully Inventory and Condition Assessment*. The first volume was published in 2020 (the *2020 Gully Inventory and Condition Assessment* or 2020 Project). The data presented here builds on the 2020 Project and identifies new gullies within Dakota and Scott Counties within the LMRWD.

The LMRWD developed standards and rules focused on protecting steep-sloped areas prone to erosion and gully formation. In 2008, the LMRWD inventoried actively eroding gullies and pipe outfalls to collect information about the severity of erosion occurring at each site. The 2008 Inventory was conducted from 2007 to 2008 by the Minnesota Conservation Corps and identified gullies, pipe outfalls, and other sites encountered, such as trash heaps, within the LMRWD watershed. In 2020, the District tasked their technical consultant, Young Environmental Consulting Group, LLC (Young Environmental), with conducting an updated inventory and condition assessment using the 2008 Inventory as a baseline. *The Gully Inventory and Condition Assessment Project, Volume 1* (2020 Project), is a comprehensive review and assessment of the 2008 Inventory. This effort, the 2021 Project, is intended to identify new gullies in areas not surveyed in 2008 or 2020 that may be contributing sediment to the Minnesota River. The project comprised three components: desktop assessment, field work, and data evaluation.

1. **Desktop Assessment**

   This phase of the project included an in-depth review of gully formation processes and available data sets to develop a process for identifying gullies remotely, using GIS software, publicly available geospatial data, and information provided by the LMRWD local municipalities based on resident concerns.

2. **Fieldwork**

   The fieldwork component was used to determine whether the desktop assessment was able to identify a physical gully and if so, to assess the existing condition of the gully. The gully condition was summarized by its erosion potential, a risk-based assessment of the general likelihood that the site would contribute sediment to the Minnesota River without intervention. Areas with high erosion potential were actively eroding, showing

signs of sediment transport to the river, and in need of immediate restoration to prevent further degradation whereas areas with low erosion potential were relatively stable and not in need of immediate restoration.

3. **Data Evaluation**

   The data collected in the field and developed during the desktop analysis were used to create a list of high-priority regions (HPRs), or areas that contained more than one high-priority gully, and high priority sites within the LMRWD boundary. From the data collected, it is likely these gullies are contributing large amounts of sediment to the Minnesota River. The high-priority sites were grouped by city and are generally summarized below.

Full descriptions of each high-priority site and HPR are detailed in the individual city sections of the report, but the following offers a brief summary of each community evaluated, including the conditions encountered in the field and areas of concern.

Burnsville

The City of Burnsville is located in Dakota County on the south side of the Minnesota River and had previously undertaken an internal effort to identify gully locations within its municipal limits in 2018. In general, the findings from the 2021 Project corroborate the city findings.

Restricted property and private fencing made access conditions difficult, in addition to steep slopes and wet ground near the river. Most gullies in Burnsville were located near the trout streams Unnamed 3, Unnamed 4, and Unnamed 7, as well as Black Dog Lake North calcareous fen complex.

A total of 70 gullies were identified in Burnsville, with 12 sites having low erosion potential, 40 having moderate erosion potential, and the remaining 18 having high erosion potential. Of these 70 gullies, four were classified as very-high risk (VHR) of future erosion, all located in the Black Dog Lake North HPR. The very-high risk gullies should be prioritized for future study, due to their proximity to the fen and trout stream habitat.

Future efforts should include coordination with CenterPoint Energy to access the steep slopes on their property and assess the conditions of any gullies present.

Eagan

The City of Eagan is located in Dakota County on the south side of the Minnesota River. Construction was occurring at the Greenway Trailhead and limited access to a portion of the bluff area; this area should be resurveyed in the future to determine if any gullies are present in this region.

A total of 44 gullies were identified in Eagan, with seven sites having low erosion potential, 24 having moderate erosion potential, and the remaining 13 having high erosion potential. Of these 44 gullies, only one (Gully 06:15-10:06) is classified as at very high-risk of future erosion. This gully may warrant action to mitigate the erosion and protect downstream natural resources.

Many high-risk gullies were present within the Nicols Meadow Fen watershed, a resident even approached the field team to report ongoing issues with Gully 06:22–01:45. Given the known issues with the Highway 77 spoil piles, this area may warrant further review and mitigation to protect Nicols Meadow fen and the remaining viable trout stream habitat.

Jackson Township

Jackson Township an incorporated area located in Scott County, immediately west of the city of Shakopee on the south side of the Minnesota River. The 2020 Project included portions of Jackson Township to reassess the gullies identified in 2008. The 2021 work focused on identifying potential gullies outside of these known locations.

A total of ten gullies were identified in Jackson Township, with two sites had low erosion potential, seven had moderate erosion potential, and one had high erosion potential. Only one very-high risk gully was identified near the Minnesota River. However, it is located near the Minnesota River and may have only been observed only because of low river levels. Rather than recommend mitigation, future monitoring should occur during higher river levels to determine whether this site is in fact a gully and not a backwater channel to the Minnesota River. Additionally, the inaccessible areas should be surveyed in the future to determine whether gullies are present. Finally, the 2020 and 2021 gullies in Jackson Township should be evaluated together for inclusion in the District's gully prioritization efforts so that future partnership and collaborations can be planned.

Mendota Heights

The City of Mendota Heights is located in Dakota County along the south side of the Minnesota River. The 2020 Project included portions of Mendota Heights to reassess the gullies identified in 2008. The 2021 work focused on identifying potential gullies outside of these known locations. There was no access along the Big Rivers Regional Trail due to a summer-long construction project.

A total of 21 gullies were identified in Mendota Heights, with five sites had low erosion potential, 14 had moderate erosion potential, and two had high erosion potential. No gully locations were identified as VHR although six were identified as high-risk, with the rest in medium- and low-risk categories. Of those locations identified as high-risk, only the sites near Gun Club Lake North warrant further attention at this time because of the potential effects on the nearby calcareous fen.

It is recommended that the Big Rivers Regional Trail area be assessed when construction is complete to confirm whether the gullies identified by desktop analysis exist and to confirm the impact construction may have had on the existing Gun Club Lake North gullies and the gullies that were surveyed in 2020.

Savage

The City of Savage is located in Scott County along the south side of the Minnesota River. The field team identified four areas that could not be accessed and were likely to contain gullies. The inaccessible locations were either fenced off, guarded by a dog, or inaccessible due to dense vegetation. Discussions with the owners of the land will be valuable for surveys of this area in the future.

A total of the 31 gullies were found in Savage, with seven sites having low erosion potential, 20 having moderate erosion potential, and four having high erosion potential. No gully locations were identified as VHR although ten were identified as high-risk, with the rest in medium, low, and very low risk categories. Generally the high-risk gullies were found in two locations, along the main branch of Eagle Creek and the Savage Bluff line. Though not VHR, these HPRs should be considered for regular monitoring to determine the rate at which these gullies are eroding and whether further actions are necessary to protect Eagle Creek and Savage Fen from degradation.

Shakopee

The City of Shakopee is located in Scott County along the south side of the Minnesota River. Only one small area was inaccessible, however a number of potential gullies identified in the desktop assessment did not contain actual gullies. This indicated that there may have been recent changes in the landscape and the topography was out of date.

A total of 75 gullies were surveyed, containing a mix of gullies running into the Minnesota River, gullies formed by pipe outfalls, and gullies in woods behind residential and business land. Of these sites, 17 had low erosion potential, 41 were moderate, and 17 locations had high erosion potential. No gullies were identified as VHR; but 23 gully locations were identified as high risk, generally grouped in two HPR, Shakopee River Bluffs and Kelly Court.

The Kelly Court HPR appeared to have the greatest need for intervention, particularly given its proximity to private residences, the Eagle Creek HVRA, and the steep slopes, the potential for continued erosion is high.

Future evaluation of the Shakopee River Bluffs HPR near the Minnesota River should occur when river levels are higher to determine whether these sites are true gullies and not backwater channels to the Minnesota River. Additionally, the inaccessible areas should be surveyed in the future to confirm whether gullies are present.

1.0 INTRODUCTION

The 2021 Gully Inventory and Condition Assessment Project (2021 Project) continues the gully inventory started in 2008 by the Minnesota Conservation Corps (2008 Inventory) and updated with the 2020 Gully Inventory and Condition Assessment Project (2020 Project) within the Lower Minnesota River Watershed District (LMRWD). The purpose of the current assessment is to determine the number and condition of gullies contributing to the turbidity impairment of the Minnesota River. The 2008 and 2020 Projects were conducted mainly on the north side of the river; the 2021 Project seeks to establish baseline conditions for gullies on the south side of the river.

Following the completion of the 2020 Project, the District asked Young Environmental to continue the work to develop a comprehensive assessment of the entire watershed district. The following sections of this report present Young Environmental's methodology, findings, city summaries, and recommendations for next steps.

Additionally, the 2021 Project builds on a partnership with the University of Minnesota through the Environmental Sciences, Policy and Management Spring 2021 class called Hydrology and Water Quality Field Methods. Young Environmental staff worked with students in this class to provide a hands-on educational experience to develop a methodology to remotely identify gullies and confirm the existence of gullies in the field. The results of this partnership are summarized in Appendix A.

2.0 DESKTOP ANALYSIS

2.1 Site Identification

Before field work could begin on the 2021 Project, a computer desktop analysis was completed to identify potential gully locations. QGIS, a free and open-source desktop geographic information system (GIS) application, was used to analyze the LMRWD watershed area-based publicly available data, including the following:

- Minnesota Department of Natural Resources (MnDNR) LiDAR data and digital elevations model (DEM)
- Natural Resources Conservation Service (NRCS) soils data
- Minnesota Geological Survey (MGS) surficial geology data
- LMRWD Steep Slopes Overlay District (SSOD)

Using the results from the University of Minnesota Environmental Sciences, Policy and Management Spring 2021 class, Hydrology and Water Quality Field Methods (Appendix A), groundwater data were not included, and greater emphasis was placed on steep slopes and information from the municipal partners in the 2021 analysis (Young Environmental Consulting Group 2021). The following generally summarizes the process used to identify potential gully locations:

1. **Steep Slope Identification**

   The MnDNR developed a methodology to highlight bluff areas in the Mississippi River Corridor Critical Area using its 2011 LiDAR data (Minnesota Department of Natural Resources 2021). This method uses GIS to identify steep areas within the DEM by identifying areas where the slope rises at least 25 feet and the grade of slope averages 18 percent or greater. This was the same process used to originally develop the SSOD in 2018 and was repeated for Dakota and Scott Counties to ensure a small 100-foot buffer around the LMRWD boundary was included in the mapping to identify all potential gully and sediment sources.

2. **Valley Tracing**

   Using the above steep slopes information, potential gully locations were then identified by tracing clearly defined valleys in the MnDNR LiDAR data found within the steep slope areas.

3. **Municipal Input**

   The potential gully locations were supplemented by information received from municipal partners that identified local erosion hot spots. Young Environmental staff reviewed local water plans and sent requests to the LMRWD city engineers, notifying them about the project goals and requesting that they submit the names of any potential gully or erosion areas they wanted incorporated into the field surveys.

4. **Field Survey and Documentation**

   The sleep slope locations and municipal points of concern were uploaded to an online application, Survey123, to allow the data to be viewed and navigated to the field with the survey iPads. Young Environmental staff validated the process and located each potential gully in the field and documented whether a gully was found. If a gully was found, then the condition of the gully was assessed using the following gully-ranking method.

2.2 Survey Collection

The 2021 Project built on the data collection methods outlined in the 2020 Project (Young Environmental Consulting Group 2020) and sought to refine the questions asked of the field team to facilitate the ranking process by limiting the options for answers. The primary adjustment made was using a single survey for all gully sites rather than having multiple surveys for gullies, pipe outfalls, and combination pipe outfall and gully sites.

The 2020 Project contained 27 different data points for each gully-only or combination site, specifically included to assess the potential for future erosion. After a review of the data collected, it was clear that the following data points are either subjective, duplicative, or unnecessary and should be optionally collected. In other words, the data points below may or may not be seen at any given site. They should be recorded if observed but should not be included in the ranking analysis. The rationale for making these data points optional and effectively removing them from the ranked analysis appears below:

- Game Trails: Subjective and may not correlate with erosion
- Scour from Channel Obstruction: Captured by other included metrics such as debris and degradation
- Dense Canopy: Subjective and may not correlate with erosion
- Top Width: Captured by included metrics: gully shape and bottom width
- Number of Invasive Species Present: Does not correlate with soil erosion potential
- Water Velocity: Velocity data not collected because of safety concerns
- Incision: Without comparison photos, this sign of erosion difficult to determine

The refinements to the survey questions appear below and were limited to necessary modifications to preserve the comparative potential among the 2020 data collected:

Table 1. *Survey123 survey form modifications*

Data Field	2020 Intent	2021 Revisions
1. Previous Waypoint ID	This field was used to highlight the gully ID from the 2008 Inventory.	Deleted from Survey123 form as not applicable to 2021 Project
2. Type of Site	This field was used to identify which survey was used (gully, combination, or pipe outfall).	Deleted from Survey123 form as not applicable to 2021 Project
3. Gully Head UTM Estimation	This field was intended to note locations where the field team could not access the gully head to collect the data point.	Deleted from Survey123 form, was not used consistently or uniformly in 2020
4. Bank Angle	This was indicated by problem indicator field flags for flat, vertical, undercut, or overhanging banks.	Added as a separate field with the following options: obtuse (> 90 degrees or flat), mid-range (45–90 degrees), or acute (< 45 degrees or undercut)
5. Seeps	This information was contained in the Apparent Causes field.	Created a separate field for observed seeps or springs
6. Stormwater Runoff	This information was contained in the apparent causes field.	Created a separate field for observed stormwater inputs and runoff
7. Fallen Trees	Leaning or pistol-butted trees were flagged within the apparent causes field.	Created a separate field for observed fallen, leaning, or pistol-butted trees
8. Degradation	This information was contained within the problem indicators field.	Created a separate field for observed degradation and severity
9. Aggradation	This information was contained within the problem indicators field.	Created a separate field for observed aggradation and severity
10. Slumping	This information was contained within the problem indicators field.	Created a separate field for bank slumping and severity
11. Water in Gully	The water levels field was infrequently used to document observed water in the gully.	Created separate fields for presence of water and quantity of water in the gully, recognizing this information may be dependent on recent rainfall events
12. Erosion Potential	Field team observation	No change

3.0 FIELD DATA COLLECTION

During the 2021 season of field work, the team focused on collecting data in the region of the LMRWD that lies south of the Minnesota River. This included six cities: Burnsville, Eagan, Mendota, Mendota Heights, Savage, Shakopee, and one township, Jackson Township. In this region, a total of 257 gullies were found and are discussed in subsequent sections (Figure 1).

Similar to the 2020 Project, wi-fi- and cellular-enabled iPads, Survey123, and the ESRI Collector for ArcGIS application were used to navigate to different potential sites in the field. For details on the training, community outreach, and field data collection methods used, please refer to the 2020 Project report.

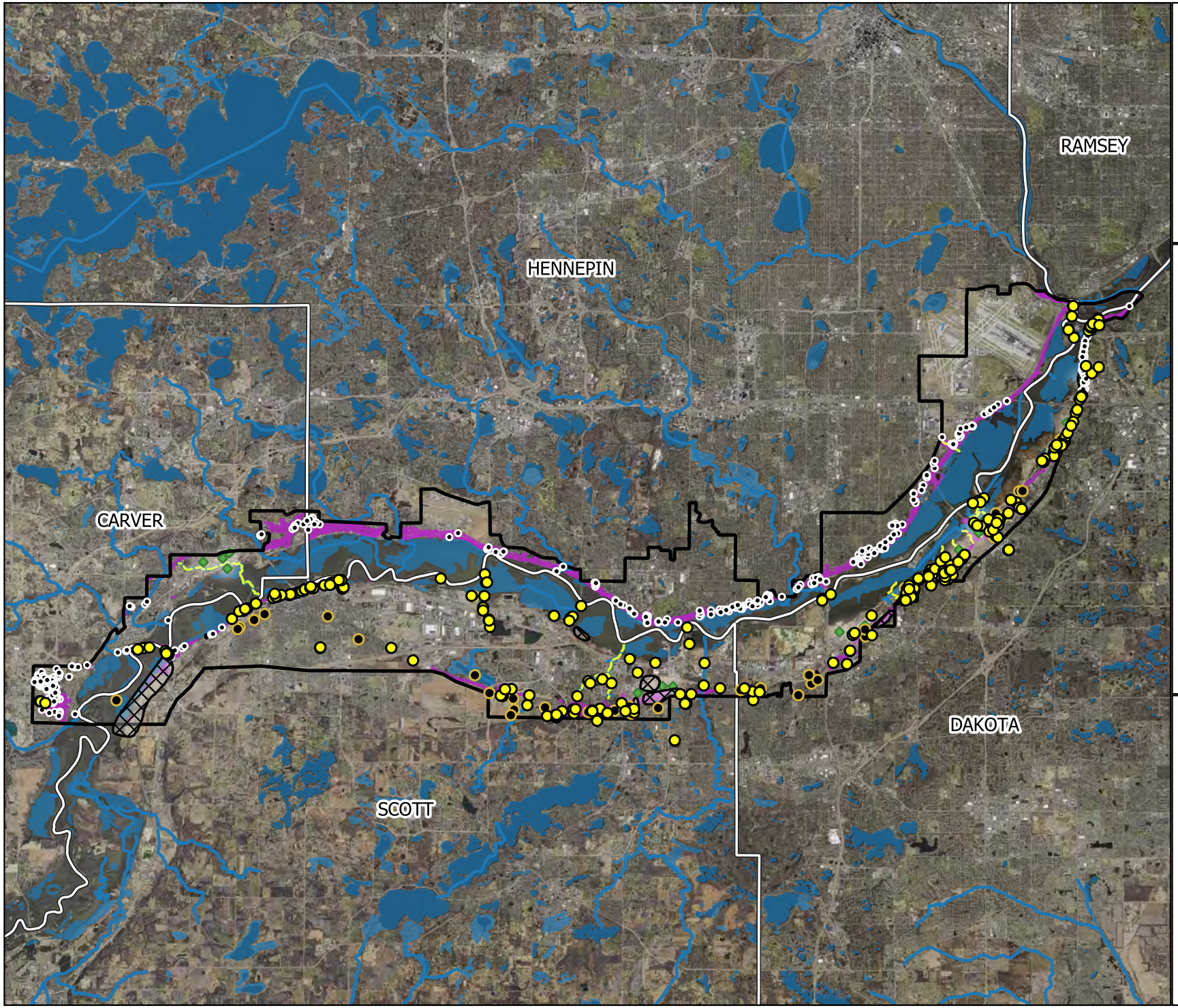

Figure 1: 2021 Gully Waypoints

Legend

- 2021 Gullies Surveyed
- 2021 Potential Gully, Not Found
- 2020 Gully Inventory
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Public Waterbodies
- 2021 No Access
- Steep Slopes Overlay District
- County Boundaries
- LMRWD Boundary

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4.0 BURNSVILLE

The City of Burnsville (Burnsville) is located south of the Minnesota River in the northwestern corner of Dakota County, with the northwest portion of Burnsville located in the Lower Minnesota River Watershed District. It is home to several trout streams and calcareous fens as well as many steep slopes.

4.1 City-Provided Information

The LMRWD contacted Burnsville in October 2020 to notify them of the upcoming gully investigation work and met with LMRWD staff on April 21, 2021, to discuss the upcoming 2021 Project. The city provided their Geohazards Assessment Report (GA Report), which was completed in 2018 by WSB (WSB & Associates 2018). This report used similar methods as this study to identify areas prone to slope instabilities within Burnsville. The report identified the issues leading to slope instability as gully development, such as easily erodible soils, steep slopes, and the presence of groundwater springs, and identified the Minnesota River Valley as the area most at risk within the city. WSB's general recommendation was that all sites be monitored following a two-year rainfall event (2.82 inches in 24 hours). The following table highlights the priority sites from the 2018 report located within the LMRWD.

Table 2. Summary of 2018 Burnsville Gullies within LMRWD

Name and Location	Concerns, Management Category, and Recommendations
Site 3 (Gully 07:21-11:37) 10550 McCool Court	**Concerns:** Private irrigation and groundwater springs were destabilizing the slope on a private residential property. Spring flows were also observed to be contributing to erosion. **Management Category:** Management required **Recommendations:** Stabilize the gully with fill and riprap; encourage the landowner to extend downspouts and drainpipes to the toe of slopes, and provide energy dissipation at these outlets to prevent further erosion (i.e., private irrigation management). Increase vegetation and add boulders around the spring to slow flows. In severe cases the report recommended installing dry wells or a vegetated swale to collect water and increase permeability in the soil. 
Site 4 (Gully 08:11-10:27) 10640 McCool Court	**Concerns:** Private irrigation was destabilizing the slope on a residential property. **Management Category:** Management required **Recommendations:** Stabilize the gully with fill, turf reinforcement mat, and vegetation in addition to private irrigation management. 

Name and Location	Concerns, Management Category, and Recommendations
Site 7 (Gully 06:08-11:05) 10700 Cambridge Court	**Concerns:** Failing and eroded slope on private residential property caused by inadequate storm drainage was threatening the municipal storm sewer and private property. **Management Category:** Management required **Recommendations:** Stabilize the gully with fill, geotextile fabric, and riprap; correct private irrigation management and work to divert gully flows from the eroded bank. 
Site 8 (Gully 06:08-11:03) 10700 Cambridge Court	**Concerns:** Failing and eroded slope on private residential property caused by inadequate storm drainage was threatening municipal storm sewer and private property. **Management Category:** Management required **Recommendations:** Stabilize the gully with fill, geotextile fabric, and riprap; encourage landowner to extend downspouts and drainpipes to toes of slopes and provide energy dissipation at outlets; divert gully flows from the eroded bank. 

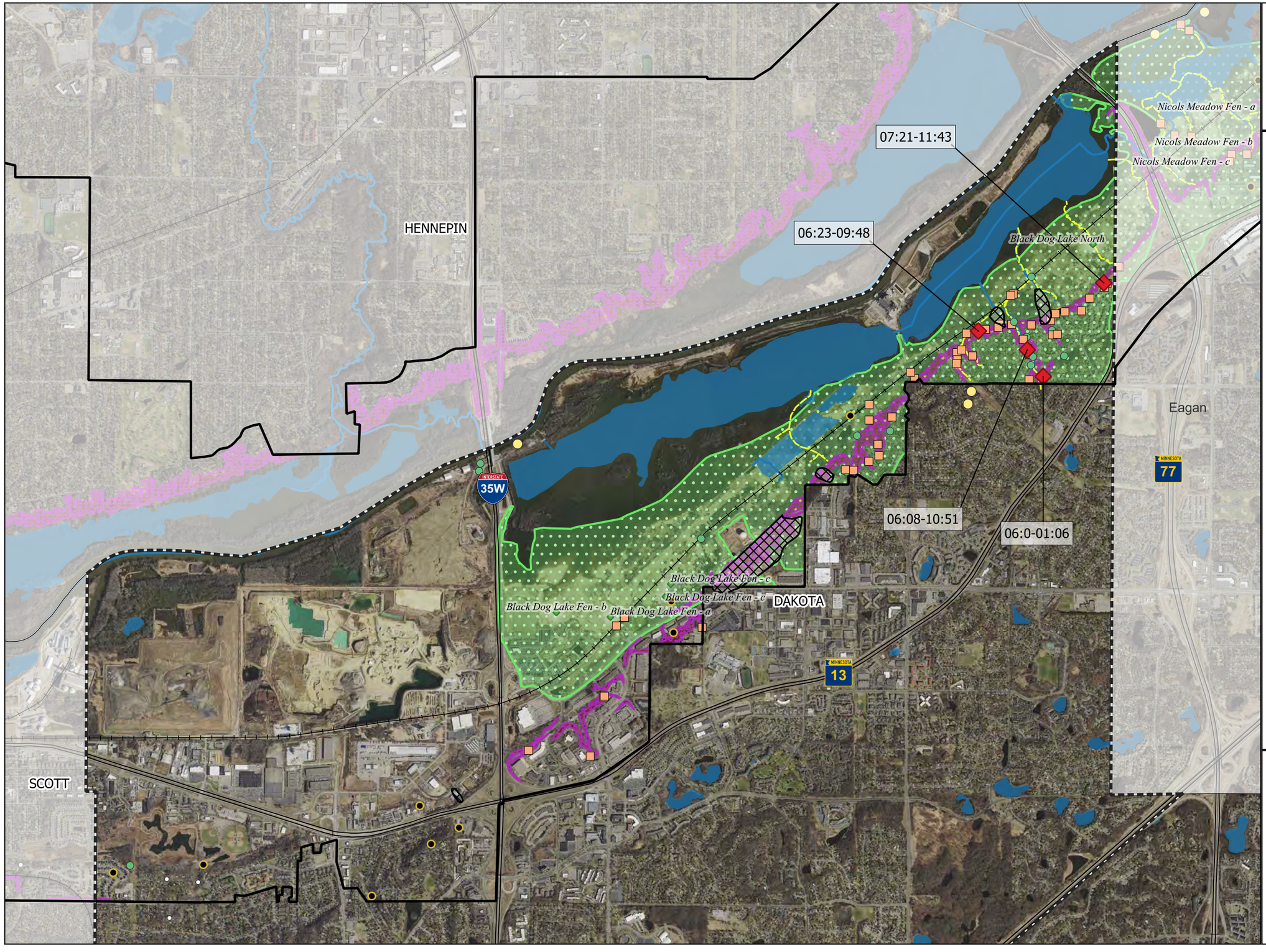
Name and Location	Concerns, Management Category, and Recommendations
Burnsville Sites 23 **(Unable to be accessed)** CenterPoint Energy Facility	**Concerns:** Landslide on CenterPoint Energy property **Management Category:** Management required **Recommendations:** Vegetation establishment and private irrigation management 
Burnsville Site 27 (Unable to access) CenterPoint Energy Facility	**Concerns:** Gully on CenterPoint Energy property **Management Category:** Management required **Recommendations:** Vegetation establishment and private irrigation management. 

Name and Location	Concerns, Management Category, and Recommendations
Site 32 (Gully 06:29-01:23) 401 Cliff Road	**Concerns:** Retaining wall stress because of poor drainage and ground subsidence could impact infrastructure. **Management Category:** Management required **Recommendations:** Encourage landowner to install drainage behind retaining wall; monitor for additional erosion after 2.8 inches or more of rainfall within 24 hours. 

4.2 Field Survey Discussion

There were 84 potential gully locations identified through the desktop analysis in Burnsville (Figure 2). Of the identified gullies, the team collected data from 70 locations in Burnsville in addition to five locations that could not be accessed, specifically the CenterPoint Energy property near Black Dog Park. Following the Union Pacific Railroad (UPR) tracks was a strategy that proved successful in finding gullies in Burnsville, given that eight of the sites identified were located near the UPR.

Figure 2: Burnsville Gullies



Legend

2021 Gully Scores

- Very Low Risk
- Low Risk
- Moderate Risk
- High Risk
- Very High Risk
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Burnsville
- County Boundaries
- LMRWD Boundary

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4.3 Burnsville Findings

Using the field team evaluation criteria (discussed in Section 2), 12 sites had low erosion potential, 40 had moderate erosion potential, and the remaining 18 had high erosion potential. When the impact and risk analysis scoring methods (Appendix B) were applied to the Burnsville gullies, four gully locations were identified as very high-risk (VHR) whereas 44 were identified as high-risk, with the rest in medium-, low-, and very low-risk categories.

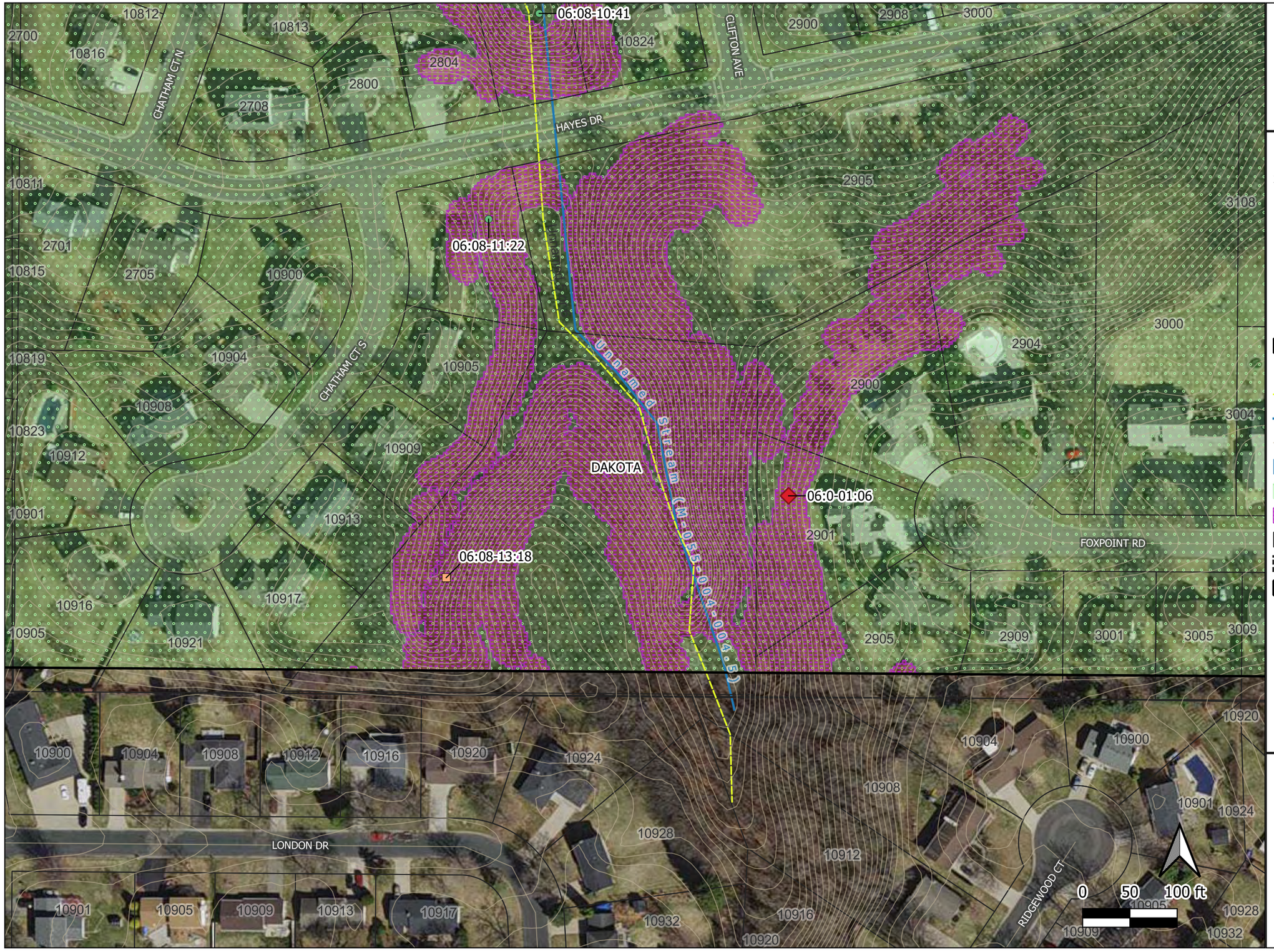
4.4 Burnsville High Priority Gullies

The VHR gullies and the cluster of high-risk gullies within the Black Dog Fen HVRA make up the majority of the high-priority sites within Burnsville and are discussed individually below. Below are specifics about the four VHR and Black Dog Fen gullies.

4.4.1 Gully 06:08-01:06

This site is in the southeast region of Cedarbridge Park in Burnsville at the end of Foxpoint Road and upstream of Hayes Drive (Figure 3). There was moderate vegetation on the banks, mainly soil on the bottom with some boulders and larger rocks placed throughout. The pipe was surrounded by concrete and riprap and an energy dissipater at the outlet (Figure 4). This site is near Site 10 in the GA report and was ranked as Further Study without any additional details (WSB & Associates 2018). Given the severe amount of degradation and slumping of the banks observed in the field as well as a general lack of vegetation throughout the gully, in 2021 it ranked as having high erosion potential with a score of 38. Because the gully is a tributary to trout stream Unnamed 4, in addition to being located within the LMRWD HVRA and SSOD, the erosion in this area is classified as Tier I–critical impact. Because of its location, the potential impact of uncontrolled erosion and continued gully development could degrade Unnamed 4 and further destabilize the existing steep slopes; therefore, this site ranked as a VHR gully, warranting potential mitigation efforts to protect the remaining trout stream habitat.

Figure 3: Gully 06:08-01:06



Legend

2021 Gully Scores

- Very Low Risk
- Low Risk
- Moderate Risk
- High Risk
- Very High Risk
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Parcels_Dakota
- Burnsville
- LMRWD Boundary

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Figure 4: Photos of Gully 06:08-01:06 A) Upstream view of gully, B) Upstream view of pipe, C) Downstream view of gully

4.4.2 Gully 06:08-10:51

This VHR gully was located downstream of Gully 06:08-01:06 and was bordered by three high-risk gullies with moderate erosion potential (Gully 06:08-10:45 and Gullies 06:08-10:57 and 06:08-11:10), shown on Figure 5. This is the area in which Sites 7 and 8 from the GA report are also located. A large stormwater outfall pipe protrudes under the headcut of this gully and has severely destabilized the gully bottom, despite being armored (Figure 6). The gully bottom material consisted mainly of silt but with some large rocks interspersed downstream. Active erosion was visible on the banks along with significant slumping. Approximately 50 feet downstream was another pipe, but it showed no signs of erosion. This site received an erosion probability score of 38; similar to Gully 06:08-01:06, it is a direct tributary to Unnamed 4, a Tier I impact category. The site received the highest risk factor of Very High.

4.4.3 Gully 06:23-09:48

This gully is located north of Hayes Drive and south of the Union Pacific Railroad in Burnsville (Figure 7). Similar to the other VHR sites in Burnsville, it is located within the Unnamed 4 watershed and is actively eroding (Figure 8). The gully development appears to be tied to the large storm sewer outfall, and although the outfall is somewhat protected either naturally or from previous riprap, there is little vegetation on the banks; there is evidence of bank slumping and exposed tree roots further downstream. This site was not identified in the GA report but scored 38, placing it in the high erosion potential category. Combined with the Tier I impact zone, this gully was placed in the VHR category, warranting potential mitigation to arrest the erosion. Several other high-risk sites surround this one and should be considered for restoration as well. In particular, Gully 06:23-09:32 (Figure 9) is a nearby storm sewer outfall that has created a significant gully and channel, which enters the Unnamed 4 tributary.

Figure 5: Gully 06:08-10:51

Legend

2021 Gully Scores

- Very Low Risk
- Low Risk
- Moderate Risk
- High Risk
- Very High Risk
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Parcels_Dakota
- Burnsville
- LMRWD Boundary

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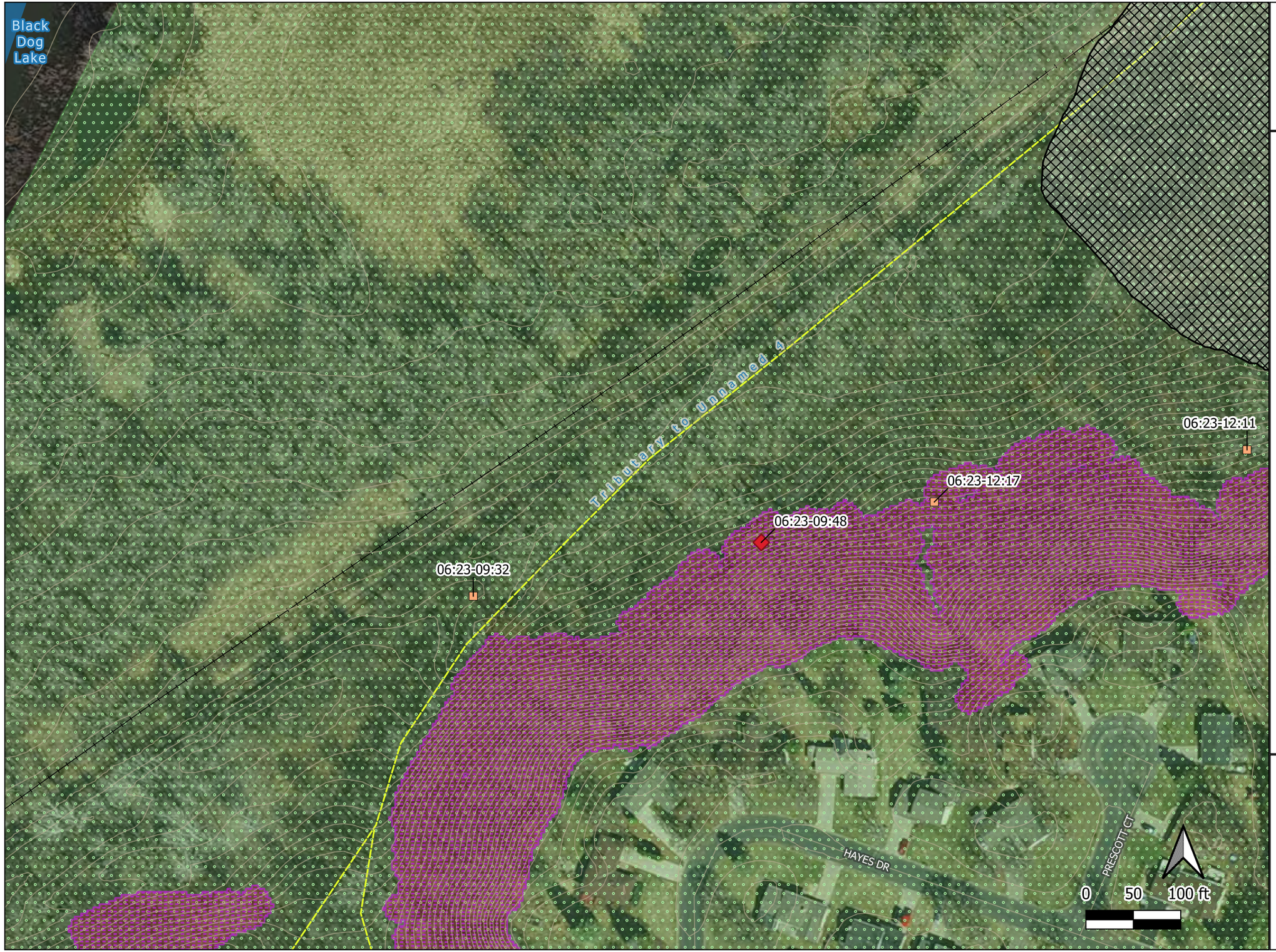
Figure 6: Photos of Gully 06:08-10:51 A) Downstream view of gully, B) View of other side of pipe

Figure 7: Gully 06:23-09:48



Legend

2021 Gully Scores

- Very Low Risk
- Low Risk
- Moderate Risk
- High Risk
- Very High Risk
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Parcels_Dakota
- Burnsville
- LMRWD Boundary

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Figure 8: Photos of Gully 06:23-09:48 A). Looking upstream at pipe outfall, B) Looking downstream at right bank, C) Looking downstream at gully channel

Figure 9: Photos of Gully 06:23-09:32 A) Upstream view of left bank, B) Upstream view of right bank, C) Upstream view of pipe outfall, D) Downstream view of where gully reconnects

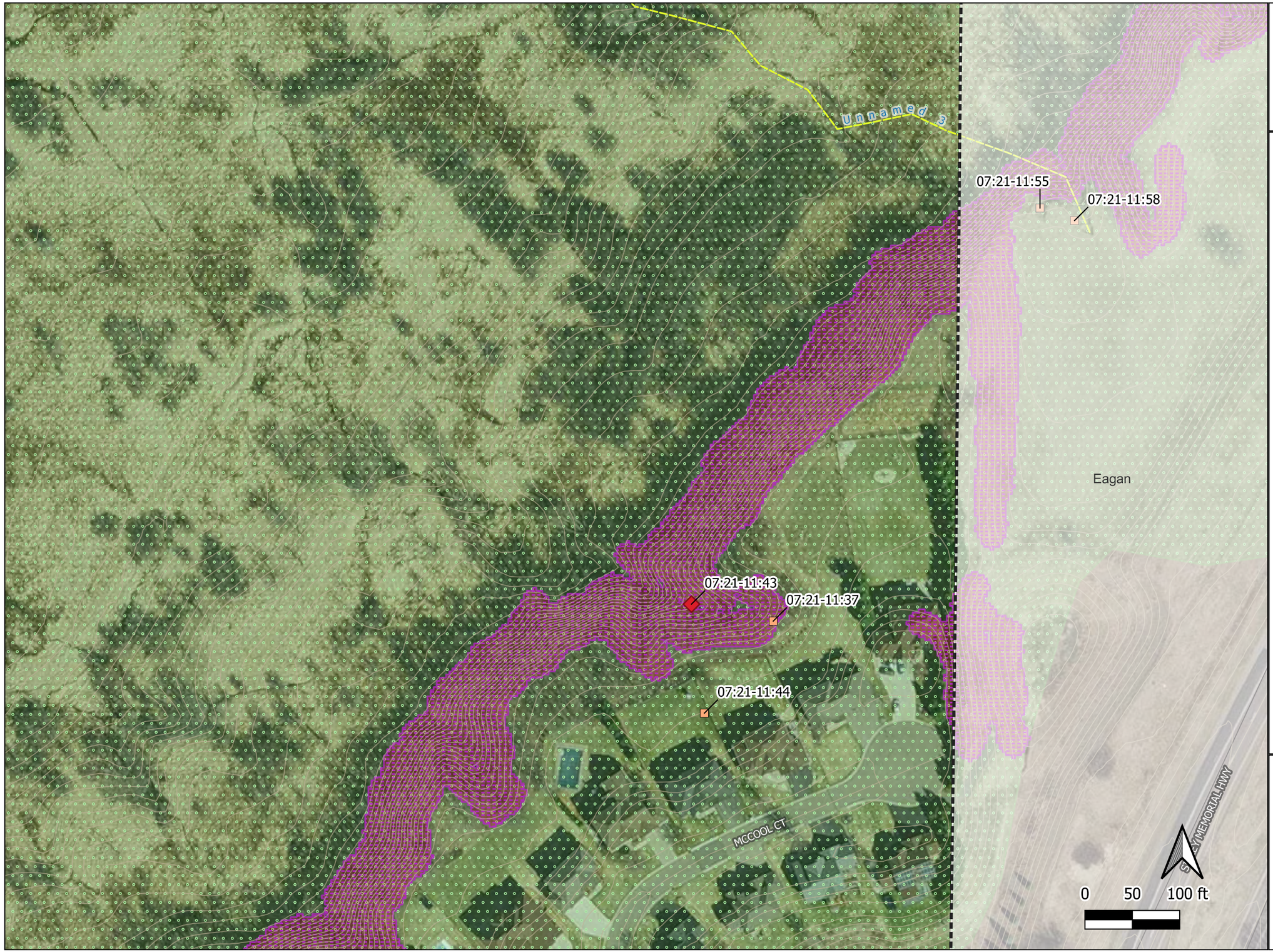
4.4.4 Burnsville Black Dog Fen HPR

The following subsections detail the high-priority region (HPR) around the Black Dog Lake Fen HVRA. Although there are numerous high-risk gullies in Burnsville that should be monitored, some of the most severe appear to be naturally grouped by the trout stream subwatersheds of Black Dog Fen and Unnamed 4.

4.4.4.1 Black Dog Fen—Gully 07:21-11:43

The Black Dog Creek–Gully 07:21-11:43 site is located north of McCool Court in the vicinity of Sites 3 and 4 discussed in the GA Report (Figure 10). It was a medium-length, deep gully with a narrow bottom that gave it a general V-shape. The bottom of the gully was completely lacking in vegetation. The banks were very steep, even undercut in some areas, and had a moderate amount of vegetation along them (Figure 11). There was severe degradation throughout the gully, including many fallen trees and heavy slumping. There were also instances of hanging roots along the gully. This gully scored 39 points and was placed in the high erosion potential category. This gully is located within the LMRWD high value resource area (HVRA) and SSOD, placing it in the Tier 1–Critical Impact category, particularly because it is immediately upstream of the Black Dog Lake North Fen complex. The combination of the Tier 1 impact and high erosion potential score places this gully in the VHR category, particularly because of the two adjacent gullies (07:21-11:37 and 07:21-11:44), both of which have moderate erosion potential and are also in the Tier 1 impact class (Figures 12 and 13).

Figure 10: Black Dog Fen Gullies



Legend

2021 Gully Scores
- Very Low Risk
- Low Risk
- Moderate Risk
- High Risk
- Very High Risk
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Parcels_Dakota
- Burnsville
- LMRWD Boundary

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Figure 11: Photos of Gully 07:21-11:43 A) Downstream view of left bank, B) Downstream view of gully middle, C) Downstream view of right bank

Figure 12: Photos of Gully 07:21-11:37 A) Downstream view of left bank, B) Downstream view of right bank, C) Upstream view of left bank, D) Downstream view of meeting with Site 07:21–11:44

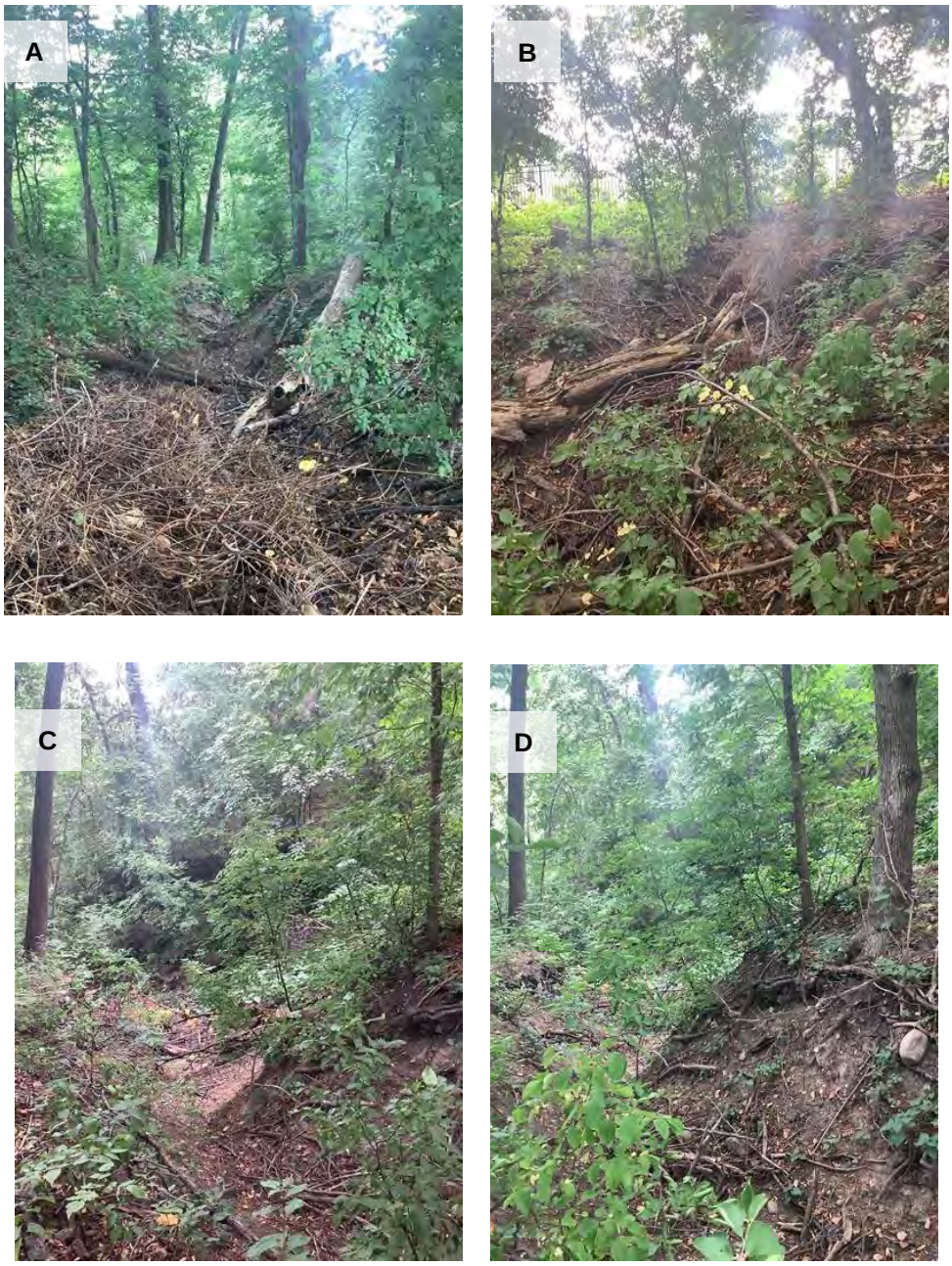


Figure 13: Photos of Gully 07:21–11:44 A) Downstream view from top of gully, B) Upstream view of headcut, C) Downstream view of confluence with Gully 07:21–11:43, D) Downstream view of right bank

4.4.4.2 Unnamed 4

High-risk gullies in this subwatershed contribute sediment and convey stormwater runoff directly to the state-designated trout stream, Unnamed 4 (Figure 14). Unnamed 4 watershed has been subject to intense development since the late 1800s with the construction of the railroad; however, with more recent commercial and residential development in the watershed, the Minnesota Department of Natural Resources (MnDNR) noted that runoff from the landscape was causing scour of the streambed (Stewart 2000). Stormwater intrusions from the development at the top of the bluff have long been suspected of contributing to poor water quality from gully erosion. The following provide examples of the gully development typical in this watershed.

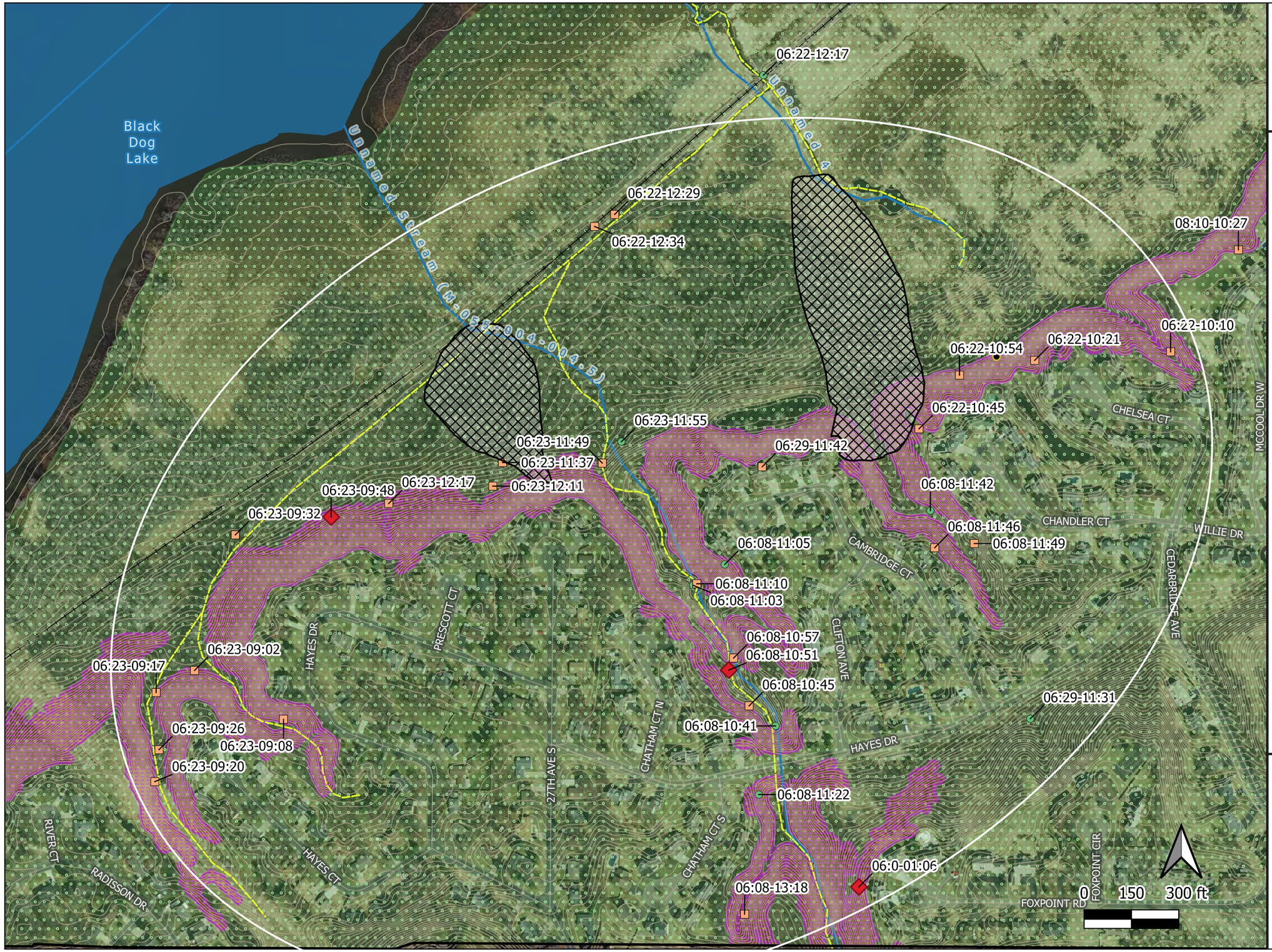
4.4.4.2.1 Gully 06:08-10:45

This site was located north of Cedarbridge Park, between Chatham Court North and Clifton Avenue in Burnsville. It was a large gully with boulders at the bottom, and it had no vegetation on either bank (Figure 15). The banks were very steep, and the gully took a general V-shape. There were significant numbers of slumping and fallen trees throughout and a constant flow of water at the bottom of the gully. This site scored a 34 for erosion potential, placing it in the moderate erosion category; however, when combined with the Tier 1 impact zone, this gully is classified as a high-risk site.

4.4.4.2.2 Gully 06:08-13:18

This site was located at the west end of Cedarbridge Park in Burnsville. This was a very large gully with a constant flow of water at the bottom. The bottom of the gully had no vegetation although each bank had a moderate amount (Figure 16). The bank angles were about 45˚, and the gully took a general V-shape. There was severe degradation on the banks of the gully along with moderate slumping of the banks. Additionally, there were many pistol-butted trees, indicating a slowly progressing slope failure. This site scored a 37 for erosion potential, placing it in the moderate erosion category; however, when combined with the Tier 1 impact zone, this gully is classified as a high-risk site.

Figure 14: Unnamed 4 Gullies



Legend

2021 Gully Scores
- Very Low Risk
- Low Risk
- Moderate Risk
- High Risk
- Very High Risk
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Parcels_Dakota
- Burnsville
- LMRWD Boundary

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Figure 15: Photos of Gully 06:08-10:45 A) Downstream view of left bank, B) Upstream view of gully, C) Downstream view of right bank

Figure 16: Photos of Gully 06:08-13:18 A) Upstream view of gully, B) Downstream view of gully

4.4.4.2.3 Gully 06:23-11:37

This gully was located north of 27th Avenue South at the bottom of a very steep slope. This site was long but shallow, with some riprap armoring (Figure 17). The gully began from a small pipe that was heavily armored and stable. Approximately 50 feet downstream, the gully slope steepened, and the degradation became severe, with very little vegetation on the banks and gully bottom. The gully banks are steep, forming a V-shape. There were trees leaning over the channel, and the banks were slumping. This site scored a 34 for erosion potential, placing it in the moderate erosion category; however, when combined with the Tier 1 impact zone, this gully was classified as a high-risk site. This gully discharged into an area that was inaccessible because of a homeless encampment. This site should be revisited to confirm the severity of the overall gully erosion.

Figure 17: Photos of Gully 06:23-11:37 A) Downstream view of gully, B) Upstream view of gully, C) Upstream view of pipe, D) Downstream view past pipe outfall

4.5 Recommendations

The GA report identified gullies with significant erosion concerns that could not be accessed as part of this project because they were on private property. The findings from the 2021 Project corroborate the GA report findings.

These sites and the gully locations presented in this section represent the highest priority sites for the LMRWD within Burnsville. The four VHR gullies should be further evaluated with the city of Burnsville for future restoration and partnership opportunities. In addition, the high-risk gullies within the Unnamed 4 watershed should also be monitored to ensure the remaining trout habitat in Unnamed 4 is preserved.

It is recommended that the LMRWD pay special attention to the inaccessible locations, as there may be gullies contributing sediment to the LMRWD trout streams and calcareous fens, particularly on private property, such as CenterPoint Energy's facilities, where the City may not have authority to take action. Future efforts should include coordination with the City of Burnsville and CenterPoint Energy to access the gullies, assess the conditions, and develop a prioritization and schedule for the District for future partnership and collaboration.

5.0 EAGAN

The city of Eagan (Eagan) is located south of the Minnesota River in Dakota County. The area north of Highway 13 marks the boundary of the LMRWD. Eagan also contains the southern portion of Fort Snelling State Park.

5.1 City-Provided Information

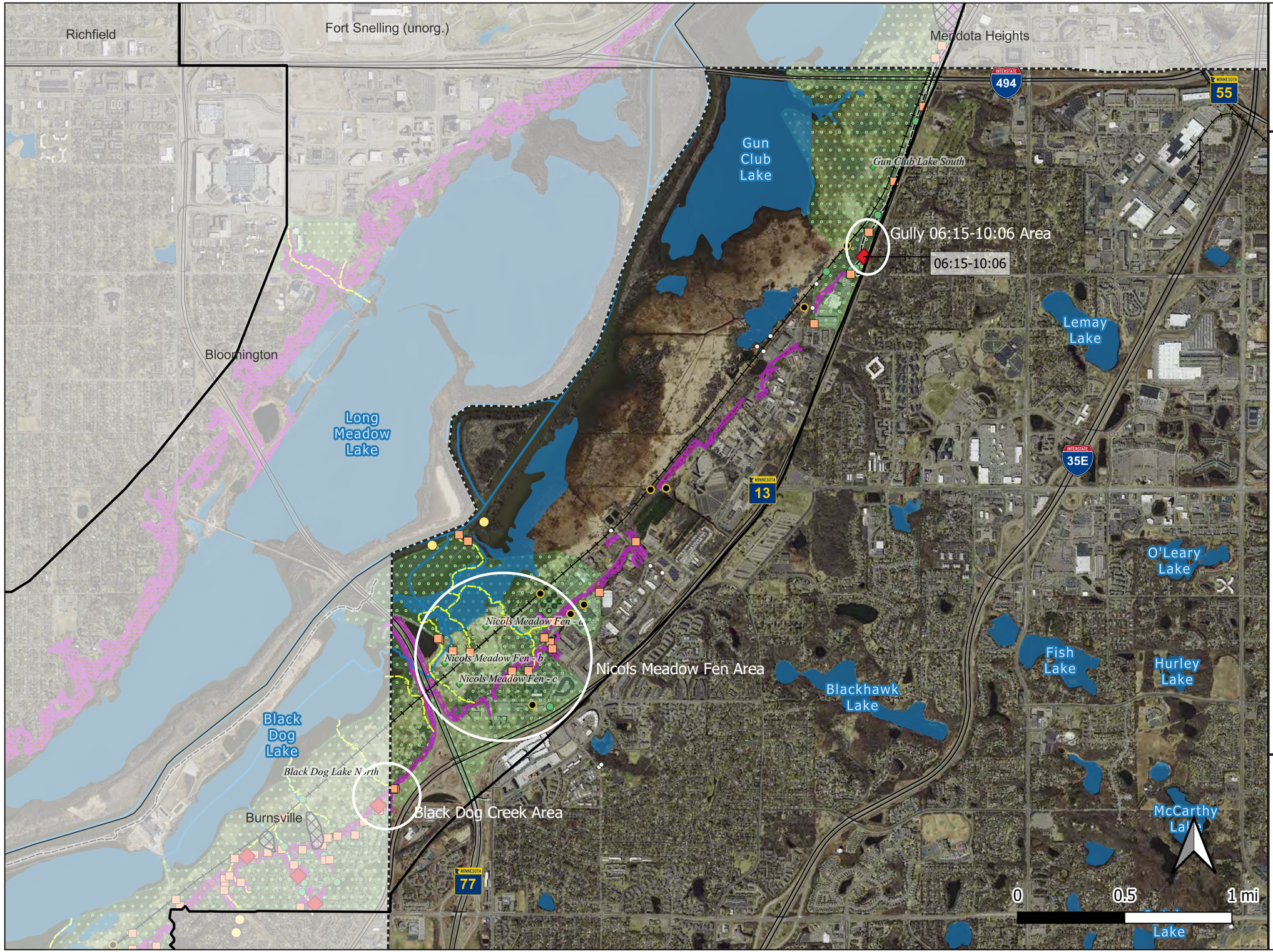
The LMRWD staff contacted Eagan in October 2020 and hosted a municipal coordination meeting with their staff on June 1, 2021, to discuss the 2021 Gully Project. Eagan did not identify any specific projects within the LMRWD boundary; however, staff mentioned that the River Valley Acres project was upcoming and would provide some mitigation of existing ravines along its border with Apple Valley, but this work is outside of the LMRWD. No other areas of concern were mentioned.

5.2 Field Survey Discussion

There were 52 potential gully locations identified through the desktop analysis in Eagan (Figure 18). Of the identified gullies, the team confirmed and collected gully data at 44 locations in Eagan within the LMRWD. The field team did not have any issues accessing these sites.

Along with the 44 gullies found in Eagan, there were eight sites visited that had the potential for, but did not contain, a gully. Typically, these areas of steep slopes were between property lines, open grassy areas, and a hill that appeared to be a gully on the topographic maps but needed visual confirmation.

Figure 18: Eagan Gullies



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Paved Trail
- Railroad
- Highways
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Eagan
- County Boundaries
- LMRWD Boundary

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5.3 Eagan Findings

Using the field team evaluation criteria (discussed in Section 2) of the 44 gullies found in Eagan, seven sites had low erosion potential, 24 had moderate erosion potential, and the remaining 13 had high erosion potential. When the impact and risk analysis scoring methods (Appendix B) were applied to the Eagan gullies, of the 44 gullies, only one ranked as VHR for gully erosion (Figure 18). This gully, 06:15–10:06, is located within the Minnesota River Greenway Trailhead area between the trail and Highway 13. Two other areas of significance are the Nicols Meadow Fen watershed and the Black Dog Creek watershed.

5.4 Eagan High Priority Gullies

The one VHR gully and the cluster of high-risk gullies within the Nicols Meadow Fen HVRA are discussed individually below.

5.4.1 Gully 06:15-10:06

This site was located off the Big Rivers regional trail west of Highway 13 in Mendota Heights (Figure 19). This gully was of medium depth with a narrow bottom and steep bank angles (Figure 20). The bottom of the gully had no vegetation, and the banks had moderate vegetation. There was severe degradation throughout the gully, including fallen trees and some slumping. This gully scored 38 for high erosion potential and is located within a Tier I impact zone. It is located within the LMRWD HVRA for the Gun Club Lake South fen complex. This gully ranks as a VHR gully because of its potential to adversely affect Gun Club Lake South fen and because of its high levels of degradation.

Figure 19: Gully 06:15-10:06

Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Paved Trail
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Dakota Co. Parcels
- LMRWD Boundary

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Figure 20. Photos of Gully 06:15-10:06 A) Upstream view of the gully, B) Downstream view of the pipe at the end of the gully

5.4.2 Gully 06:15-10:13

This site was located off the Big River Trail, along trail, approximately 600 feet north of Gully 06:15–10:06. This gully runs under the trail from Sibley Memorial Highway through a culvert to the west towards the Union Pacific Railroad and ultimately to the Gun Club Lake South calcareous fen complex and Minnesota River (Figure 21). There was water present in the gully at the time of observation; the water was slow-moving but constant. The gully had a medium depth and width and was long, and moderate vegetation lined the bottom and banks (Figure 22). This gully scored 31 for moderate erosion potential; but because of its location within the Gun Club Lake South fen complex HVRA, it is considered a Tier I impact zone and is classified as a gully with a high risk of erosion.

Figure 21: Gully 06:15-10:13

Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Paved Trail
- Railroad
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Dakota Co. Parcels
- LMRWD Boundary

LOWER MINNESOTA RIVER WATERSHED DISTRICT

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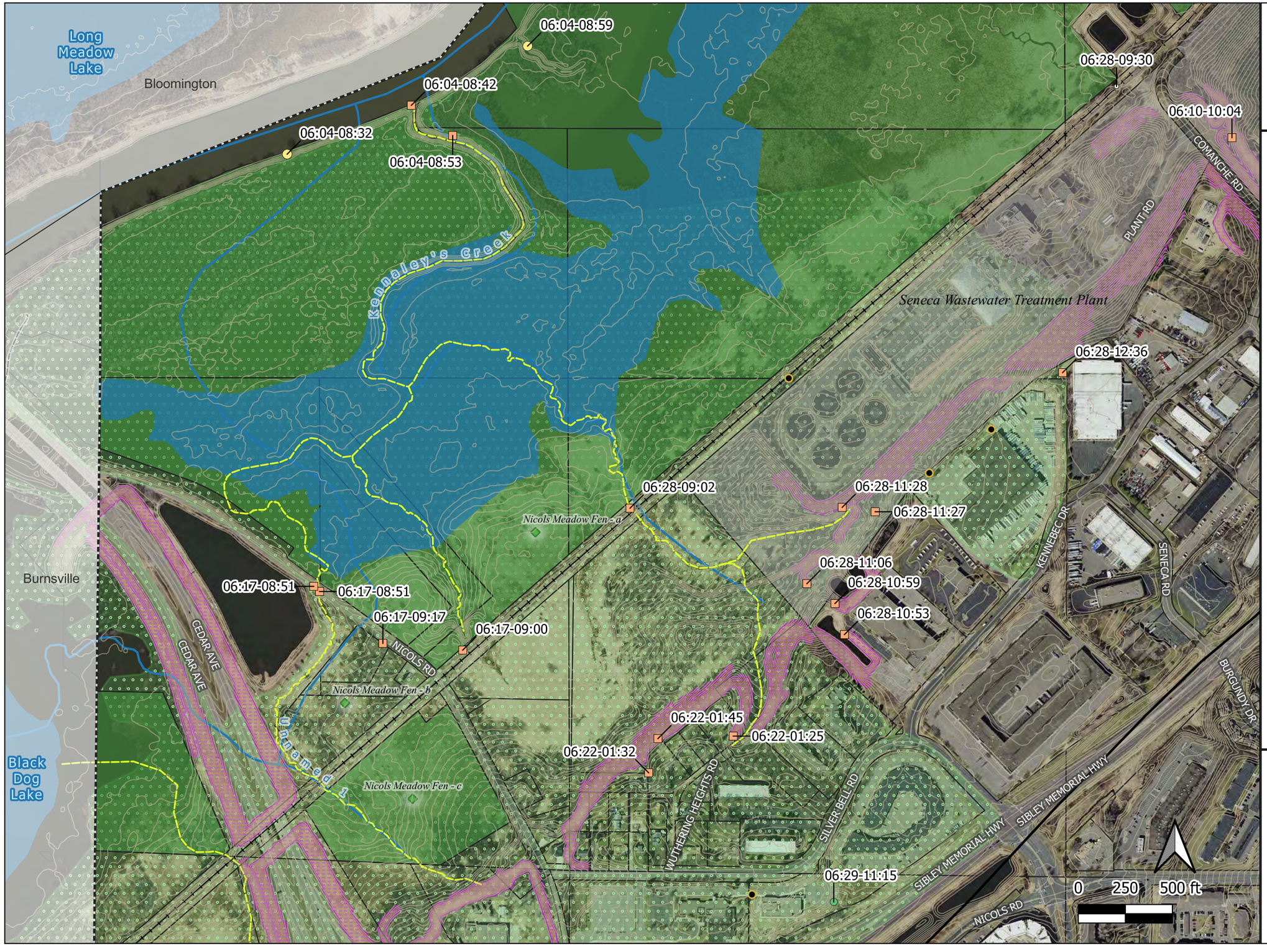
Figure 22. Photos of Gully 06:15-10:13. A) Upstream view of south side of trail. Severe degradation is visible on the left bank upstream. B) Downstream view of north side of trail of gully with stagnant water

5.4.3 Nicols Meadow Fen HPR

Unnamed 1 and Kennaley's Creek are two state-designated trout streams located within Eagan (Figure 23). They are part of the Nicols Meadow Fen complex, located northeast of the Highway 77 (Cedar Avenue) and Highway 13 (Sibley Memorial Highway) intersection. The area surrounding these trout streams has been heavily disturbed by the construction of Highway 77 and upstream development. During construction of Highway 77, spoils material was placed in the upper watershed of Kennaley's Creek; it quickly eroded and has caused severe habitat degradation for the trout fishery (Gilbertson and Ramsell 1994). The following are two examples of gullies (Gully 06:22-01:45 and Gully 06:28-10:59) forming in these historic spoil areas, in addition to examples of typical high-risk gullies within this area.

Figure 23: Nichols Meadow Fen Gullies



Legend

2021 Gully Scores
- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Paved Trail
- Railroad
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Dakota Co. Parcels
- Seneca Wastewater Treatment Plant
- Fort Snelling State Park
- LMRWD Boundary

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5.4.3.1 Gully 06:22-01:45

This site was located north of Wurthington Heights Road behind a resident's yard (Figure 23). There was no water present in the medium-sized V-shaped gully. Some vegetation lined the bottom and banks, which were composed of silt and clay (Figure 24). The resident said that this gully has been getting worse over the years, and he has dumped truckloads of dirt, branches, cut-up tree trunks, cement, and other yard waste into the gully to try and prevent it from further eroding into his property. The degradation was severe, and there were trees leaning over the channel and slumping banks. The gully scored a 35 for moderate erosion potential and when combined with the Tier I impact zone, is considered at high risk for future erosion and should be further reviewed and studied to prevent further degradation to the remaining viable trout habitat in Kennaley's Creek.

Figure 24. Photos of Gully 06:22-01:45. A) Downstream view from top of gully, B) Downstream view of headcut of gully filled with log chopping, C) Downstream view of entire gully, D) Upstream view of yard waste thrown in gully to prevent erosion

5.4.3.2 Gully 06:28-10:59

This site was located west of the Cedar Bluffs Business Center and north of Gully 06:28–10:53 (Figure 23), a moderate erosion potential gully. This gully was located on a constructed slope leading down to a pond. There was almost no vegetation in this gully besides one large and several small trees (Figure 25). Although the gully was short and shallow, the bottom and banks had no vegetation besides a couple of trees and was actively eroding. There was no water in the gully or visible pipes draining into this site. The degradation was severe, exposing half of one tree's root ball; trees were leaning in, and there was slumping of the banks. The gully scored a 35 for moderate erosion potential; and when combined with the Tier I impact zone, the gully is considered to be at high risk of future erosion and should be further reviewed and studied to prevent further degradation to the remaining viable trout habitat in Kennaley's Creek.

Figure 25. Pictures of Gully 06:28–10:59. A) Upstream view of the gully, B) Upstream view of left bank where severe degradation is visible, C) Downstream view of gully. A pond can be seen in the background.

5.4.3.3 Gully 06:04-08:59

This site was located in Fort Snelling State Park, northeast of the confluence of Kennaley's Creek and the Minnesota River (Figure 23). There was very little vegetation on the banks, and severe degradation was visible downstream, closer to its connecting point with the river (Figure 26). It should be noted that the Minnesota River was exceptionally low throughout most of the summer, and this gully may normally be inundated by higher river flows. However, based on the observations at the time, this gully was given a high erosion potential because of degradation and a lack of vegetation. This site is not located within the HVRA and is in the Tier III impact zone, so the resulting risk for this gully was considered to be medium.

Figure 26. Photos of Gully 06:04-08:59. A) View upstream from the bridge crossing the gully. Exposed roots from trees on the right bank are visible along with some broken branches lying in the middle of the gully. B) View of the gully's confluence with the MN River, where there is visible severe degradation on the lower banks right near the stream.

5.4.3.4 Gully 06:10-10:04

This gully is located east of the intersection of Plant Road and Comanche Road (Figure 23). The gully had a medium depth, and the bottom was moderately wide but quite long. The bottom of the gully had no vegetation, but the banks each had heavy vegetation (Figure 27). The gully took a general U-shape, and there were fallen trees throughout. There appeared to be severe degradation and moderate slumping of trees. Evidence of high groundwater or dry weather stormwater flows were observed; the gully bottom was very wet despite the absence of rain during the past week. The gully scored a 31 for moderate erosion potential, and when combined with the Tier I impact zone because of its location within the SSOD, the gully is considered to be at high risk of future erosion and should be further reviewed and studied to prevent additional degradation to the steep slopes or continued release of sediment to the Minnesota River.

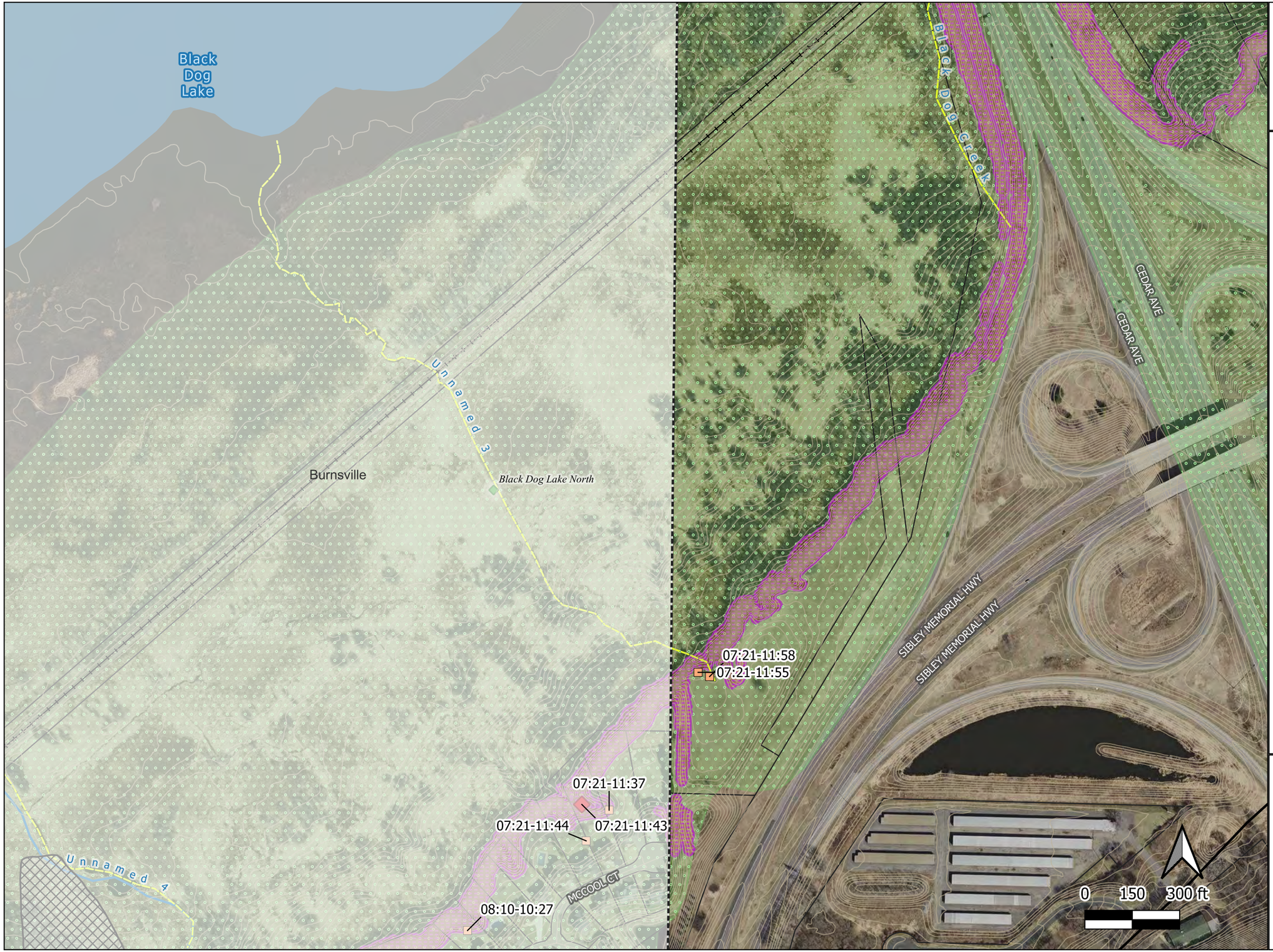
Figure 27. Photos of Gully 06:10-10:04. A) Upstream view of the gully, B) Downstream view of the pipes at the beginning of the gully

5.4.4 Eagan Black Dog Fen HPR

Gully 07:21-11:58 was located approximately 500 feet northwest of Burnsville Gully 07:21–11:43 (Section 4.4.4.1), just a few feet east of Gully 07:21–11:55, a moderate priority with high erosion risk (Figure 28). It was a long, medium-depth gully with a narrow bottom that gave it a general V-shape (Figure 29).

The bottom of the gully and the banks were well vegetated but steep. There was moderate degradation throughout the observed area, including hanging roots and bank slumping. The right bank was much more heavily eroded than the left bank. The gully scored a 33 for moderate erosion potential, and when combined with the Tier I impact zone because of its location within the SSOD and HVRA, the gully is considered to be at high risk of future erosion and should be studied for mitigation opportunities to prevent further degradation to the steep slopes and release of sediment to the Black Dog Lake North fen complex.

Figure 28: Black Dog Fen Gully 07:21-11:58



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Paved Trail
- Railroad
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Dakota Co. Parcels
- LMRWD Boundary

LOWER MINNESOTA RIVER WATERSHED DISTRICT

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Figure 29. Photos of Gully 07:21-11:58. A) Upstream view of gully headcut, B) Downstream view of right bank, C) Upstream view of right bank from further downstream

5.5 Recommendations

Within the City of Eagan, of the 44 gullies identified, only one (Gully 06:15-10:06) is classified as at very high-risk of future erosion. With the construction at the Greenway Trailhead, a significant portion of the bluff area could not be surveyed by the field team; this region should be resurveyed in the future to locate gullies in the inaccessible areas, determine whether any gullies were restored as part of the construction, and determine whether further degradation of the gullies occurred.

Additionally, the gullies within the Kennaley's Creek watershed should be monitored and considered for future study. Given the resident's history with Gully 06:22–01:45 and the known issues with the Highway 77 spoils piles, this area may warrant further review and mitigation to protect Nicols Meadow fen and the remaining viable trout stream habitat.

Finally, the HPR gullies in Eagan should evaluated as part of the District's future gully prioritization efforts so that municipal partnership and collaborations can be planned.

6.0 JACKSON TOWNSHIP

Jackson Township is located south of the river and west of Shakopee in the northwest corner of Scott County, with the northern half of the township located within the LMRWD. The 2020 Project included portions of Jackson Township to reassess the gullies identified in 2008. The 2021 work focused on identifying potential gullies outside of these known locations.

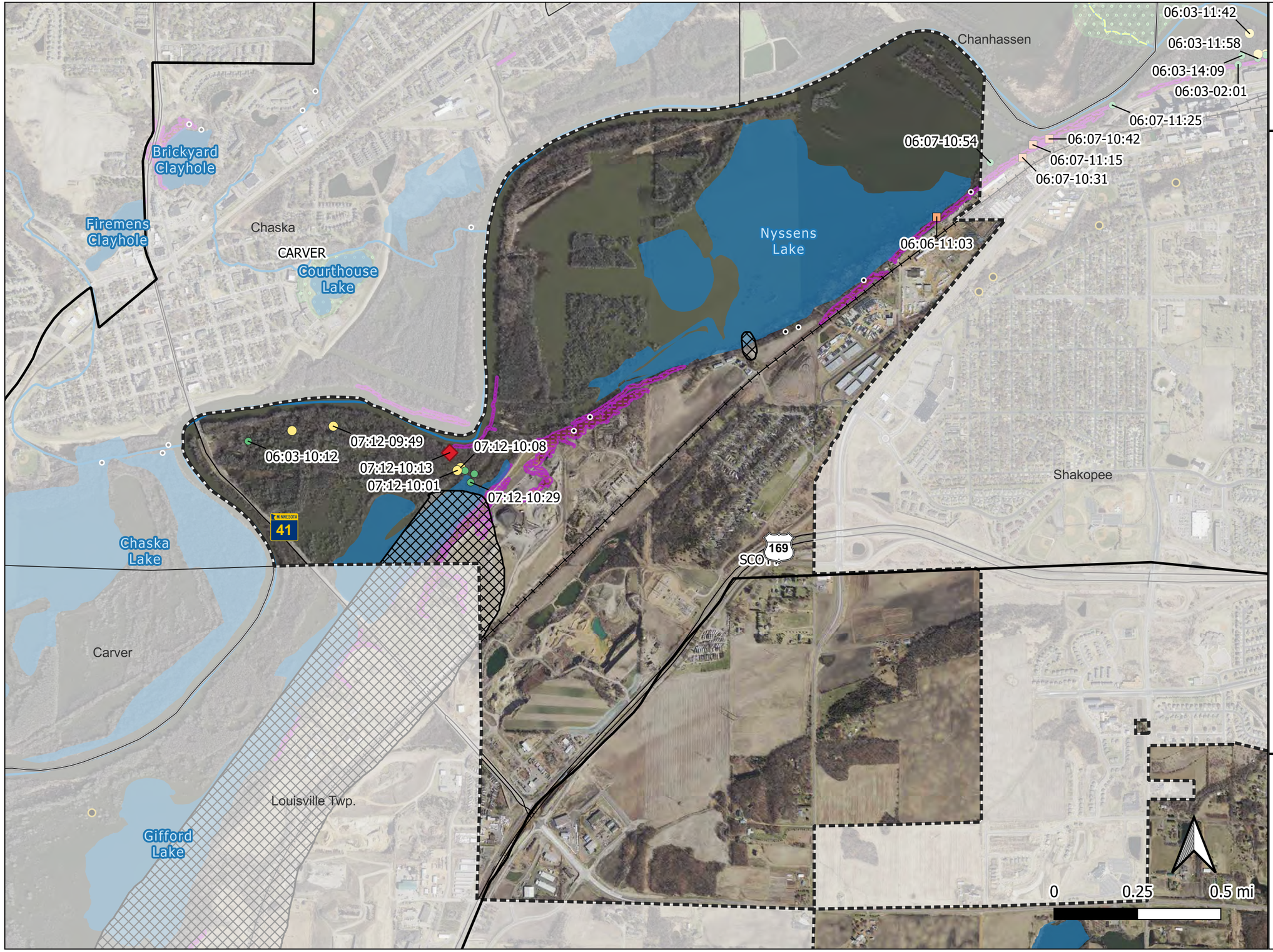
6.1 County-Provided Information

The LMRWD contacted Burnsville in October 2020 to notify them of the upcoming gully investigation work, but Scott County and Jackson Township did not provide any information regarding gully concerns within the LMRWD.

6.2 Field Survey Discussion

Because of its small size and generally flat topography, only 13 potential gully locations were identified through the desktop analysis in Jackson Township. Much of Jackson Township's land within LMRWD is located within a wide portion of the Minnesota River floodplain, which generally is not conducive to gully development. At the identified locations, only 10 gullies were found, and two locations could not be accessed (Figure 30). The former Renaissance Festival grounds were inaccessible, and it is likely that gullies are located in this area. Additionally, a small location near Nyssens Lake was inaccessible because the land was under production, and there was a concern that walking through the field could harm the crops.

Figure 30: Jackson Township Gullies



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2020 Gully Inventory
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Paved Trail
- Railroad
- Highways
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Jackson Township
- County Boundaries
- LMRWD Boundary

LOWER MINNESOTA RIVER WATERSHED DISTRICT

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6.3 Jackson Township Findings

Using the field team evaluation criteria discussed in Section 2, ten gullies were found in Jackson township: two sites had low erosion potential, seven had moderate erosion potential, and one had high erosion potential. When the impact and risk analysis scoring methods (Appendix B) were applied, none scored within the VHR category, and one scored as high risk for gully erosion. This is likely because of the weighting factors added to the impact and risk analysis, given that Jackson Township does not have any portions of HVRA located within its boundary. However, there are areas identified as SSOD, and much of the area directly contributes to the impaired Minnesota River. The single high-risk gully is described in the following section.

6.4 Jackson Township High-Priority Gully

The only high-risk gully in Jackson Township found in 2021 was Gully 07:12–10:13, located downstream of Gully 07:12–10:01 (Figure 31). A moderate erosion potential and medium-risk gully, it drains directly into the Minnesota River. This gully was long and deep with a small stream of stagnant water (Figure 32). The bottom and banks both had some vegetation and were made of silt and clay. The degradation was significant, causing slumping banks and trees leaning over the channel.

It should be noted that the Minnesota River was at historically low elevations for much of the summer of 2021, and it may be that this site is typically inundated by river flows. However, based on the observations made at the time, the gully scored 38, placing it in the high erosion potential category. Combined with the SSOD and Tier I impact zone, the gully is considered to be at very high risk of erosion. Because of its proximity to the Minnesota River, it is recommended that this site be monitored to determine whether action is necessary.

Figure 31: Gully 07:12-10:13

Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Paved Trail
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Scott Co. Parcels
- LMRWD Boundary

LOWER MINNESOTA RIVER WATERSHED DISTRICT

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Figure 32: Photos of Gully 07:12-10:13. A) Upstream view of gully, B) Downstream view of confluence with Minnesota River, C) View of severe degradation on left bank, D) View of leaning trees on right bank

6.5 Recommendations

Jackson Township only contained one gully that was in the very-high risk category. However, it is located near the Minnesota River and may have only been observed this year because of low river levels. Rather than recommend mitigation, future monitoring should occur during higher river levels to determine whether this site is in fact a gully and not a backwater channel to the Minnesota River. Additionally, the inaccessible areas should be surveyed in the future to determine whether gullies are present.

Finally, the 2020 and 2021 gullies in Jackson Township should be evaluated together for inclusion in the District's gully prioritization efforts so that future partnership and collaborations can be planned.

7.0 MENDOTA HEIGHTS

The city of Mendota Heights is in the northeast corner of the LMRWD boundary, south of the Minnesota River in Dakota County. Fort Snelling State Park and part of the Minnesota Valley National Wildlife Refuge lie in this city. The 2020 Project reassessed the gullies found in Mendota Heights in 2008. Numerous additional gullies were noted by the field team but not always collected because of time constraints. The 2021 work focused on identifying potential gullies outside of the 2020 known locations.

7.1 City-Provided Information

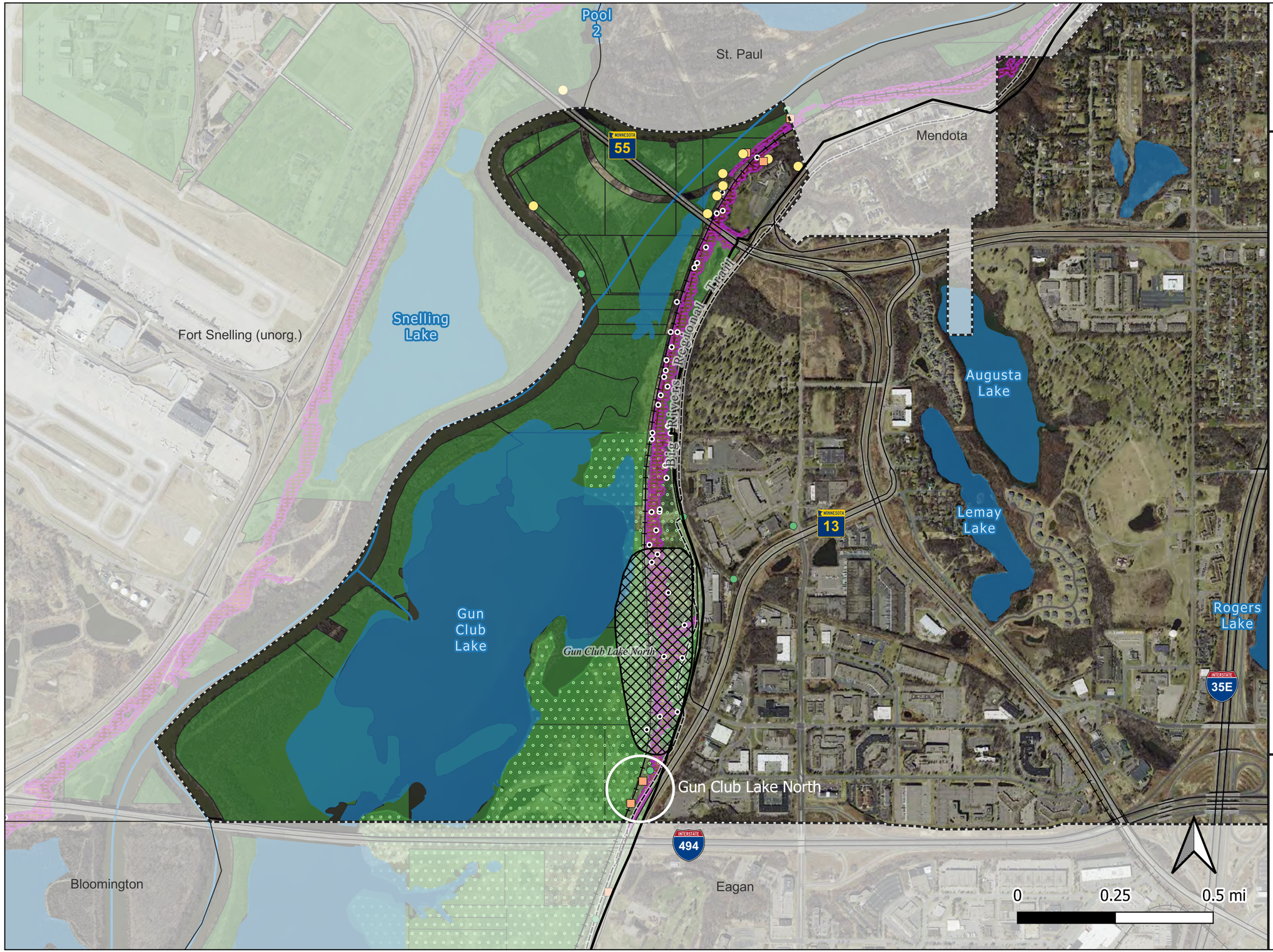
LMRWD staff and the City of Mendota Heights met on May 18, 2021, to discuss the 2020 Project report findings, including 37 gullies and the three HPRs identified. The city had previously provided the locations of 22 culverts under the Union Pacific railroad and two storm sewer and stormwater projects within the LMRWD.

At the May 2021 meeting, the city noted that the gully findings were consistent with their knowledge of erosion issues and that soil erosion along the bluffs and scour at storm sewer outfalls are known issues. City staff noted that all three 2020 HPRs are located within Fort Snelling State Park, limiting the city's ability to restore these sites. The city also noted that MnDOT was planning to return Sibley Memorial Highway (Highway 13) to city ownership but would stabilize an existing ravine before doing so.

7.2 Field Survey Discussion

The 2021 work identified an additional 19 potential sites earmarked for a survey in 2021 (Figure 33). The survey in Mendota Heights focused on the areas not covered by the 2020 survey, but few additional sites were found. Of the identified potential gully locations, the field team collected data on 21 gullies in addition to several areas that could not be accessed (Figure 33). The Big Rivers Regional Trail construction impeded access to the trail and surrounding land from the Big Rivers Regional Trail parking lot to about 0.5 miles north where the trail crosses Sibley Memorial Highway. The project is expected to run through December 2021. It is recommended that this area be assessed once construction is complete to confirm that the gullies identified by desktop analysis exist, especially because of the proximity to Gun Club Lake HVRA.

Figure 33: Mendota Heights Gullies



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Paved Trail
- Railroad
- Highways
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Mendota Heights
- County Boundaries
- Fort Snelling State Park
- LMRWD Boundary

LOWER MINNESOTA RIVER WATERSHED DISTRICT

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7.3 Findings

Using the field team evaluation criteria discussed in Section 2, five sites had low erosion potential, 14 had moderate erosion potential, and two had high erosion potential. When the impact and risk analysis scoring methods (Appendix B) were applied to the Mendota Heights gullies, no gully locations were identified as VHR although six were identified as high-risk, with the rest in medium- and low-risk categories.

7.4 Mendota Heights High-Priority Gullies

Of those locations identified as high-risk, only the sites near Gun Club Lake North warrant further attention at this time because of the potential effects on the calcareous fen (Figure 34).

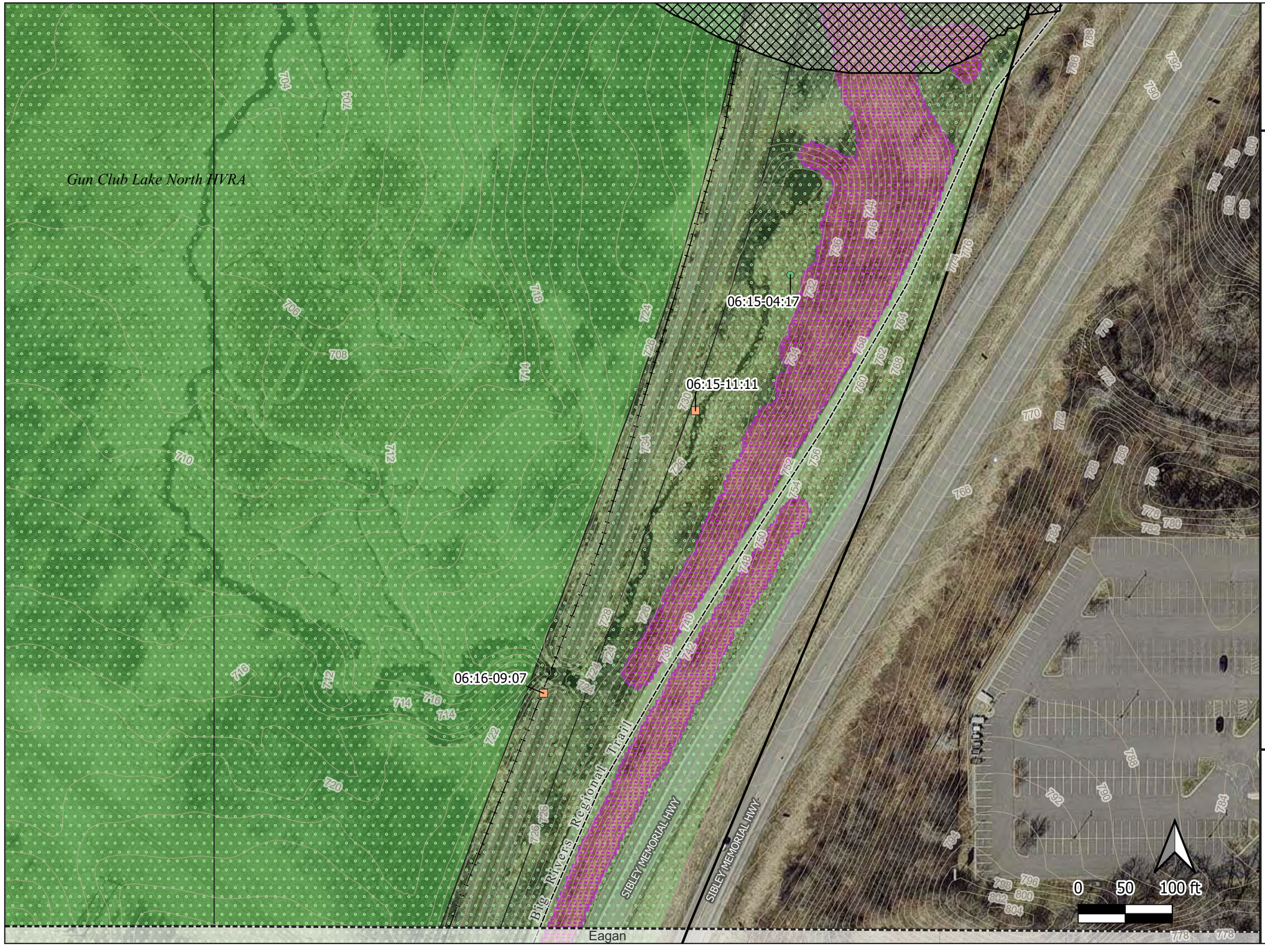
7.4.1 Gun Club Lake North HPR

This area is already under review as part of a stormwater intrusion study for the Gun Club Lake North fen complex. This area has been degraded because of the influx of warmer and more polluted stormwater runoff, which has created a scar on the fen. As part of the 2021 Gully Project, this area was surveyed to establish the current conditions in this gully.

7.4.1.1 Gully 06:16-09:07

Site 06:16–09:07 was a stream located a few hundred feet northwest of where Interstate 494 crosses Sibley Memorial Highway. It was a deep and long gully with a constant flow of fast-moving water going through it (Figure 35). The bottom of the gully had no vegetation, but the banks both had some vegetation. The banks were very steep and undercut at some places, and there were chunks of fallen dirt in the stream from the banks. The gully started from a stream that runs under the Union Pacific railroad tracks. After the site visit, the gully received a score of 32, indicating it had moderate erosion potential; but combined with the Tier I impact zone, this gully is classified as a high-risk gully because of the current conditions and the potential impact uncontrolled erosion would have on the Gun Club Lake North fen.

Figure 34: Gun Club Lake North Gullies



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- 2021 No Access
- 2020 Gully Inventory
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Public Waters
- Paved Trail
- Railroad
- Dakota 2ft contours
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Dakota Co. Parcels
- Fort Snelling State Park
- Mendota Heights
- LMRWD Boundary

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Figure 35: Photos of Gully 06:16-09:07. A) Downstream view of the left bank, B) Upstream view of the right bank showing severe slumping, C) Downstream view of the right bank from a higher perspective

7.5 Recommendations

The Gun Club Lake North gullies show evidence of extreme slumping, and the information has been incorporated into the stormwater intrusion study. It is recommended that the Big Rivers Regional Trail area be assessed once construction is complete to confirm whether the gullies identified by desktop analysis exist and to confirm the impact construction may have had on the existing Gun Club Lake North gullies and the gullies that were surveyed in 2020. It is possible that some of these sites may have been fixed during Big River Regional Trail construction; but because of the trail's proximity to Gun Club Lake and waters that connect the Minnesota River, it is crucial that this area be surveyed.

8.0 SAVAGE

The city of Savage is located south of the Minnesota River in Scott County. McColl Drive generally marks the boundary of the city within the LMRWD, the area north of the street in the district. The northwest corner of Savage consists of the National Wildlife Refuge.

8.1 City-Provided Information

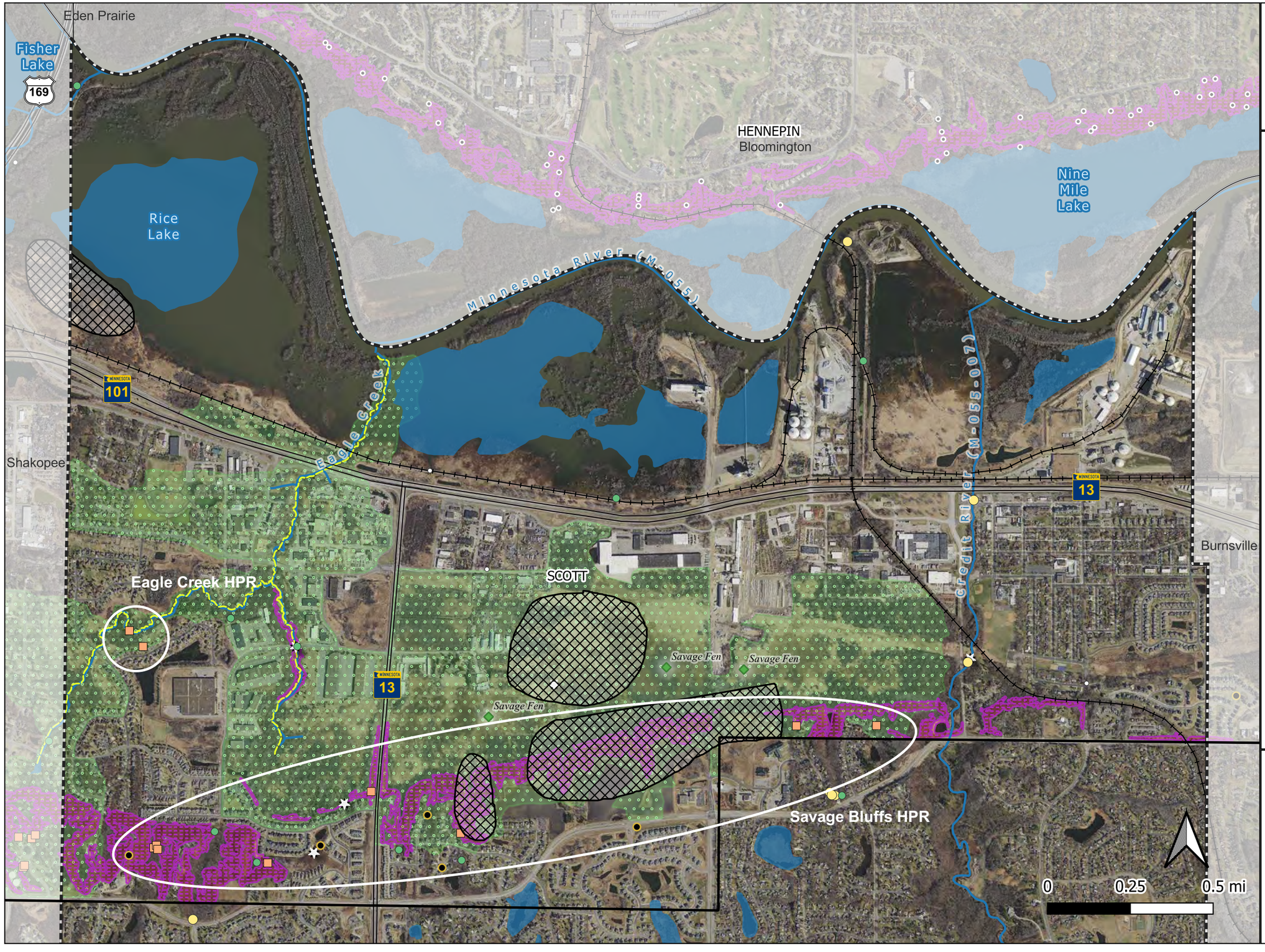
The city of Savage was contacted in October 2020 with notification of the upcoming gully investigation work; there was a meeting with LMRWD staff on April 21, 2021, to discuss the 2021 Gully Project. The city completed two gully repair projects in 2016 but was unaware of any other projects. The city recommended reviewing backyard drainage over the river bluffs as potential gully locations in addition to reviewing the Trout Run Preserve area and the area near 132nd and Virginia Streets.

8.2 Field Survey Discussion

There were 40 potential sites identified though the desktop analysis in Savage (Figure 36). Many of these sites were located in the southern part of the LMRWD, just north of McColl Drive, where there are many bluffs and steep slopes. More sites were found along Eagle Creek and along the river.

Of the identified potential gully locations, the field team collected data on 31 gullies in addition to four areas that could not be accessed. The inaccessible locations were either fenced off, guarded by a dog, or inaccessible because of heavy vegetation. There was one large area between Highway 13 and McColl Drive that was almost entirely blocked off by fences or heavy vegetation. Based on the desktop analysis, there were at least five potential sites in this area, so discussions with the owners of the land will be valuable for surveys of this area in the future. Additionally, the field team went to five potential gully sites that were accessible, but no gullies were found.

Figure 36: Savage Gullies



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- City Erosion Concerns
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Railroad
- Highways
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Savage
- County Boundaries
- LMRWD Boundary

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8.3 Findings

Using the field team evaluation criteria discussed in Section 2, of the 31 gullies found in Savage, seven sites had low erosion potential, 20 had moderate erosion potential, and four had high erosion potential. When the impact and risk analysis scoring methods (Appendix B) were applied to the Savage gullies, no gully locations were identified as VHR although ten were identified as high-risk, with the rest in medium, low, and very low risk categories.

One high erosion potential site, Gully 07:19–11:55, is located at the mouth of the Fisher Lake Outlet and the Minnesota River. Similar to other locations near or within the Minnesota River floodplain, the severity of this location may be overrepresented because of the historic low water levels of the Minnesota River in 2021. This site should be evaluated again during a year with normal rainfall to determine whether it is typically underwater.

8.4 Savage High-Priority Gullies

Within the city of Savage, there were two clusters of high priority sites, the Eagle Creek HPR and the Savage Bluffs HPR (Figure 36). Both are discussed in the following sections.

8.4.1 Eagle Creek HPR

This HPR comprises two gullies directly contributing to Eagle Creek, Gully 06:09–10:55 and Gully 06:09–11:00, both shown in Figure 37 and discussed below.

8.4.1.1 Gully 06:09–10:55

Gully 06:09–10:55 is located northeast of Independence Avenue and south of Eagle Creek. When examined, it had no water and was shallow and narrow with a V-shape. This short gully had moderate vegetation, degradation, and slumping (Figure 38). Some of the small trees growing on the banks appeared to be pistol-butted, indicating a slow-moving slope failure. This gully scored 30, indicating moderate erosion potential, but is located within the state-designated Eagle Creek trout stream. Combined with the Tier I impact zone, this gully is classified as a high-risk gully.

Figure 37: Eagle Creek HPR

Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- City Erosion Concerns
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Trout Streams
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Savage
- Scott Co. Parcels
- LMRWD Boundary

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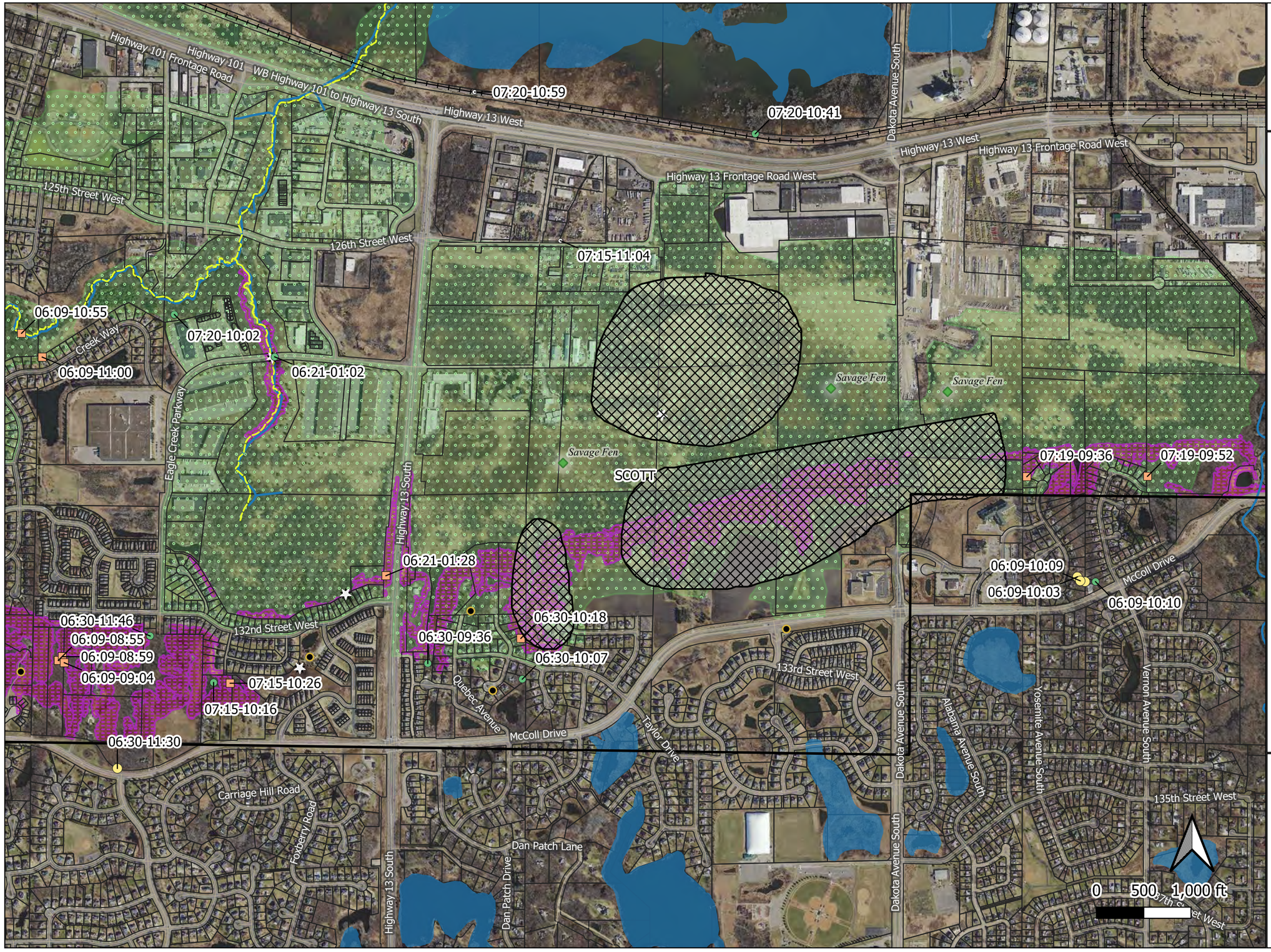
Figure 38: Photos of Gully 06:09-10:55. A) Downstream view of gully, vegetation makes picture difficult to make out. B) Downstream view of gully from right bank

8.4.2 Savage Bluffs HPR

The Savage Bluff area includes the southern border of the LMRWD within Savage and the bluffs that drop down into the Savage Fen Natural Science Area (Figure 39). Many high-risk gullies were identified in this area; however, none were classified as VHR. An example of one of these high-risk gullies appears below and in Figure 40.

Figure 39: Savage Bluffs HPR



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- City Erosion Concerns
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Trout Streams
- Public Waters
- Public Waterbodies
- LMRWD Calcareous Fens
- High Value Resource Area
- Steep Slopes Overlay District
- Railroad
- Savage
- Scott Co. Parcels
- LMRWD Boundary

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8.4.2.1 Gully 07:19–09:52

Gully 07:19–09:52 is located in the Savage Fen HVRA and at the end of Vernon Avenue South. The silt channel had some seeps at the bottom of its long, shallow, and medium-width gully. The gully began very narrow and shallow; and then approximately 30 feet down from the headcut, it sloped down and got deeper, wider, and more severe. The bottom had heavy vegetation although the banks had only some vegetation with an acute V-shape. The degradation was severe, and aggradation was moderate. Some trees were leaning over the channel, and there were many dead, fallen branches along with some slumping on the banks. The gully received a score of 32, placing it in the moderate erosion potential category. Combined with the Tier I impact zone, it is a high-risk gully that should be monitored or considered for future mitigation efforts.

Figure 40: Photos of Gully 07:19-09:52. A) Downstream view of where the gully widens, B) Upstream view of increasing severity, C) Downstream view of gully, D) Upstream view of beginning of gully

8.5 Recommendations

The high-risk sites at Eagle Creek and in the Savage Bluffs HPRs should be considered for regular monitoring to determine the rate at which these gullies are eroding and whether further actions are necessary to protect Eagle Creek and Savage Fen.

Future evaluation of the gullies near the Minnesota River should occur during higher river levels to determine whether these sites are true gullies and not backwater channels to the Minnesota River. Additionally, the inaccessible areas should be surveyed in the future to confirm whether gullies are present.

Finally, the Savage gullies should be included in the District's future gully prioritization efforts so that future partnerships and collaborations can be planned.

9.0 SHAKOPEE

The City of Shakopee is located in the west part of the LMRWD, and the portion inside the district is primarily the area north of Highway 169 with the exception of the Deans Lake area near the border of Savage. In Shakopee, most of the residential area is flat and lacking erosion, but in the bluffs near and along the Minnesota River, a lot of erosion was found.

9.1 City-Provided Information

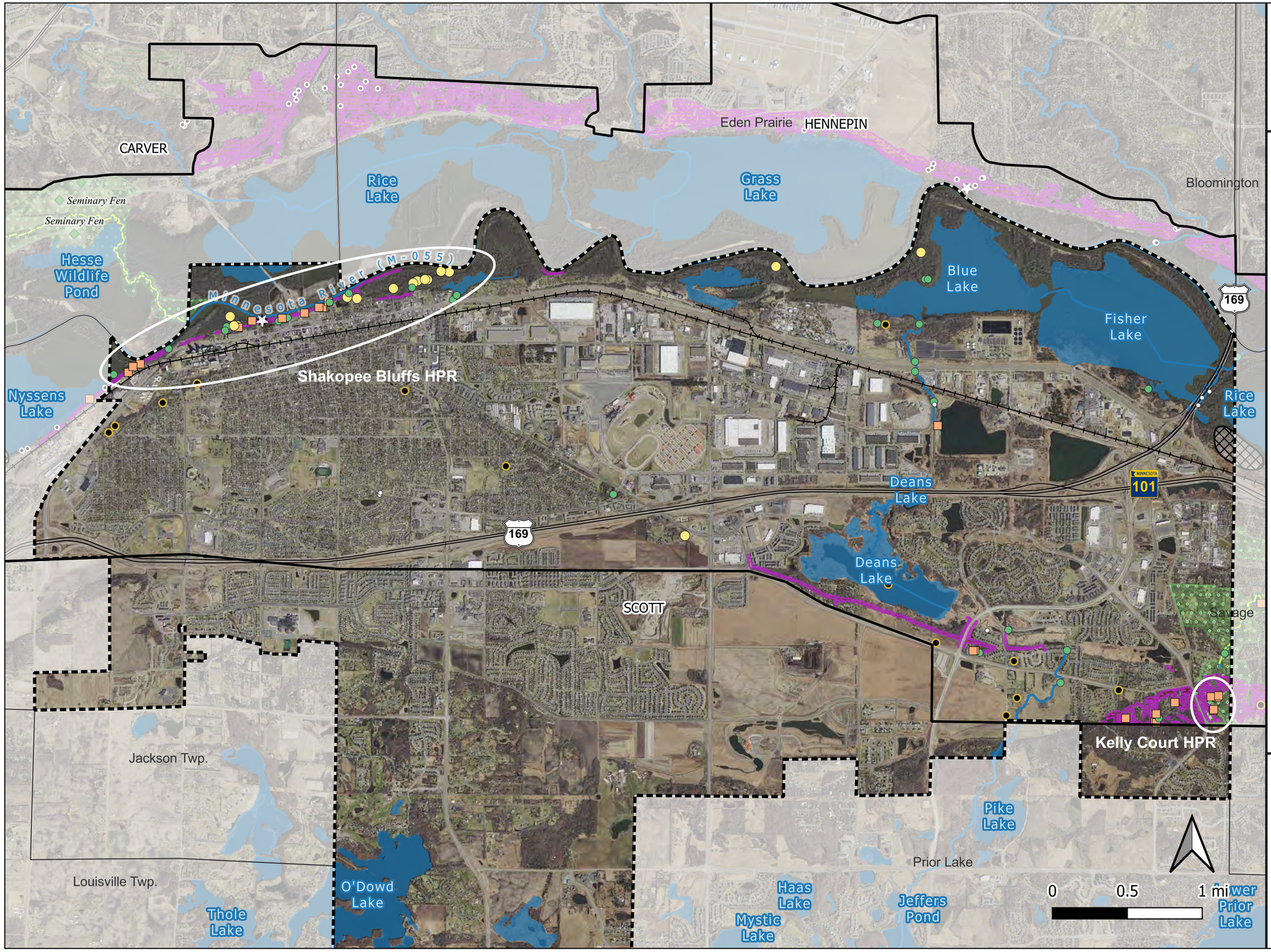
The City of Shakopee was notified in October 2020 of the upcoming gully investigation work; there was a meeting with LMRWD staff on April 20, 2021, to discuss the 2021 Gully Project. The city noted concerns regarding ongoing Minnesota Riverbank erosion in downtown Shakopee and the discharge channel from Rahr Malting Co.

9.2 Field Survey Discussion

Shakopee had the most potential gully sites, with the desktop analysis identifying 89 potential gully locations. Of the identified potential locations, the field team collected data on 75 gullies in addition to one potential gully location that was inaccessible and 13 potential gully sites did not contain a gully (Figure 41). These were primarily grassy areas, divots between properties, or land that was not gully-like at all, indicating potential changes to the landscape since the MnDNR LiDAR data were collected.

One of these locations included Deans Lake and its surrounding area. From the topography it appeared that there could potentially be sites present, but upon closer inspection and visiting the land surrounding the lake, there was no significant erosion to be found. The rest of these potential sites with no gully were located behind private, residential properties in the flatter parts of Shakopee, south of the bluffs and the Minnesota River. Gullies were found primarily near the southern part of the Minnesota River, and the rest were scattered further south within the LMRWD border. Of the 75 gullies surveyed, there was a mix of gullies running into the Minnesota River, gullies formed by pipe outfalls, and gullies in woods behind residential and business land.

Figure 41: Shakopee Gullies



Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found
- City Erosion Concerns
- 2020 Gully Inventory
- 2021 No Access
- LMRWD Calcareous Fens
- LMRWD Trout Streams
- Railroad
- Highways
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Shakopee
- County Boundaries
- LMRWD Boundary

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9.3 Findings

A total of 75 gully sites were found in Shakopee; of these sites, 17 had low erosion potential, 41 were moderate, and 17 locations had high erosion potential based on the field team's assessment outlined in Section 2. When the impact and risk analysis scoring methods (Appendix B) were applied to the Shakopee gullies, no gullies were identified as VHR; and 23 gully locations were identified as high risk, with the rest in medium-, low-, and very low-risk categories (Figure 41).

9.4 Shakopee High-Priority Gullies

The numerous high-risk sites can be categorized into two general regions, the Shakopee River Bluffs and Kelly Court HPRs.

9.4.1 Shakopee River Bluffs HPR

These gullies represent areas within Shakopee that are adjacent to the Minnesota River and subject to periodic flooding from it (Figure 42). At the time of observation, the Minnesota River was at historically low levels; future evaluation of the gullies near the Minnesota River should occur during higher river levels to determine whether these sites are true gullies and not backwater channels to the Minnesota River.

The high-priority gullies within the Shakopee River Bluffs HPR are detailed below.

9.4.1.1 Gully 07:08-09:17

This site was located at the west end of Huber Park in Shakopee, near the County Road 101 bridge (Figure 42). It was a medium-length, shallow gully with a narrow bottom that forms a general V-shape (Figure 43). The bottom of the gully was bare soil, and each of the banks was very steep and had no vegetation. There was severe degradation throughout the gully; however, there was no visible slumping or evidence of fallen trees in the gully. There were some hanging roots on the banks of the gully, and the gully fed directly into the Minnesota River. High erosion potential was assigned to this gully. This gully received an erosion potential score of 35 and a risk class of high.

Figure 42: Shakopee Bluffs HPR

Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- City Erosion Concerns
- 2021 Potential Gully, Not Found
- 2021 No Access
- LMRWD Trout Streams
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Shakopee
- Scott Co. Parcels
- LMRWD Boundary

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Figure 42: Photos of Gully 07:08-09:17. A) Downstream view of the gully, B) Downstream view showing the severely eroding left bank of the gully, C) Downstream view of the gully's confluence with the Minnesota River

9.4.2.1 Gully 07:08-09:29

This site was located in Huber Park in Shakopee where there was a series of small, short, shallow, and narrow gullies running through the silt and clay of the southern bank of the Minnesota River (Figure 43). From the observations made, it appeared that these small gullies were the result of a broken pipe that used to drain directly into the Minnesota River. Since it was broken, the pipe has drained about halfway down the bank and caused these small channels. There was no vegetation in the acute, U-shaped gully. At the time of observation, there was no water flowing out of the pipe, but the gullies had some water flowing in them as a result of seeps. The degradation was severe, and aggradation was moderate; some sediment was visible moving in the water. The banks had some signs of slumping. Overall, this site had a moderate erosion potential score of 34 and a high risk.

Figure 43: Photos of Gully 07:08–09:29. A) Downstream view of mini gullies and broken pipe. There was a very steep drop-off along with a lot of vegetation, so pictures were difficult to obtain. B) Downstream view of where pipe outfall broke and now drains

9.4.3.1 Gully 07:08-09:58

This site was located just off a pond east of Huber Park in Shakopee. It was a short, medium-length gully with very steep banks that had a narrow bottom and a general V-shape (Figure 44). The bottom of the gully was just bare soil with no vegetation, and each of the banks was also lacking in vegetation. There was a pole-like pipe in the middle of the gully with a hose shooting out a constant, fast stream of water into it, causing heavy degradation, including some slumping trees. This gully received a score of 37 and a risk category of moderate.

9.4.3.2 Gully 07:08-10:03

This site was located in Huber Park downstream of moderate-priority site 07:08–09:59 and upstream of low-priority site 07:08–10:10, which drained directly into the Minnesota River in Shakopee. This gully had fast-moving water flowing into it from the upstream pipe, and the water ran out of the channel from the downstream pipe (Figure 53). The channel was short, deep, medium-width, and made of silt and clay. The bottom had no vegetation, but the banks had some along with a mid-range U-shape. The inflow pipe had high flow; the degradation was moderate with low aggradation and some leaning trees. On the right bank of the gully, the degradation was more severe than on the left. The gully received an erosion potential score of 30 and moderate risk.

9.4.3.3 Rahr Malting Co. (Gully 06:03-11:34)

This gully was found just north of Levee Drive West in Shakopee; it was connected to Site 06:03–11:27, a potential low-erosion site (Figure 42). It was just further downstream, but the difference in erosion levels was drastic. There was a pipe sending a constant, high flow of water from the top of the gully, which caused erosion on the banks (Figure 46). The channel slopes were steep, and there was little to no vegetation on both the banks or the bottom of the gully. There was moderate degradation and slumping, so this gully received a moderate erosion potential score of 36 and a risk category of medium.

Figure 44: Photos of Gully 07:08-09:58. A) Upstream view of high flow of water exiting pipe, B) Downstream view of water draining into this pond area where the gully flows, C) Upstream view of the left bank, D) Upstream view of the right bank

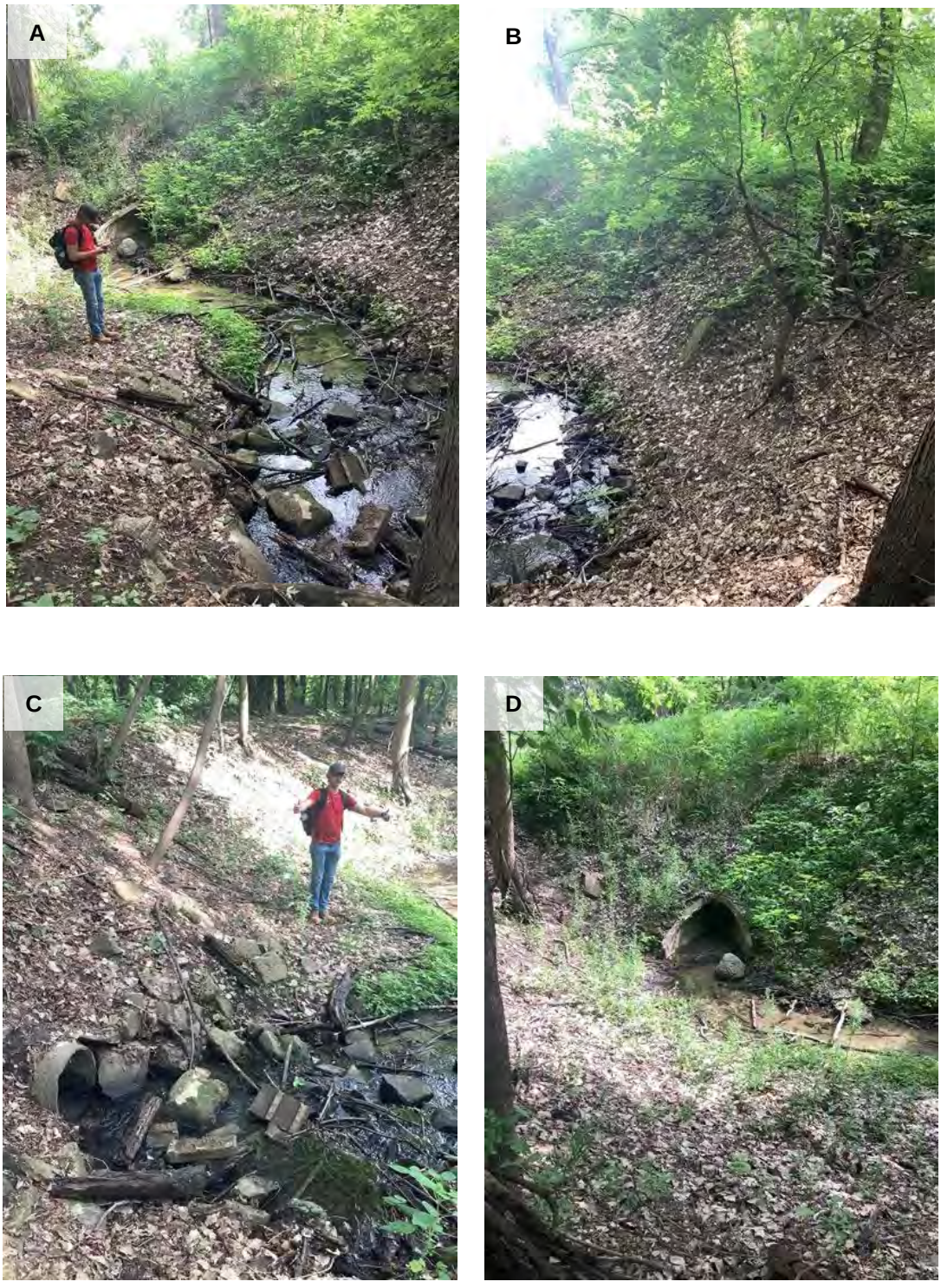

Figure 45: Photos of Gully 07:08–10:03. A) Downstream view of gully; inflow and outflow pipes are visible. B) Downstream view of the right bank, which has worse degradation, C) Downstream view of inflow pipe and left bank, D) Downstream view of outflow pipe

Figure 46: Photos of Gully 06:03-11:34. A) Downstream view of left gully bank, B) Upstream view of pipe with constant, high flow of water exiting the pipe, C) Downstream view of the right gully bank

9.4.5 Kelly Court HPR

These gullies represent the gullies forming in and around the residential development on Kelly Court in Shakopee (Figure 47). These gullies are within the Eagle Creek HVRA and sediment from these gullies contributes directly to the downstream trout stream. They are also within the LMRWD SSOD, indicating the potential for continued erosion if not corrected.

9.4.5.1 Gully 07:07-08:50

This site was located at 2108 Kelly Court in Shakopee. This gully began as a large, U-shaped gully, then transitioned to a narrower, V-shaped gully (Figure 48). The gully was long, medium depth, medium width, and made of silt. The bottom had no vegetation, but the banks were covered in moderate vegetation. The degradation was moderate, and some trees were leaning over the channel with slumping banks. This gully received a moderate erosion potential score of 34 for a risk rating of high.

9.4.5.2 Gully 07:08-11:17

This gully was located at 2168 Kelly Circle, close to the border of Savage. It was very long and deep and of medium width (Figure 49). The bottom and banks had some vegetation and a mid-range V-shape. The degradation was severe, and there was some slumping of the banks and leaning trees over the channel. The gully received an erosion potential score of 35 and a risk category of high.

Figure 47: Kelly Court HPR

Legend

2021 Gully Scores

- Very Low, No Action
- Low, Monitor As Needed
- Medium, Monitor Regularly
- High, Further Study
- Very High, Mitigation Required
- 2021 Potential Gully, Not Found

- 2021 No Access
- LMRWD Trout Streams
- Public Waters
- Public Waterbodies
- High Value Resource Area
- Steep Slopes Overlay District
- Shakopee
- Scott Co. Parcels
- LMRWD Boundary

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Figure 48: Photos of Gully 07:07-08:50. A) Upstream view of the flatter area at the beginning of the gully, B) Downstream view of the gully where there were fallen trees and a boardwalk running across the banks, C) Upstream view of area where slope drops off and gully becomes more severe, D) Downstream view of fallen tree

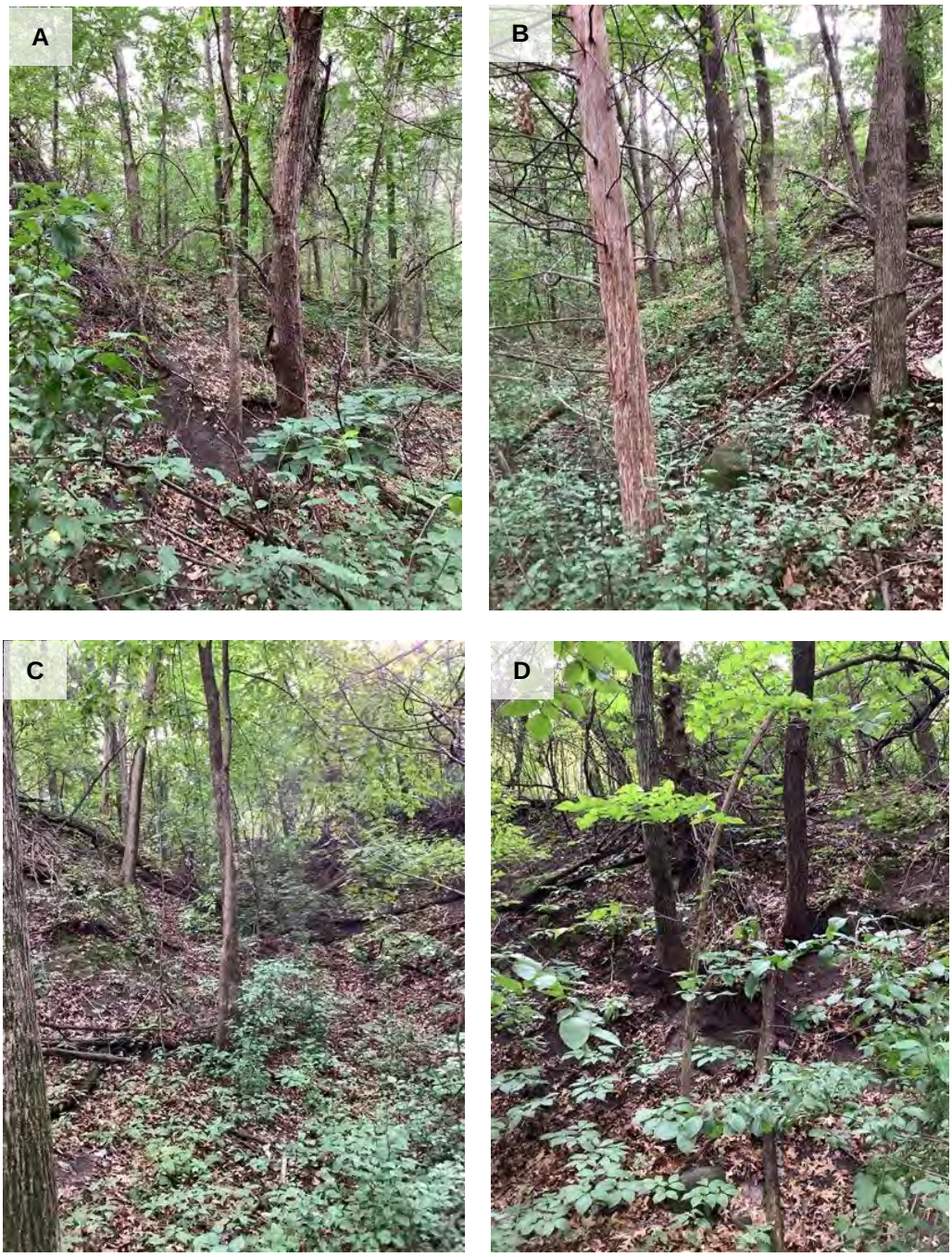

Figure 49: Photos of Gully 07:08–11:17. A) Downstream view of the left bank, B) Downstream view of the right bank, C) Upstream view of the area where the gully is narrower: the tree on the left edge of the photo is where the small gully connects to this larger one. D) Left bank view of degradation, slumping and pistol shaped trees

9.5 Recommendations

The city of Shakopee has many sites ranked as high-risk gullies; however, the Kelly Court HPR appeared to have the greatest need for intervention. Given its proximity to private residences, the Eagle Creek HVRA, and the steep slopes, the potential for continued erosion is high.

Future evaluation of the Shakopee River Bluffs HPR near the Minnesota River should occur when river levels are higher to determine whether these sites are true gullies and not backwater channels to the Minnesota River. Additionally, the inaccessible areas should be surveyed in the future to confirm whether gullies are present.

Finally, the Shakopee gullies should be included in the District's gully prioritization efforts so that future partnerships and collaborations can be planned.

10.0 CONCLUSIONS AND RECOMMENDATIONS

The 2021 Gully Project identified and assessed a total of 247 new gullies within the LMRWD, including six VHR gullies found in the cities of Burnsville and Eagan and Jackson Township and 108 high-risk gullies across Dakota and Scott Counties. The data are summarized in Table 3.

Table 3. *2021 Gully inventory summary*

	Burnsville	Eagan	Jackson Twp	Mendota Heights	Savage	Shakopee	**Total**
No. Gullies	70	44	10	21	31	75	**251**
Erosion Potential							
High erosion potential	18	13	1	2	4	17	**55**
Medium erosion potential	40	24	7	14	20	41	**146**
Low erosion potential	12	7	2	5	7	17	**50**
Risk Assessment							
Very high risk	4	1	1	0	0	0	**6**
High risk	44	24	1	6	10	23	**108**
Medium risk	3	2	4	9	7	16	**41**
Low risk	15	7	4	6	10	29	**71**
Very low risk	3	10	0	0	4	7	**24**

With the 2020 Gully Project's 358 identified gullies, there is a total of 609 gullies within the LMRWD, and although there are only six VHR gullies, all the gullies should be assessed and prioritized within the LMRWD to aid in future planning efforts. Given the sheer number of high, medium-, low-, and very low-risk sites identified, in addition to the 2020 gully locations, a comprehensive evaluation and prioritization effort needs to be undertaken to better aid LMRWD planning efforts.

No restoration actions are recommended at this time for the gullies with medium, low, and very low risk; but the information from this report will be shared with the municipal partners. High-risk sites should be surveyed on a semiregular basis to determine whether conditions are stable or worsening (potentially once every five to ten years).

The VHR sites should be discussed with Burnsville, Eagan, Scott County, and the MnDNR with the intent to restore these gullies to prevent further degradation to the downstream natural resources.

The VHR locations should be surveyed annually to determine the average rate of erosion and identify whether these problem areas are growing in size or scale. Additionally, as with the recommendations in the GA Report, site inspections should occur following intense rainfall events or severe flooding to determine whether further degradation of the gully has occurred.

Finally, the results from this analysis will be appended to the 2020 *Gully Inventory and Condition Assessment* for a single reference on all identified gullies within the LMRWD.

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APPENDIX A—University of Minnesota Partnership for the Gully Assessment and Condition Project Memo

Young Environmental Consulting Group, LLC

Technical Memorandum

To: Linda Loomis, Administrator
Lower Minnesota River Watershed District

From: Katy Thompson, PE, CFM
Della Schall Young, PMP, CPESC

Date: July 14, 2021

Re: University of Minnesota Partnership for the Gully Assessment and Condition Project

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Dr. Joe Magner, with the University of Minnesota's Department of Bioproducts and Biosystems Engineering, reached out to the Lower Minnesota River Watershed District (LMRWD or District) through Young Environmental Consulting Group (Young Environmental) in December 2020 to discuss field data collection opportunities for his students taking the Spring Semester 2021 class, Hydrology and Water Quality Field Methods (Environmental Sciences, Policy and Management [ESPM] 3111 and ESPM 5111). The District has enjoyed the benefits of collaborating with Dr. Magner's students because his students helped the District conduct geomorphic assessments of the District's trout streams in 2019. One student, Phil Margarit, who worked for Young Environmental as an intern, also collected gully condition surveys in 2020.

Because of this strong partnership, Young Environmental staff met with Dr. Magner and Phil to discuss opportunities for the ESPM students and developed a workplan for them to help further the identification of gullies in Dakota and Scott Counties during Spring Semester 2021.

Katy Thompson from Young Environmental presented the LMRWD gully project to the ESPM students on January 21, 2021, to provide them with background on the project and the need for additional data collection. The ESPM students were split into two groups to first identify potential sites for field inspections, collect data in the field to determine if the desktop assessment was accurately predicting the location of gullies, and then draft a summary report on their methods and results. Following this initial

meeting, Katy met with Phil and the ESPM students every two weeks for the remainder of the semester in an advisor role to provide feedback on their approach and plan.

Desktop Assessment

As part of the class assignment, the ESPM students were tasked with identifying potential gully locations using GIS software and publicly available data before entering the field. The goal of this desktop assessment was to determine if there is a correlation between these data and the likelihood that gullies may develop within the LMRWD. Between the two groups, the ESPM students utilized publicly available information, including the 2020 Gully Inventory and Conditions Assessment report and GIS data:

- LMRWD Steep Slopes Overlay District (SSOD)
- Minnesota Department of Natural Resources (MnDNR) LiDAR data
- Historic and current landcover information
- Minnesota Department of Health groundwater and well index
- MnDNR spring data
- Natural Resources Conservation Service soils data
- Minnesota Geological Survey surficial geology data

Each team assessed the data differently; however, both teams placed priority on utilizing the SSOD, topography, soil drainage types (with emphasis on poorly drained soils), depth to water table, and proximity to springs.

Field Data Collection

The ESPM students reviewed the available information and discussed internally how to apply the data to assess if an area within LRMWD had potential for gully development. The two groups provided a comprehensive list of 31 potential areas to assess in the field.

The ESPM students went into the field from April 18 to April 25, 2021, to assess the potential gully areas and the conditions of any found gullies using the same format as the *2020 Gully Inventory and Condition Assessment*. Katy provided the students with public access maps and information to avoid trespassing on private property, which removed four locations from the field collection activities.

Of the remaining twenty-seven sites, thirteen were identified in the field as being gullies, whereas six were determined to not be gullies. Several of the potential gully areas were not visited because of difficulties accessing the sites, time limitations, or user error with the survey equipment.

Results

The two ESPM student groups reviewed the data they collected and summarized their findings in independent reports. These reports indicated that some of the criteria used to identify gully locations did not have a noticeable correlation to gully development, in particular the springs and groundwater data. Although groundwater and seeps are known to destabilize soils, the depth to water table and historic springs data did not seem to accurately predict gully development. The factors that did have a more direct correlation to gully development appeared to be steep slopes and stormwater outfalls. Additionally, the ESPM students recommended incorporating land cover, placing more emphasis on the steep slopes, and developing a more objective survey to reduce judgment and estimation for future phases of the gully project.

2021 Gully Inventory and Condition Assessment

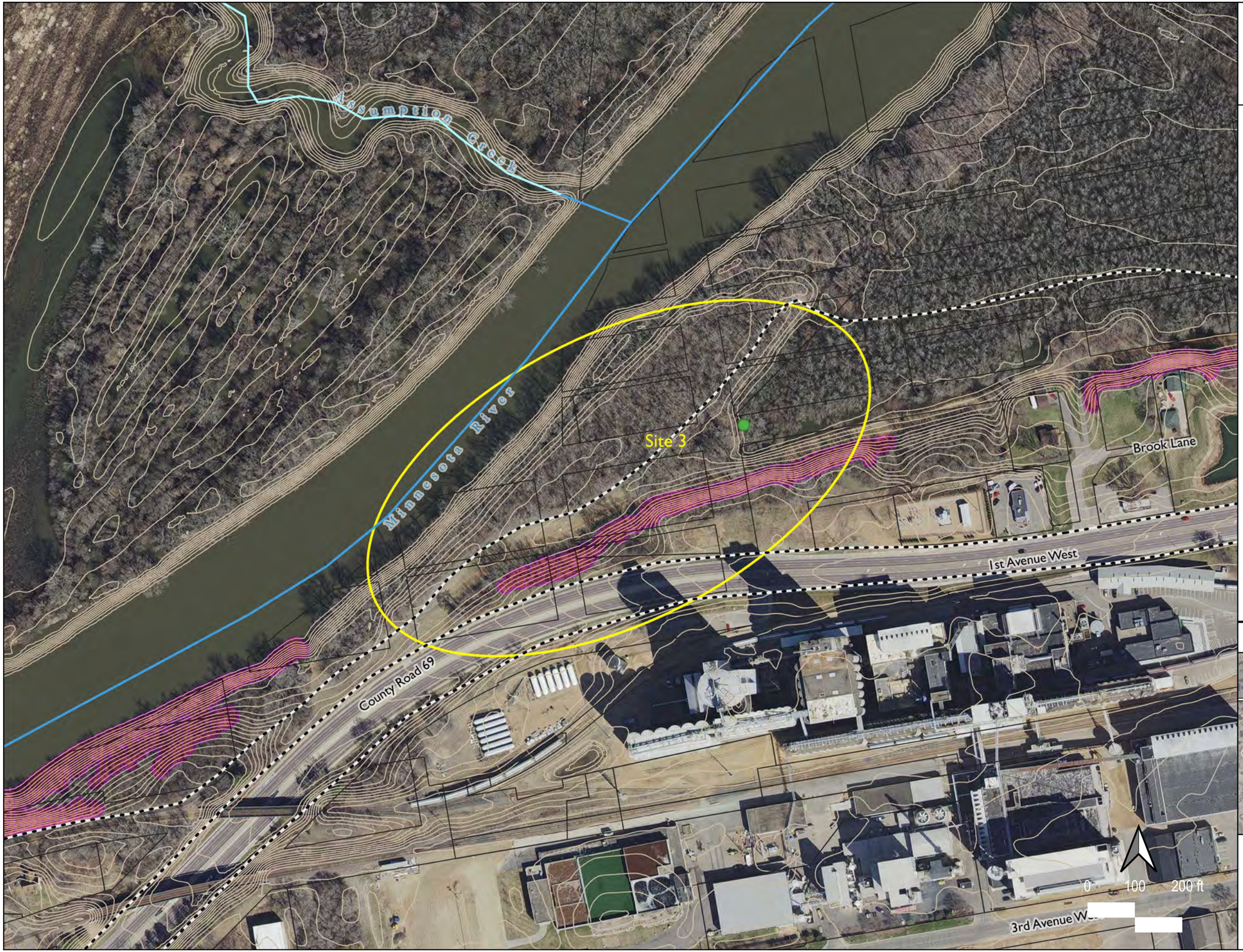
The 2021 gully project is currently underway and is utilizing the information the ESPM students vetted. The desktop analysis completed for the 2021 gully inventory work placed the most importance on identifying steep slopes outside of the SSOD, reviewing upstream land use data, and incorporating city-identified erosion hazards into the 2021 field locations. In addition, the survey forms used in 2020 have been revised to incorporate impartial scoring criteria to objectively evaluate gully erosion risk, which can also be applied to the 2020 sites. The interns have surveyed 187 sites to date and will be presenting their findings to the LMRWD managers at the August 18, 2021, board meeting.

Attachments

- Attachment 1—ESPM Survey Locations
- Attachment 2—ESPM Gully Survey Sheets

ATTACHMENT 1 - ESPM CLASS SURVEY LOCATIONS

Figure 1:
Site 3



LEGEND

April 2021 Gully Locations
- High Erosion Potential
- Moderate Erosion Potential
- Low Erosion Potential
- No Gullies Found

- Potential Gully Areas
- Scott Co. Trails
- State Trails
- MnDNR Spring Inventory
- LMRWD Trout Streams
- Public Waters
- Dakota Co. Parcel Data
- Scott Co. Parcel Data
- MnDNR LiDAR 2-ft Contours
- Public Waterbodies
- Steep Slopes Overlay District
- US Fish & Wildlife Service Property
- LMRWD Boundary

LMRWD Watershed Location Map

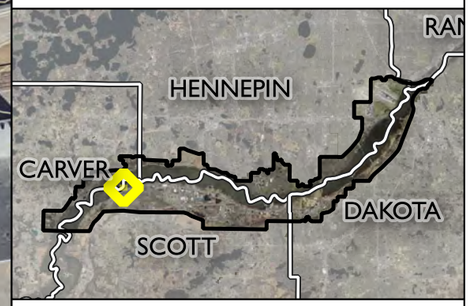


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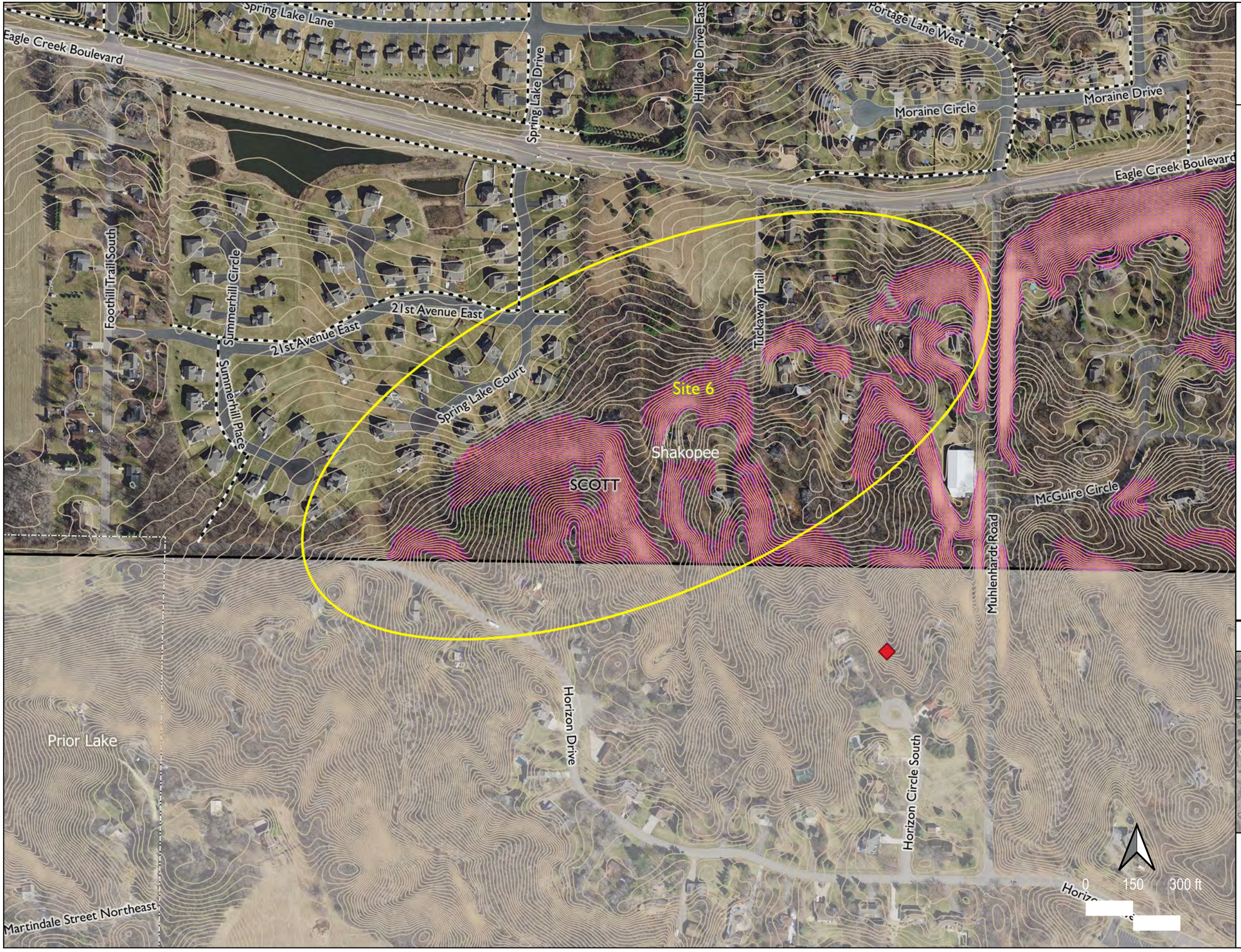
Figure 2:
Site 6



LEGEND

April 2021 Gully Locations
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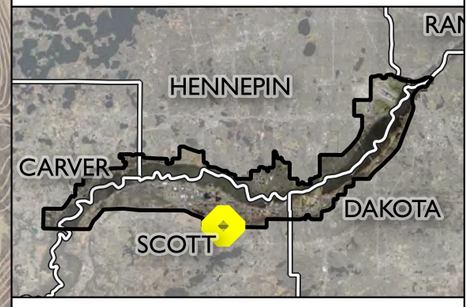
- Public Waterbodies
- Steep Slopes Overlay District
- US Fish & Wildlife Service Property
- LMRWD Boundary

LMRWD Watershed Location Map



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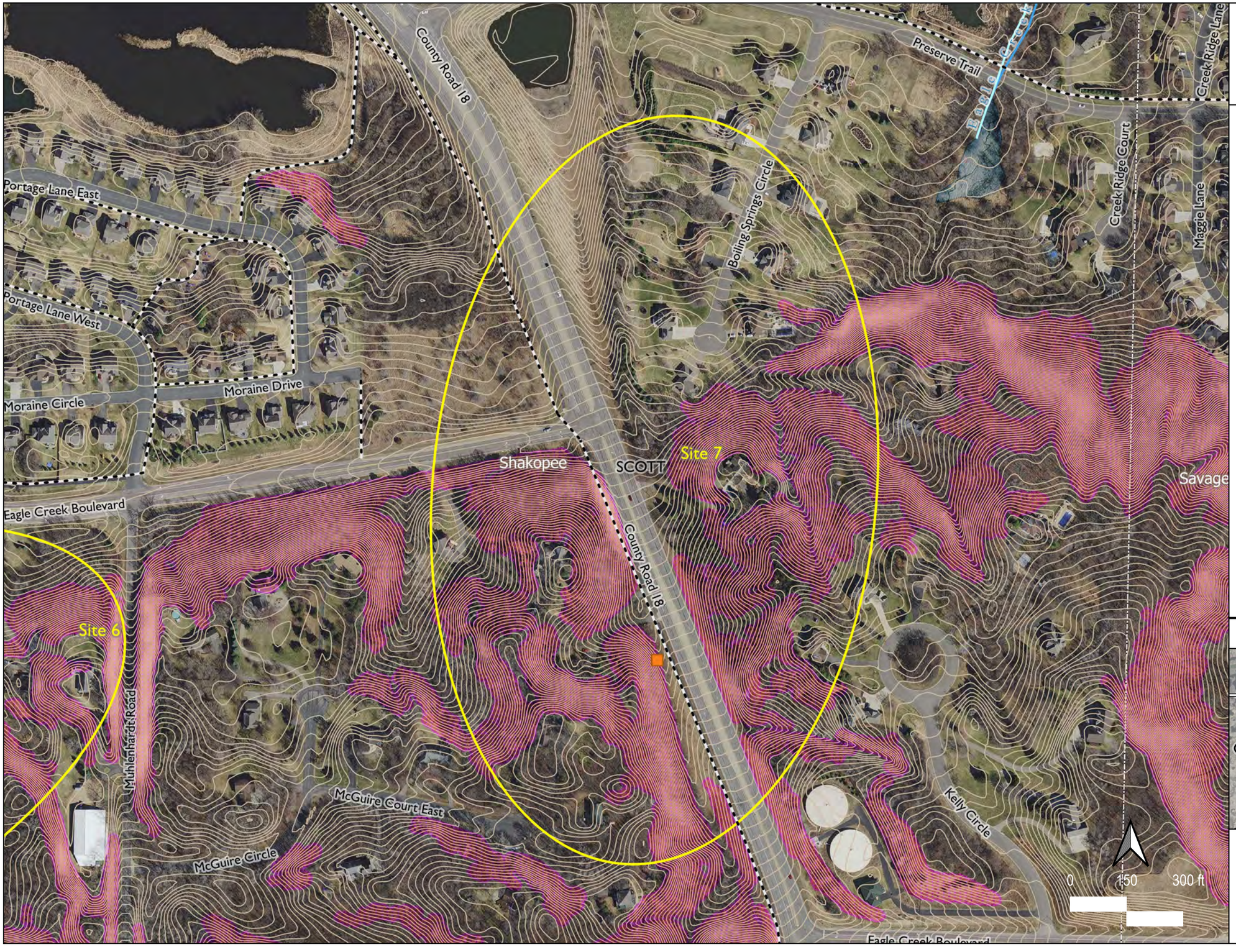
LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 3:
Site 7



LEGEND

April 2021 Gully Locations
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Potential Gully Areas
Scott Co. Trails
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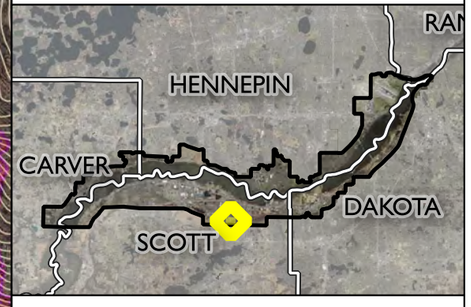
LMRWD Trout Streams
Public Waters
Dakota Co. Parcel Data
Scott Co. Parcel Data
MnDNR LiDAR 2-ft Contours
Public Waterbodies
Steep Slopes Overlay District
US Fish & Wildlife Service Property
LMRWD Boundary

LMRWD Watershed Location Map



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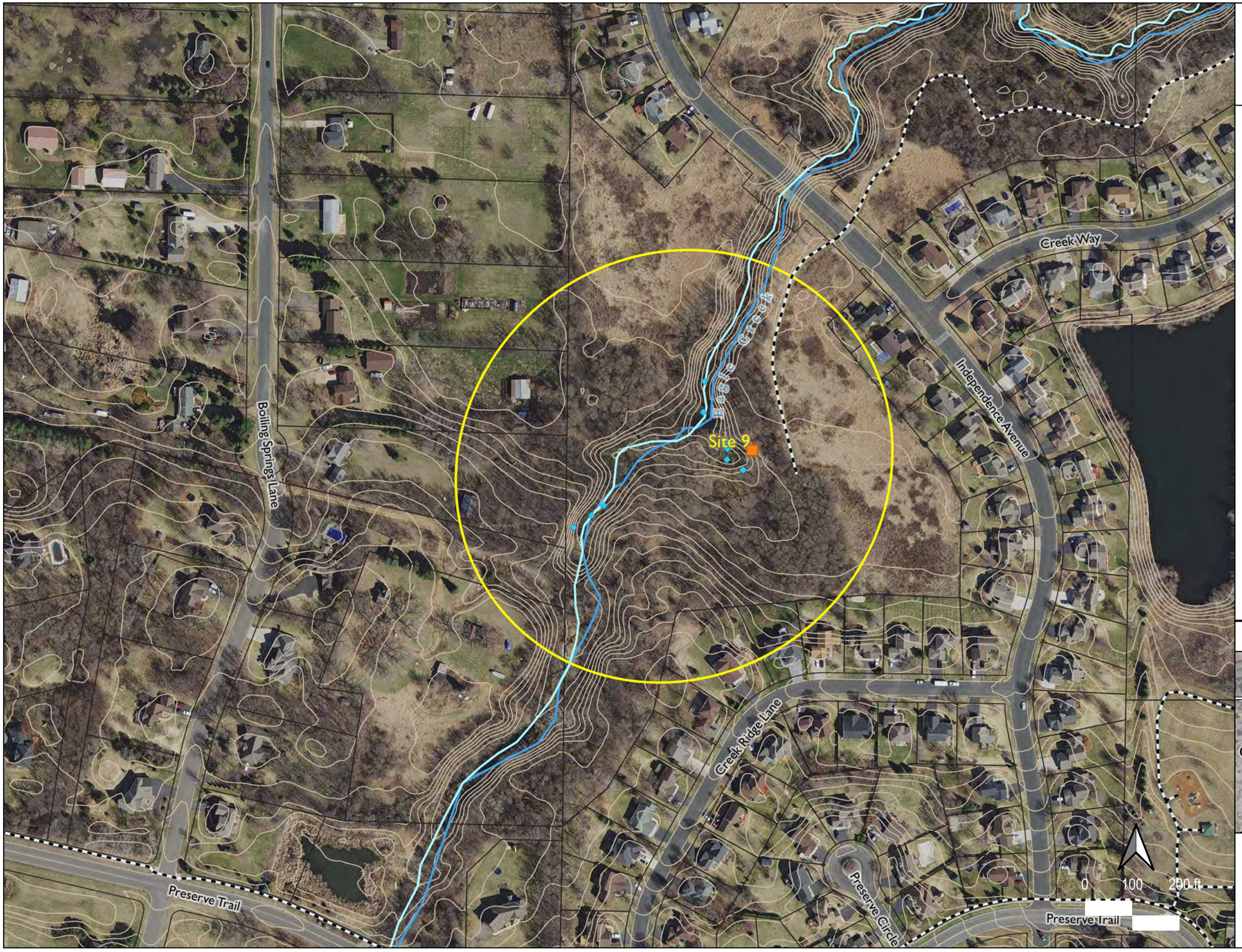
LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 4:
Site 9



LEGEND

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- Scott Co. Parcel Data
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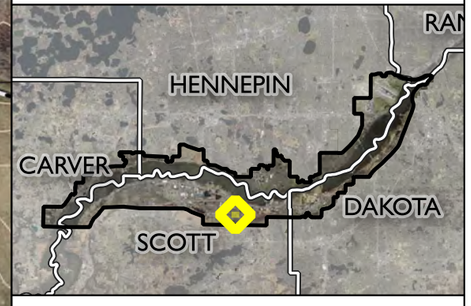
- Public Waterbodies
- Steep Slopes Overlay District
- US Fish & Wildlife Service Property
- LMRWD Boundary

LMRWD Watershed Location Map



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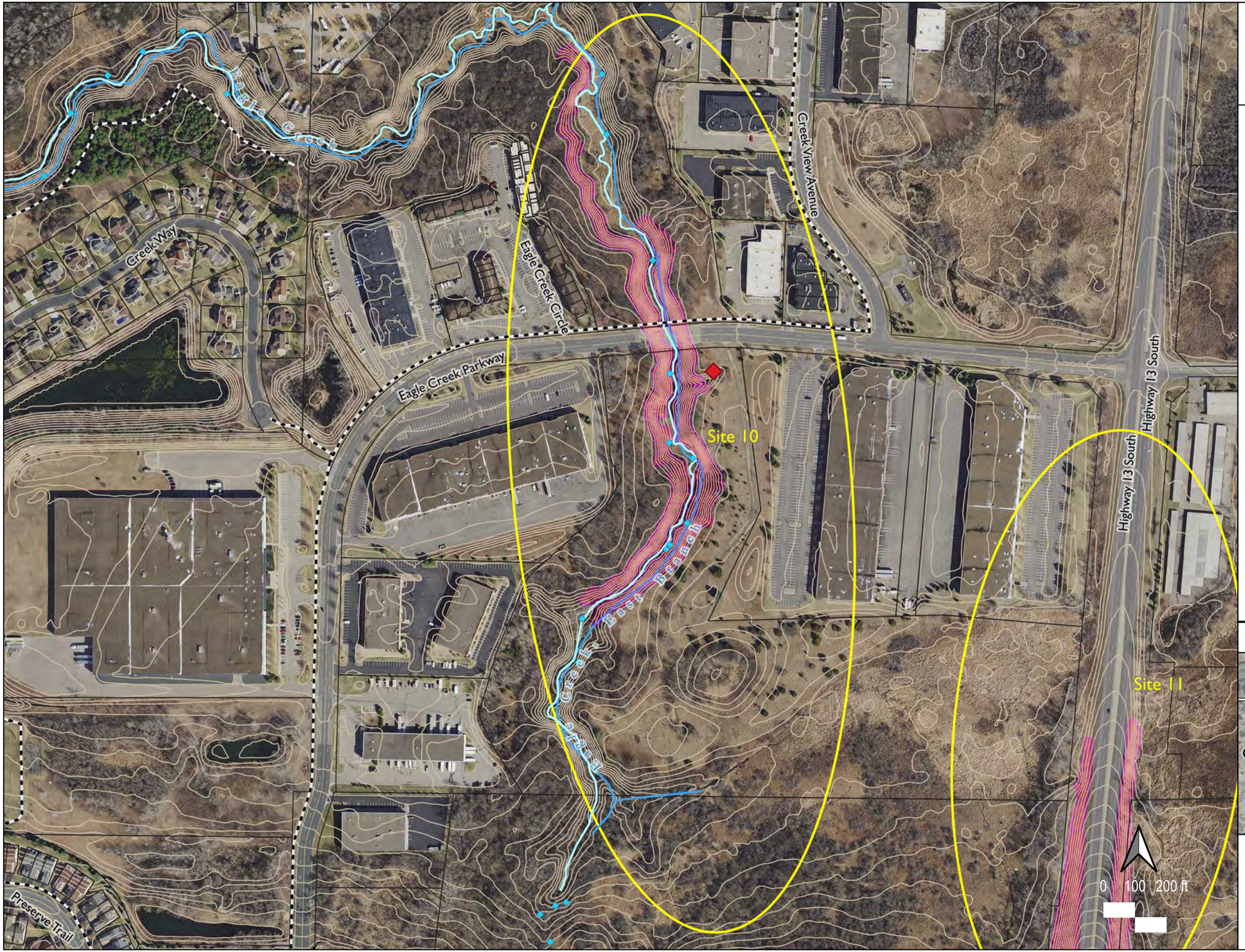
LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 5:
Site 10



LEGEND

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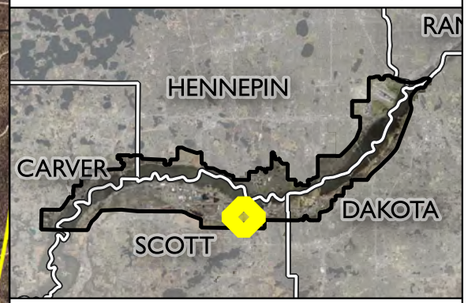
MnDNR LiDAR 2-ft Contours
Public Waterbodies
Steep Slopes Overlay District
US Fish & Wildlife Service Property
LMRWD Boundary

LMRWD Watershed Location Map



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LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 6:
Site 11

LEGEND

April 2021 Gully Locations
- High Erosion Potential
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Potential Gully Areas
Scott Co. Trails
State Trails
MnDNR Spring Inventory
LMRWD Trout Streams
Public Waters
Dakota Co. Parcel Data
Scott Co. Parcel Data
MnDNR LiDAR 2-ft Contours
Public Waterbodies
Steep Slopes Overlay District
US Fish & Wildlife Service Property
LMRWD Boundary

LMRWD Watershed Location Map

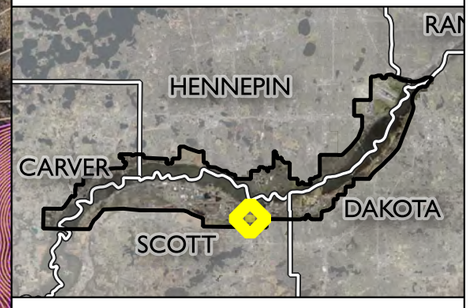

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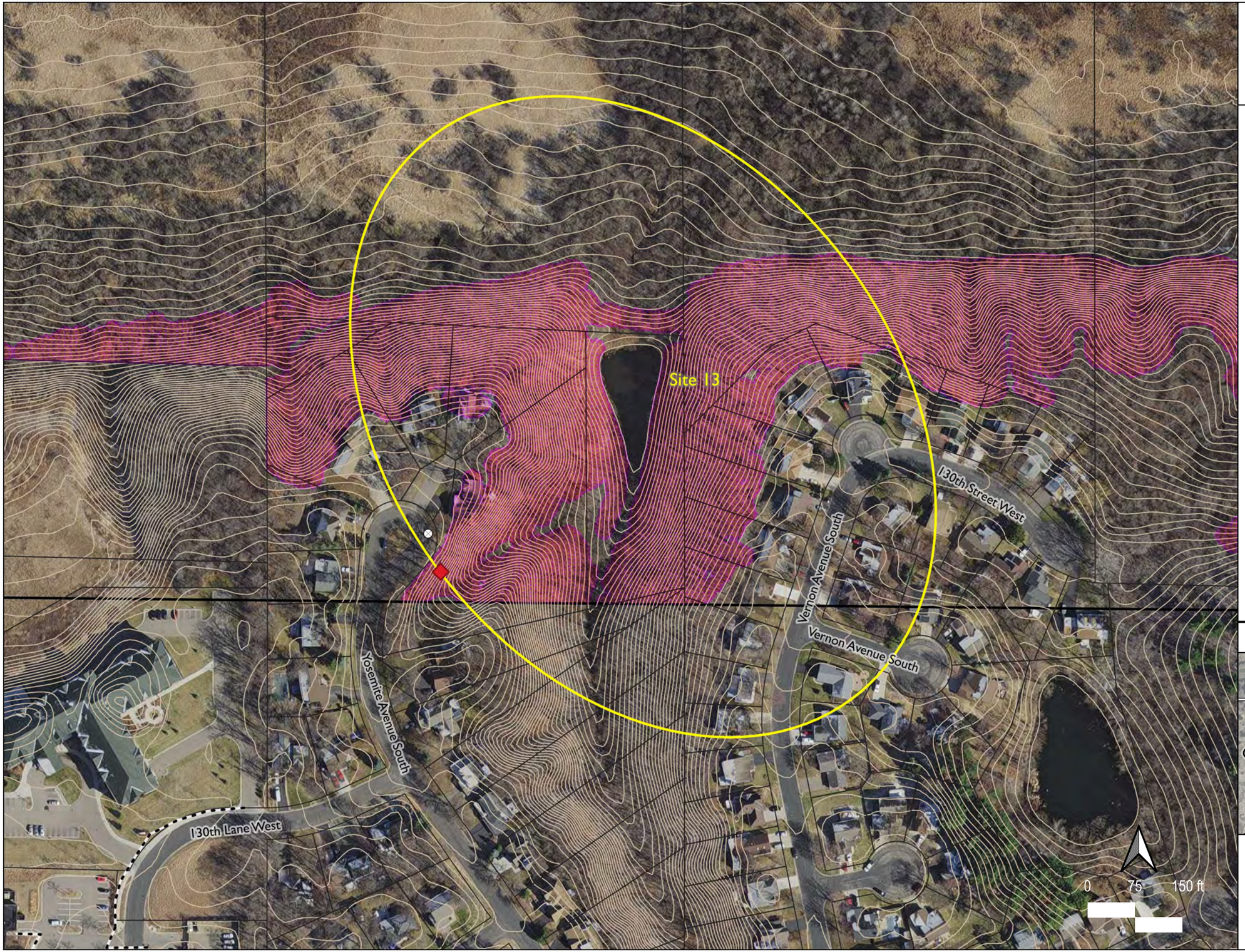
Figure 7:
Site 13



LEGEND

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Steep Slopes Overlay District
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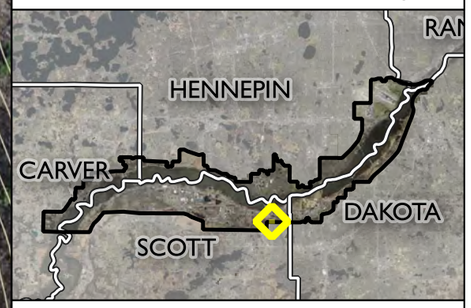
LMRWD Boundary

LMRWD Watershed Location Map



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LOWER MINNESOTA RIVER WATERSHED DISTRICT

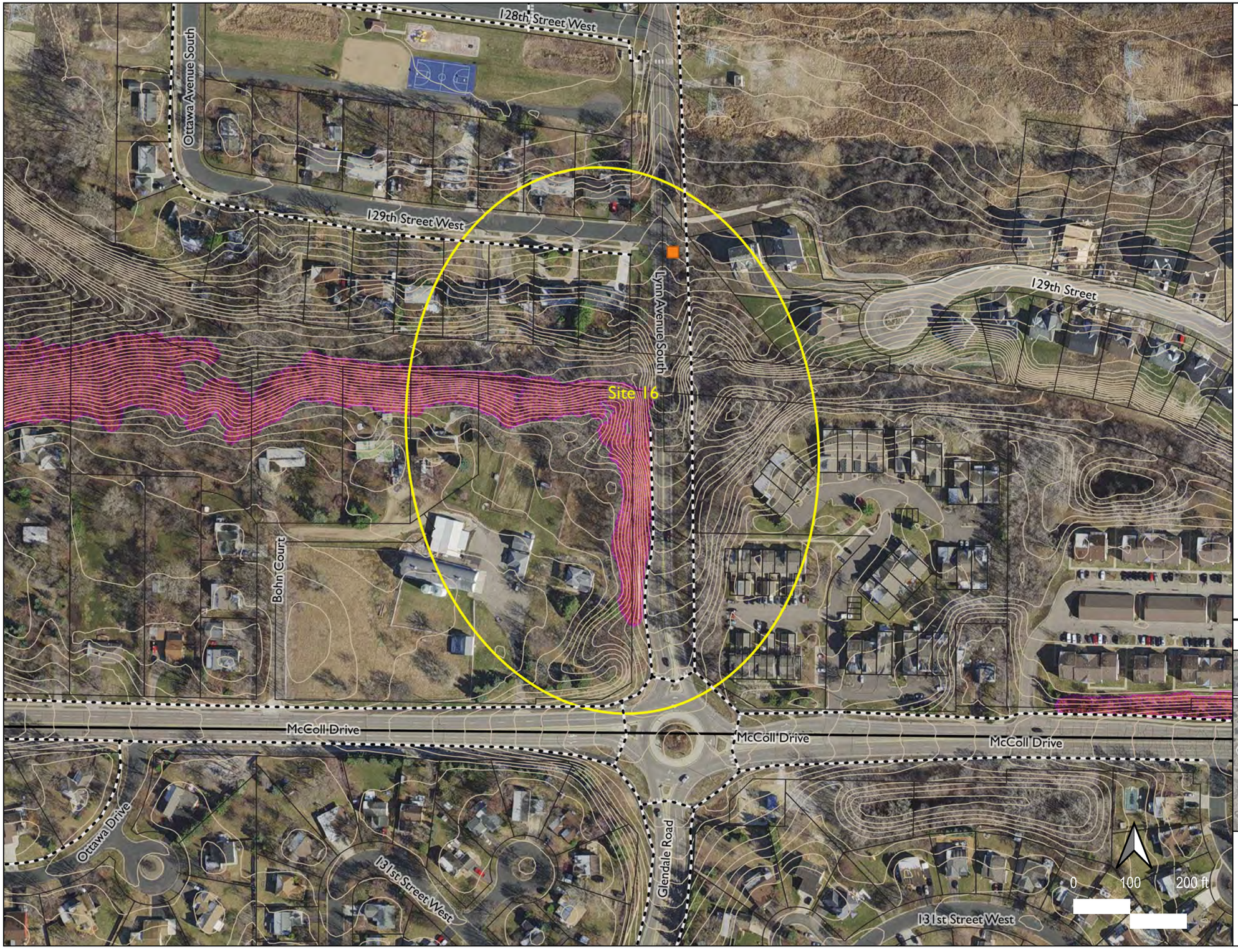

Figure 8:
Site 16

LEGEND

April 2021 Gully Locations
- High Erosion Potential
- Moderate Erosion Potential
- Low Erosion Potential
- No Gullies Found

Potential Gully Areas
Scott Co. Trails
State Trails
MnDNR Spring Inventory
LMRWD Trout Streams
Public Waters
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MnDNR LiDAR 2-ft Contours
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Steep Slopes Overlay District
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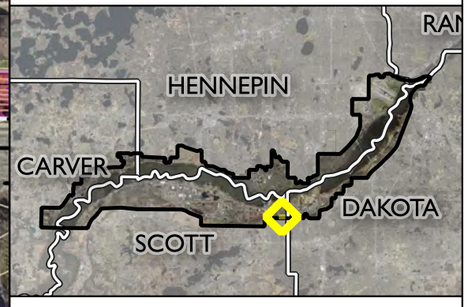
LMRWD Boundary

LMRWD Watershed Location Map



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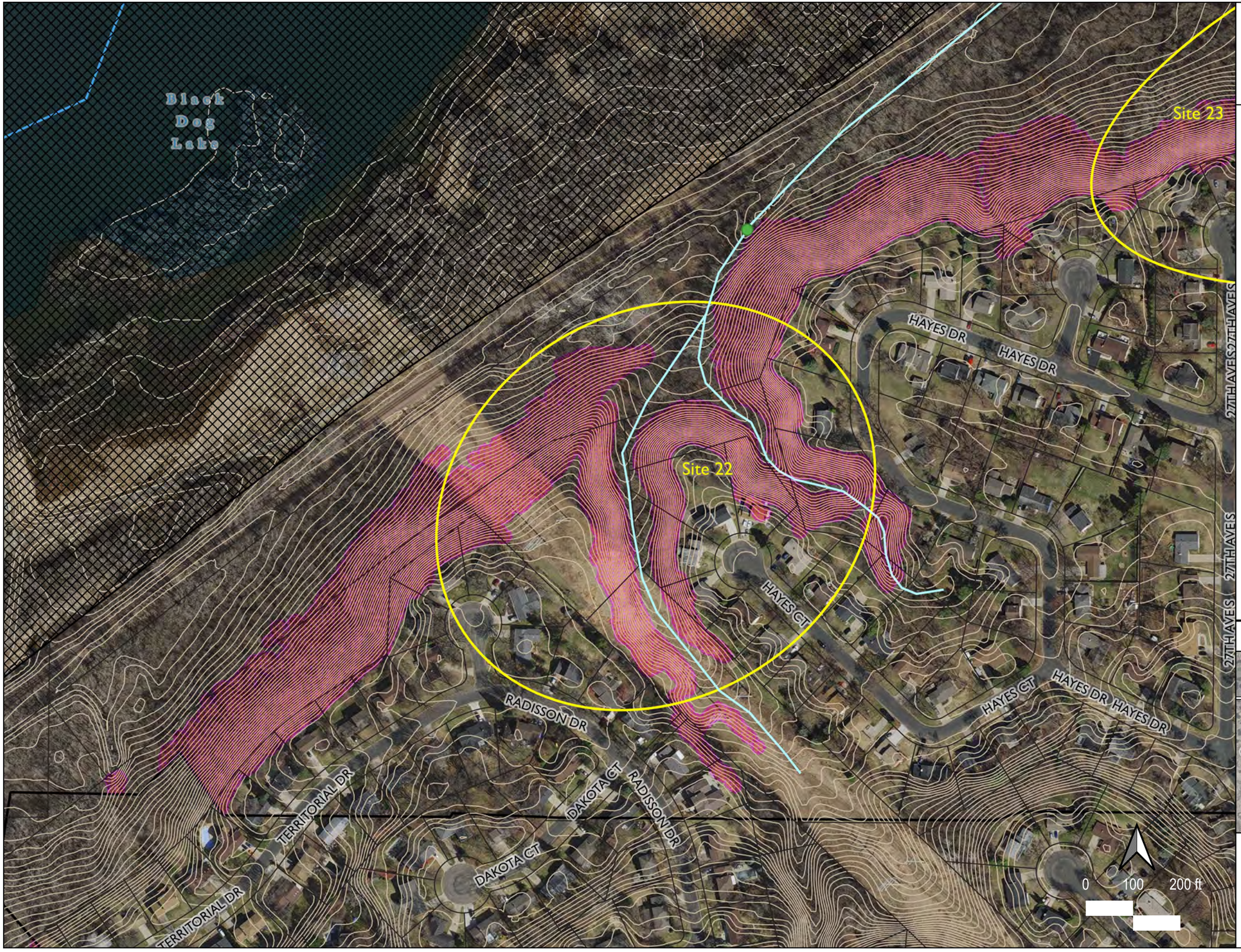
LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 9:
Site 22



LEGEND

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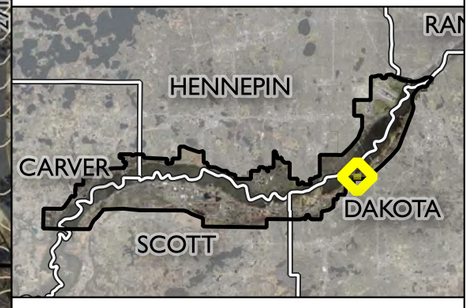
- Public Waterbodies
- Steep Slopes Overlay District
- US Fish & Wildlife Service Property
- LMRWD Boundary

LMRWD Watershed Location Map



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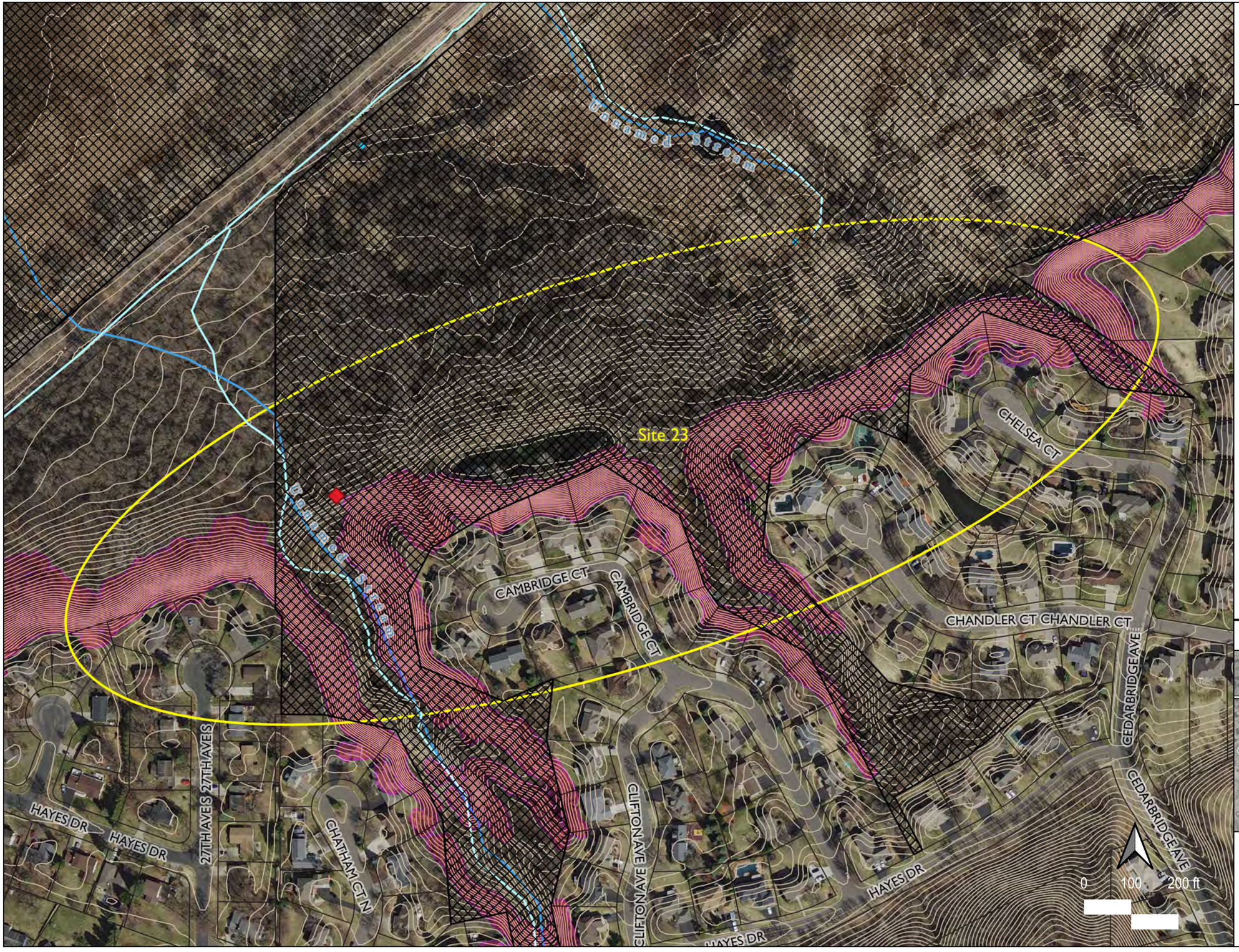
LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 10:
Site 23



LEGEND

April 2021 Gully Locations
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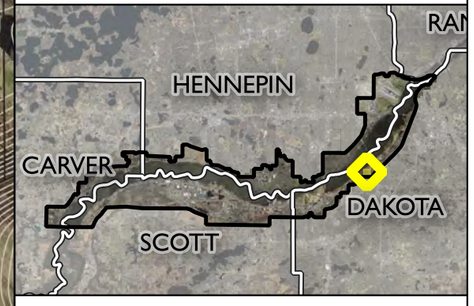
LMRWD Watershed Location Map



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LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 11:
Site 26

LEGEND

April 2021 Gully Locations
- High Erosion Potential
- Moderate Erosion Potential
- Low Erosion Potential
- No Gullies Found

- Potential Gully Areas
- Scott Co. Trails
- State Trails
- MnDNR Spring Inventory
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- Scott Co. Parcel Data
- MnDNR LiDAR 2-ft Contours
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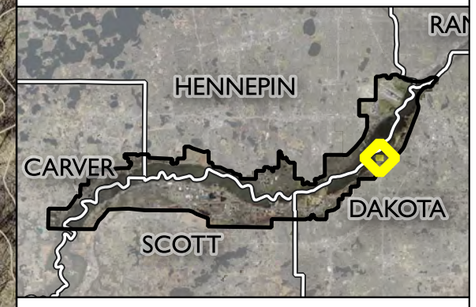
- LMRWD Boundary

LMRWD Watershed Location Map



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LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 12:
Site 28

LEGEND

April 2021 Gully Locations
- High Erosion Potential
- Moderate Erosion Potential
- Low Erosion Potential
- No Gullies Found
- Potential Gully Areas
- Scott Co. Trails
- State Trails
- MnDNR Spring Inventory
- LMRWD Trout Streams
- Public Waters
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- Scott Co. Parcel Data
- MnDNR LiDAR 2-ft Contours
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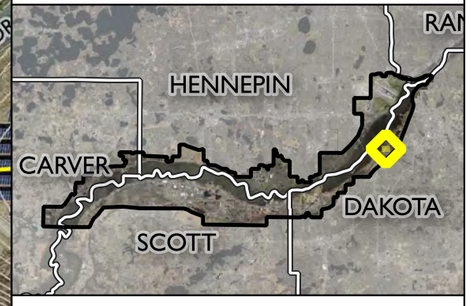
LMRWD Watershed Location Map



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LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 13:
Site 29

LEGEND

April 2021 Gully Locations
- High Erosion Potential
- Moderate Erosion Potential
- Low Erosion Potential
- No Gullies Found

Potential Gully Areas
Scott Co. Trails
State Trails
MnDNR Spring Inventory
LMRWD Trout Streams
Public Waters
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Scott Co. Parcel Data
MnDNR LiDAR 2-ft Contours
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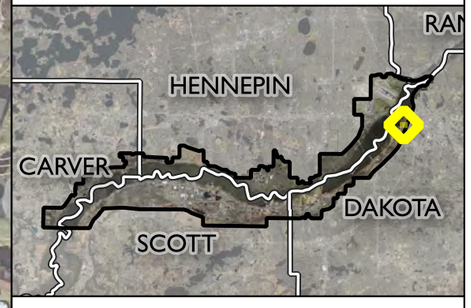
LMRWD Boundary

LMRWD Watershed Location Map



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LOWER MINNESOTA RIVER WATERSHED DISTRICT

ATTACHMENT 2 - ESPM CLASS GULLY DATA SHEETS

GULLY ID: ESPM Site 3	
PREVIOUS WAYPOINT ID: 3	Gully Head UTM Estimation: 30’,
SURVEY DATE: April 18, 2021 1:33 PM	Observation Point correction, if applicable:
LOCATION: Shakopee	Connections to other points, if applicable:
TYPE OF SITE: Gully	
SITE SUMMARY: Partly Cloudy Rain in previous 24 hours: No Off bike trail Long: >100' gully. The problem indicators were: pistol-butted or leaning trees	

GULLY INFORMATION	
EROSION POTENTIAL:	Low
GULLY DEPTH:	Medium: 3'-15'
BOTTOM WIDTH:	Wide: >5'
TOP WIDTH:	Wide: >10'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Flat
GULLY SHAPE:	Trapezoid
GULLY MATERIAL:	Fine-grained cohesive
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	Slope, Unstable drainage feature entering system

ADDITIONAL NOTES:

Invasive Species? Unkown
Type: Unkown

Debris? Some debris and trash

Existing Stabilization? Riprap/large stones
Success: Yes

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PICTURES:

Bank reinforcing stones

Edge of gully opposite reinforcing edge

Drainage feature blocked by sticks

GULLY ID: ESPM Site 6	
PREVIOUS WAYPOINT ID: Site 6	
SURVEY DATE: April 22, 2021 12:04 PM	
LOCATION:	Gully Head UTM Estimation: 30 ft, Observation Point correction, if applicable: 15T4674994956382 Connections to other points, if applicable:
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: Yes: Low Intensity, No Along a Road Long: >100' gully. The problem indicators were: Degradation, Aggradation, Flattened and/or slumping banks (widening), undercut or overhanging banks (lateral scouring), pistol-butted or leaning trees	

GULLY INFORMATION	
EROSION POTENTIAL:	High
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Narrow/V Ditch, Medium: 1'-5'
TOP WIDTH:	Medium: 5'-10', Narrow: 1'-5'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Steep
GULLY SHAPE:	U-shaped
GULLY MATERIAL:	Gravel/cobble/ boulders , Sand, Fine-grained cohesive
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	Slope, Unstable drainage feature entering system

ADDITIONAL NOTES:
Near site 6
Invasive Species? None
Type: Burdock, None
Debris? Little trash
Existing Stabilization? Rip rap or burlap under rocks at top of gully
Success: No

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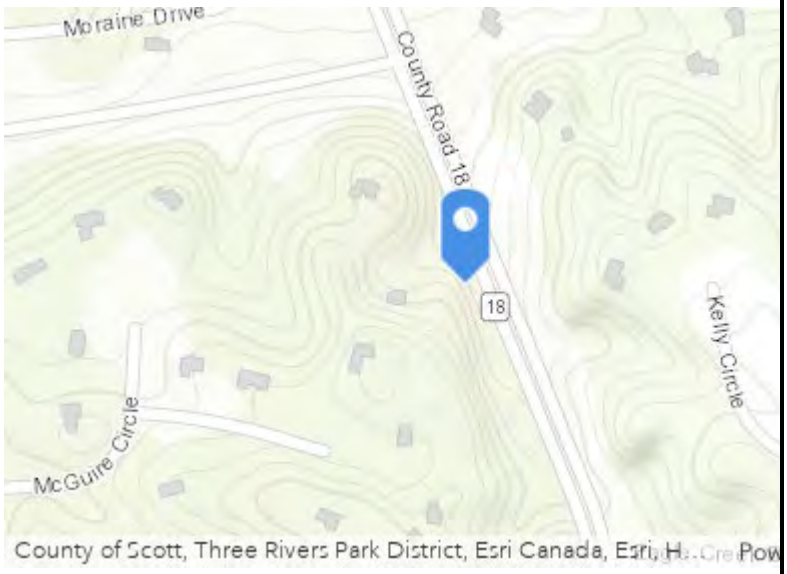
PICTURES:

GULLY ID: ESPM Site 7	
PREVIOUS WAYPOINT ID: Site 7	
SURVEY DATE: April 22, 2021 12:51 PM	
LOCATION: Shakopee	
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Off of Walking Trail Long: >100' gully. The problem indicators were: Degradation, Loss of Bank Vegetation, Flattened and/or slumping banks (widening), pistol-butted or leaning trees	Gully Head UTM Estimation: 5 ft, Observation Point correction, if applicable: Connections to other points, if applicable:

GULLY INFORMATION	
EROSION POTENTIAL:	Moderate
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Medium: 1'-5'
TOP WIDTH:	Medium: 5'-10'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Steep
GULLY SHAPE:	U-shaped
GULLY MATERIAL:	Fine-grained cohesive
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	Slope

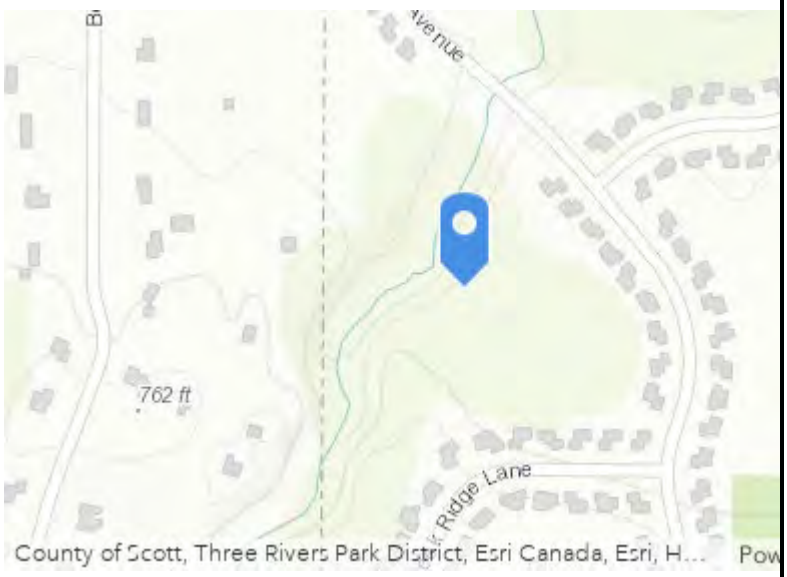
ADDITIONAL NOTES:
Slight slope drains into storm sewer at end of gully

Invasive Species?
Type:

Debris? Lots of trash
Existing Stabilization? None
Success: N/A

Young Environmental Consulting Group, LLC

PICTURES:

GULLY ID: ESPM Site 9	
PREVIOUS WAYPOINT ID: Site 9	
SURVEY DATE: April 22, 2021 1:58 PM	
LOCATION: Savage	
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Heavily Forested Medium: 50'-100' gully. The problem indicators were: Degradation, Aggradation, Loss of Bank Vegetation, Vertical and/or bare banks (incision), pistol-butted or leaning trees	Gully Head UTM Estimation: 5 feet, Observation Point correction, if applicable: Connections to other points, if applicable:

GULLY INFORMATION	
EROSION POTENTIAL:	Moderate
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Wide: >5'
TOP WIDTH:	Medium: 5'-10'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Flat
GULLY SHAPE:	Trapezoid
GULLY MATERIAL:	Fine-grained cohesive
WATER LEVELS	Moderate, Slow
SEEP	Yes
APPARENT CAUSES:	Seep/groundwater, Slope

ADDITIONAL NOTES:

Invasive Species? None
Type: None

Debris? No trash some debris

Existing Stabilization? None
Success: No, N/A

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PICTURES:

GULLY ID: ESPM Site 10	
PREVIOUS WAYPOINT ID: Site 10	
SURVEY DATE: April 22, 2021 1:11 PM	
LOCATION:	Gully Head UTM Estimation: 15 ft,
TYPE OF SITE: Gully	Observation Point correction, if applicable:
SITE SUMMARY: Sunny Rain in previous 24 hours: No Along a Road Medium: 50'-100' gully. The problem indicators were: Aggradation, Loss of Bank Vegetation, Flattened and/or slumping banks (widening), pistol-butted or leaning trees	Connections to other points, if applicable:

GULLY INFORMATION	
EROSION POTENTIAL:	High
GULLY DEPTH:	Deep: >15'
BOTTOM WIDTH:	Medium: 1'-5', Wide: >5'
TOP WIDTH:	Wide: >10'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Steep
GULLY SHAPE:	V-shaped
GULLY MATERIAL:	Fine-grained cohesive
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	Slope, Unstable drainage feature entering system

ADDITIONAL NOTES:
In state aquatic management site

Invasive Species?
Type:

Debris? Some trash
Existing Stabilization? None
Success: N/A

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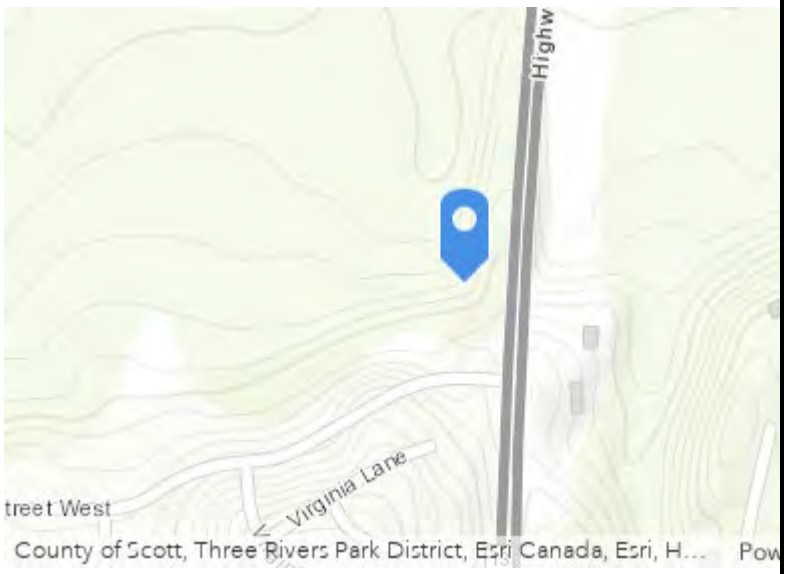
PICTURES:

Start of gully

GULLY ID: ESPM Site 11	
PREVIOUS WAYPOINT ID: Site 11	
SURVEY DATE: April 22, 2021 1:29 PM	
LOCATION: Savage	
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Along a Road Medium: 50'-100' gully. The problem indicators were: Degradation, Aggradation, Loss of Bank Vegetation, Vertical and/or bare banks (incision), Flattened and/or slumping banks (widening)	Gully Head UTM Estimation: 20 feet, Observation Point correction, if applicable: Connections to other points, if applicable:

GULLY INFORMATION	
EROSION POTENTIAL:	High
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Medium: 1'-5'
TOP WIDTH:	Narrow: 1'-5'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Bare Soil
CHANNEL SLOPE:	Steep
GULLY SHAPE:	V-shaped
GULLY MATERIAL:	Sand, Fine-grained cohesive
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	Slope, Unstable drainage feature entering system , Channel Incision

ADDITIONAL NOTES:

Invasive Species? None
Type: None
Debris? Some debris but no trash
Existing Stabilization? None
Success: No, N/A

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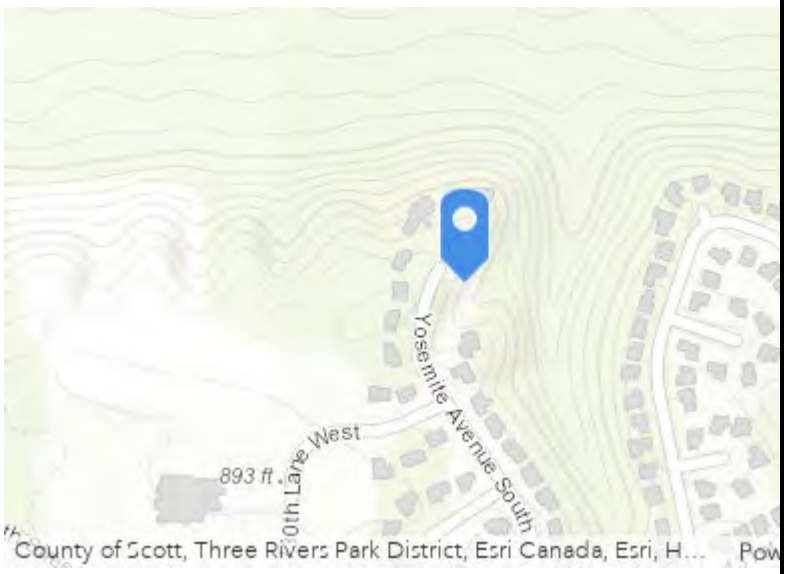
PICTURES:

GULLY ID: ESPM Site 13	
PREVIOUS WAYPOINT ID: Site 13	
SURVEY DATE: April 22, 2021 2:44 PM	
LOCATION: Savage	
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Along a Road Long: >100' gully. The problem indicators were: Degradation, Flattened and/or slumping banks (widening), pistol-butted or leaning trees	Gully Head UTM Estimation: 50 ft, Observation Point correction, if applicable: Connections to other points, if applicable:

GULLY INFORMATION	
EROSION POTENTIAL:	High
GULLY DEPTH:	Deep: >15'
BOTTOM WIDTH:	Wide: >5'
TOP WIDTH:	Wide: >10', Medium: 5'-10', Narrow: 1'-5'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Steep
GULLY SHAPE:	V-shaped
GULLY MATERIAL:	Fine-grained cohesive
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	Slope, Unstable drainage feature entering system

ADDITIONAL NOTES:

Invasive Species?
Type:

Debris? Some trash and debris

Existing Stabilization? None
Success: N/A

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PICTURES:

GULLY ID: ESPM Site 16	
PREVIOUS WAYPOINT ID: Site 16	
SURVEY DATE: April 22, 2021 3:10 PM	
LOCATION: Savage	
TYPE OF SITE: Gully	
SITE SUMMARY: Partly Cloudy Rain in previous 24 hours: Yes: Low Intensity Off of Walking Trail Medium: 50'-100' gully. The problem indicators were: Loss of Bank Vegetation, Vertical and/or bare banks (incision), pistol-butted or leaning trees	Gully Head UTM Estimation: 2', Observation Point correction, if applicable: Connections to other points, if applicable:

GULLY INFORMATION	
EROSION POTENTIAL:	Moderate
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Medium: 1'-5'
TOP WIDTH:	Narrow: 1'-5'
BANK CONDITION:	Bare Soil, Some Vegetation
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Flat
GULLY SHAPE:	Trapezoid
GULLY MATERIAL:	Gravel/cobble/ boulders
WATER LEVELS	Low, Slow
SEEP	No
APPARENT CAUSES:	Unstable drainage feature entering system , Channel Incision

ADDITIONAL NOTES:

Invasive Species?
Type:

Debris? Some trash

Existing Stabilization? Riprap
Success: Yes

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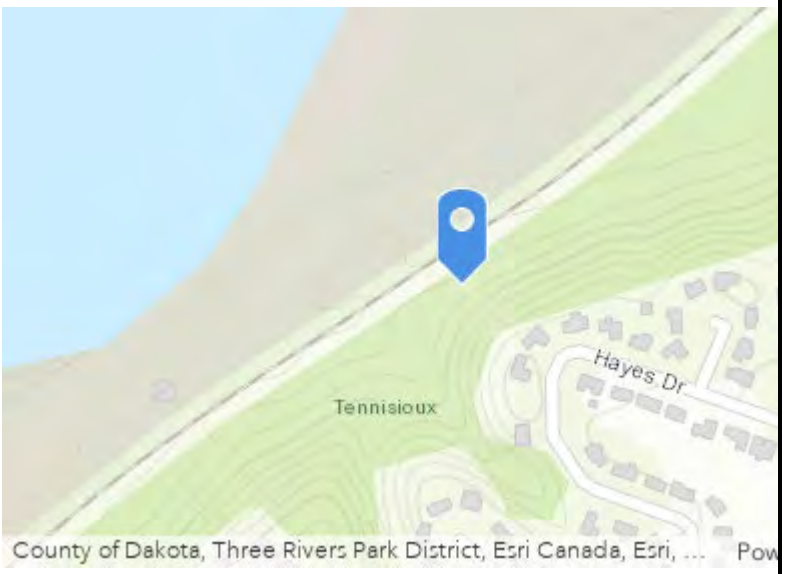
PICTURES:

Riprap surrounding outlet feature

Debris and trash

Aproned outlet

GULLY ID: ESPM Site 22	
PREVIOUS WAYPOINT ID:	Gully Head UTM Estimation: 20,
SURVEY DATE: April 17, 2021 2:26 PM	Observation Point correction, if applicable:
LOCATION:	Connections to other points, if applicable:
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Heavily Forested Long: >100' gully. The problem indicators were: Loss of Bank Vegetation, undercut or overhanging banks (lateral scouring)	

GULLY INFORMATION	
EROSION POTENTIAL:	Low
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Wide: >5'
TOP WIDTH:	Wide: >10'
BANK CONDITION:	Some Vegetation
BOTTOM CONDITION:	Armored
CHANNEL SLOPE:	Steep
GULLY SHAPE:	U-shaped
GULLY MATERIAL:	Gravel/cobble/ boulders
WATER LEVELS	Low, Slow
SEEP	No
APPARENT CAUSES:	None/Unknown

ADDITIONAL NOTES:
8ft storm drain outlet creates stream

Invasive Species? Medium
Type: Common Buckthorn

Debris? Some
Existing Stabilization? N/a
Success: N/A

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PICTURES:

Stormwater outlet

GULLY ID: ESPM Site 23	
PREVIOUS WAYPOINT ID:	Gully Head UTM Estimation: 100ft,
SURVEY DATE: April 17, 2021 2:12 PM	Observation Point correction, if applicable:
LOCATION:	Connections to other points, if applicable:
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Off of Walking Trail Long: >100' gully. The problem indicators were: Degradation, Loss of Bank Vegetation, Vertical and/or bare banks (incision), pistol-butted or leaning trees	

GULLY INFORMATION	
EROSION POTENTIAL:	High
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Wide: >5'
TOP WIDTH:	Wide: >10'
BANK CONDITION:	Bare Soil
BOTTOM CONDITION:	Some Vegetation
CHANNEL SLOPE:	Flat
GULLY SHAPE:	U-shaped
GULLY MATERIAL:	Gravel/cobble/ boulders
WATER LEVELS	Low, Slow
SEEP	Yes
APPARENT CAUSES:	Slope, Scour from debris jam or other channel obstruction, Channel Incision, Dense Canopy

ADDITIONAL NOTES:
In wildlife refuge and disappears after entering hidden pipe, couldn't find outlet

Invasive Species? Medium
Type: Common Buckthorn
Debris? No
Existing Stabilization? Boulders on slopes (pictured)
Success: Yes

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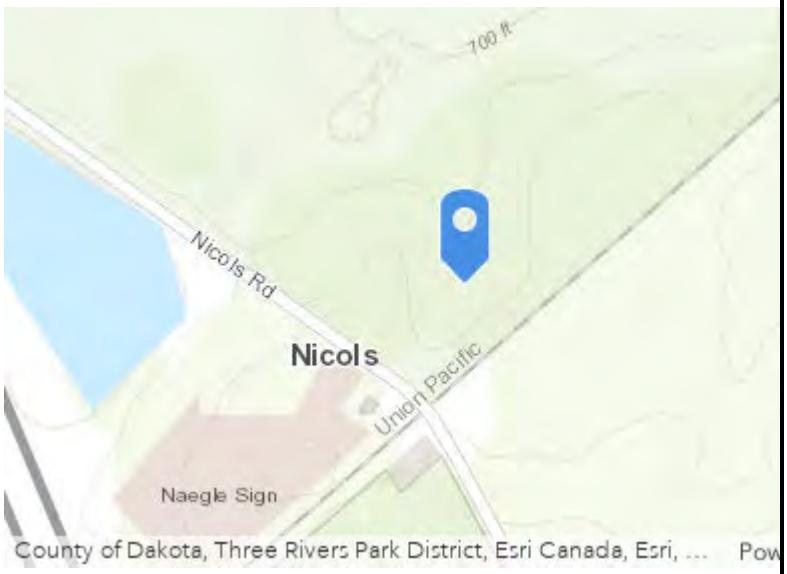
PICTURES:

Right off road access

150ft down trail

Erosion control structures

Turns into meandering stream

GULLY ID: ESPM Site 26	
PREVIOUS WAYPOINT ID:	Gully Head UTM Estimation: 100ftish,
SURVEY DATE: April 17, 2021 12:47 PM	Observation Point correction, if applicable:
LOCATION:	Connections to other points, if applicable: No
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Along a Road Long: >100' gully. The problem indicators were: None	

GULLY INFORMATION	
EROSION POTENTIAL:	Low
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Medium: 1'-5'
TOP WIDTH:	Narrow: 1'-5'
BANK CONDITION:	Heavy Vegetation
BOTTOM CONDITION:	Bare Soil, Heavy Vegetation
CHANNEL SLOPE:	Flat
GULLY SHAPE:	U-shaped
GULLY MATERIAL:	Sand
WATER LEVELS	Low, Slow
SEEP	No
APPARENT CAUSES:	None/Unknown

ADDITIONAL NOTES:

Invasive Species? None
Type: None

Debris? No

Existing Stabilization? NONE
Success: N/A

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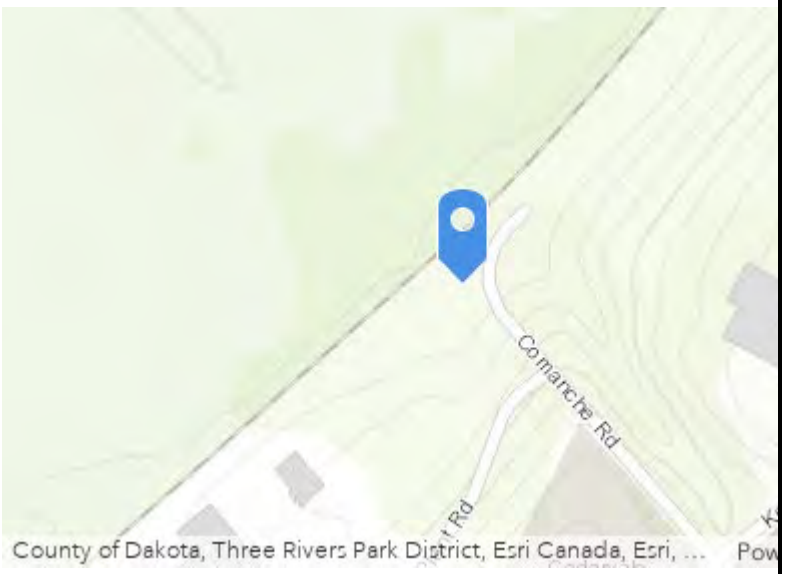
PICTURES:

Top

What rest of stream looks like

GULLY ID: ESPM Site 28	
PREVIOUS WAYPOINT ID:	
SURVEY DATE: April 17, 2021 12:18 PM	
LOCATION:	
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Along a Road Long: >100' gully. The problem indicators were: None	 Gully Head UTM Estimation: 100ft, Observation Point correction, if applicable: Connections to other points, if applicable: We had two locations which are the same gully

GULLY INFORMATION	
EROSION POTENTIAL:	Low
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	Medium: 1'-5'
TOP WIDTH:	Wide: >10'
BANK CONDITION:	Heavy Vegetation
BOTTOM CONDITION:	Armored
CHANNEL SLOPE:	Flat
GULLY SHAPE:	U-shaped
GULLY MATERIAL:	Gravel/cobble/ boulders
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	None/Unknown

ADDITIONAL NOTES:
Part of the stormwater drainage system, looks like it receives heavy flow during storm events but it's in great shape. Gully empties into wetland where it joins wastewater treatment outflow.
Invasive Species? Low
Type: Common Buckthorn
Debris? Not much trash, some
Existing Stabilization? Rip rap with energy dissipation Boulder piles (pictured) also one erosion control log
Success: Yes

PICTURES:

Near the entre to the wetland

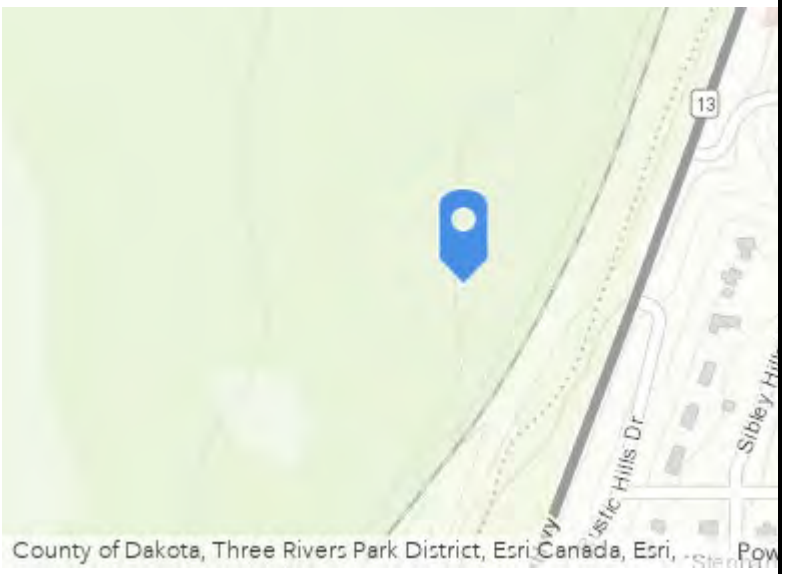
100ft further uphill

At wetland entrance

About 1/3 to top of gully

Other side of the last pictures outlet

Top of gully

GULLY ID: ESPM Site 29	
PREVIOUS WAYPOINT ID:	
SURVEY DATE: April 17, 2021 11:06 AM	
LOCATION:	
TYPE OF SITE: Gully	
SITE SUMMARY: Sunny Rain in previous 24 hours: No Off of Walking Trail Short: <50' gully. The problem indicators were: None	Gully Head UTM Estimation: N/a, Observation Point correction, if applicable: Connections to other points, if applicable:

GULLY INFORMATION	
EROSION POTENTIAL:	Low
GULLY DEPTH:	Shallow: <3'
BOTTOM WIDTH:	N/A - Not Visible
TOP WIDTH:	Narrow: 1'-5'
BANK CONDITION:	Heavy Vegetation
BOTTOM CONDITION:	Heavy Vegetation
CHANNEL SLOPE:	Flat
GULLY SHAPE:	
GULLY MATERIAL:	Sand
WATER LEVELS	None, N/A
SEEP	No
APPARENT CAUSES:	None/Unknown

ADDITIONAL NOTES:
No gully present

Invasive Species? Low
Type: Common Buckthorn

Debris? None
Existing Stabilization? Heavy vegetation, no gully presents
Success: N/A, Unknown

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PICTURES:

APPENDIX B—Gully Condition Rating and Prioritization Memo

APPENDIX C—2021 Gully Inventory Data Sheets

DISCLAIMER

Inferences and conclusions drawn on the field data sheets are limited to qualitative observations the field team was able to make at the time of survey. The inferences drawn and documented in the field notes to theorize or explain natural processes and phenomenon occurring at sites are limited by what is observed, and not proven with field measurements or more detailed investigation.

Additionally, the data sheets are limited by the site location identifiers (IDs) known at the time of the visit. In the initial stages of the study, site IDs may have not been known at the time and placeholders were given while out in the field. Please refer to map for locations.

Minor errors in spelling and grammar may also be present in the data sheets but in no way affect the overall quality of the data collected.