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Memorandum

To: Della Schall Young, Principal, Young Environmental Consulting Group, LLC
Linda Loomis, Administrator, Lower Minnesota River Watershed District
From: Jeff Weiss, PE, Senior Water Resources Engineer
Adam Howard, PE, Water Resources Engineer
Subject: East Chaska Creek Assessment
Date: January 18, 2019
Project: 23101028.02

1.0 Background and Purpose

The Lower Minnesota River Watershed District (LMRWD) has identified East Chaska Creek as a source of sediment entering the Minnesota River. In 2012, LMRWD completed a Strategic Resources Evaluation (SRE) (HDR, Inc., 2015), in which several streams, including East Chaska Creek, were assessed for current and on-going erosion and maintenance issues. In 2015, LMRWD completed a more detailed erosion assessment of East Chaska Creek and published a report in early 2016 titled East Chaska Creek Restoration Project (Burns and McDonnell, 2016). The study identified multiple areas of erosion along East Chaska Creek, which generally coincided with those identified in the SRE; and the study provided recommendations and cost estimates for channel stabilization projects. The study also identified several locations where maintenance is needed to mitigate small, localized issues. Maintenance items included removing fallen trees, removing debris, and installing riprap at storm sewer outfalls. Channel stabilization projects included larger areas of eroding banks and channel instability. Maintenance projects are the primary responsibility of the city of Chaska to complete, and LMRWD helps to facilitate the implementation of the channel stabilization projects.

Since the 2016 East Chaska Creek report, the City has completed some identified maintenance projects, and LMRWD has begun preparing to implement channel stabilization projects. The goals of this study are the following:

1) Reassess previously identified maintenance and erosion sites to
    a. Assess the condition of locations where the City has completed maintenance and stabilization work;
    b. Determine if any erosion sites have worsened;
    c. Evaluate the previous recommendations and reassess their feasibility.
2) Identify new erosion sites that may have developed.
3) Update cost estimates for completing remaining stabilization work.

2.0 Channel Assessment

2.1 Overall assessment

On November 8, 2018, staff from Barr Engineering Co. (Barr) and Young Environmental Consulting Group (Young Environmental) walked East Chaska Creek from approximately Engler Boulevard to the levee gate structure. Overall, the channel appeared to be in relatively good condition. The creek appeared to have adequate connection to a floodplain in most places, so it does not appear to be incised. There are localized erosion locations contributing sediment to the stream; however, it does not appear to have significant systemic issues related to channel incision.

As noted in the 2016 report, the channel is likely a man-made channel constructed to serve local industry. As such, it was likely designed for the industrial purposes and was not designed with geomorphic principals in mind. Some of the localized erosion issues could be attributed to the channel being constructed as a relatively straight channel with few meanders. When straightened, streams always try to create a more meandering path, so some of the localized erosion is likely caused by the channel trying to create a more sinuous, meandering path. The diversion channel located upstream of this reach controls flows through this reach and likely helps prevent some erosion from becoming worse by reducing the peak flows.

2.2 Maintenance Sites

Staff from Barr and Young Environmental noted if previously recommended maintenance activities had been completed. Table 1 and Figure 1 summarize the status of maintenance activities.

Table 1 Summary of Maintenance Sites

Maintenance No.	Description	Completed Status	Recommendation
M1	Riprap toe at RCP Outfall	No	Complete as planned
M2	Repair bank, riprap at dual 12" diameter CMP outfalls	No	Complete as planned
M3	Remove debris	No	Complete as planned
M4	Remove debris	No	Complete as planned
M5	Remove debris	No	Complete as planned
M6	Repair bank, install riprap at PVC outfall	No	Complete as planned
M7	Remove debris	No	Not necessary
M8	Remove debris	No	Not necessary
M9	Remove debris	No	Not necessary
M10	Remove debris	No	Not necessary

M11	Remove flap gate off RCP outlet, repair riprap	No	Complete as planned
M12	Remove debris	No	Complete as planned
M13	Remove debris and remove material pile on left bank, seed	Yes	N/A
M14	Install riprap at end of storm sewer outfalls and cross vane for grade control	No	Added in 2018

It appeared that one maintenance item (M13) has been completed. Most other previously recommended maintenance tasks (M1, M2, M3, M4, M5, M6, M11, and M12) should still be completed. Of those it should be noted that M12 includes failing riprap with erosion at the site. Also, the debris at M12 is significant enough that it is staging water upstream. Site M14 was added to the list with this assessment as staff observed erosion at the storm sewer outfalls on the downstream side of Chaska Boulevard.

After evaluating photos and field notes, Barr concluded that the maintenance items at M7, M8, M9, and M10 are the lowest priorities, or could be excluded from maintenance activities. Debris is still located at each site and should be removed if it can be done without creating a significant additional disturbance; however, they are minor issues that are not causing significant adverse impacts.

Photos of many of the maintenance sites are included in Attachment A.

2.3 Stabilization Sites

The 2016 report recommended stabilizing several erosion areas, and they were grouped into three recommended stabilization projects. Barr and Young Environmental evaluated the erosion at each of these locations, and the following sections provide a review of the recommended projects. The Barr and Young Environmental evaluation observed one new erosion location, so there is a new recommended stabilization project. Photos of the stabilization sites are included in Attachment A

2.3.1 Site S1: Repair Scour Hole Downstream of Crosstown Boulevard Bridge

The channel under the Crosstown Boulevard Bridge is lined with concrete so it is wide and flat (Site S1 in Figure 2). The downstream end of the concrete lining is also above the existing channel bed, resulting in a drop of approximately one to two feet. It is possible that the channel downstream developed a headcut that created the drop at this location; however, the banks downstream of the bridge do not have a similar evidence of a headcut moving through the section of stream. In general, the banks are gradually sloping and appear to be at a reasonable height compared to the stream. If a headcut came through this section, the impacts of the headcut appear to have self-mitigated downstream of the bridge. Alternatively, it is also possible that the bridge was originally installed with an elevation drop at the downstream end.

Regardless of the cause, the current situation has a handful of issues that should be mitigated. The main issue present is primarily caused by the fact that the wide, flat concrete lining disperses flow along the entire width of the channel bottom at a nearly even depth, and it spills over the end of the lining like a weir. This results in bank erosion and an over-widened channel for approximately 20-30 feet downstream of the bridge. Furthermore, the combination of the elevation drop and the flat, sheet flow through the bridge also create a barrier for aquatic organism passage.

The 2016 report recommended salvaging the existing riprap, regrading, reinstalling riprap, and adding some additional riprap. Barr concurs that this approach is likely the most cost effective option with the following considerations:

1) The design of the riprap at the end of the bridge should try to eliminate the weir flow at the end of the bridge and direct flow into a channel width that mimics the channel width downstream of the bridge. Eliminating the weir flow will reduce erosive pressure on the banks immediately downstream of the bridge. There are multiple ways of achieving this that will depend on other design parameters related to the bridge hydraulics.
2) Given the elevation drop from the end of the bridge to the existing channel, the design should plan to incorporate a scour hole at the end of riprap. Scour holes naturally occur downstream of elevation drops in streams, so a scour hole is likely to develop anyway. Incorporating it into the design will reduce the risk of adverse impacts.
3) If possible, riprap at the end of the bridge should extend above the bottom of the bridge to create additional flow depth to provide for aquatic organism passage. Bridge flow capacity and hydraulics will determine if this is possible.

The construction cost estimate for this reach is estimated to be approximately $18,980, including a 30% contingency. The estimated construction cost for specified items is similar to the cost estimated in 2016; however, this estimate includes a larger assumed percent for mobilization and contingency. A full cost estimate summary, including estimated engineering fees, is included at the end of this section.

2.3.2 Sites S2-S6: Install Bank Armoring, Toe Protection, and Grade Control Structures behind Lenzen Chevrolet

There are multiple eroding banks within this reach (Sites S2 – S6, Figure 2) that threaten the City's paved trail located between the channel and the Lenzen Chevrolet parking lot. The creek appears to be developing point bars and a meandering pattern through this reach that is otherwise relatively straight. Given the man-made origins of the channel, the original channel may have been created too large for the flows it currently experiences in this location, so a smaller, meandering pattern appears to be developing within the larger channel.

The 2016 report recommended a variety of measures to stabilize the reach, including installing a grade control structure, removing temporary asphalt repairs, installation of hard armoring for approximately 320 feet of banks, and installation of toe protection for approximately 340 feet of banks.

After reviewing the site, Barr concurs that all of the erosion sites should be stabilized, and we concur with the recommendation to remove temporary asphalt repairs. The armoring and toe protection previously recommended would be effective. The previously recommended grade control structure (S2, Figure 2) can be eliminated because headcutting does not appear to be an issue within this reach.

Alternatively, other stabilization measures could be used to achieve the same goals. Toe protection with riprap is still the most effective option in some places; however, rock vanes and root wads would be used in many locations to provide bank protection at a lower cost. The following table provides a comparison of the 2016 recommendations and alternatives considered in this analysis.

Table 2 Comparison of stabilization recommendations

Site	Original Recommendation	Alternate Recommendation
S2	Install grade control structure	Not necessary
S3	Armor bank (320 LF)	Install riprap toe protection and riprap armoring along approximately 100 feet of bank. Install approximately 6 rock vanes in other locations to direct flow away from the banks
S4	Install toe protection (130 LF)	Install riprap toe protection along approximately 50 feet, and install 4 rock vanes.
S5	Install toe protection (150 LF)	Grade banks and use removed trees from the project to install root wads for bank protection
S6	Install toe protection (60 LF)	Install 2 rock vanes to direct flow away from bank.
Construction Cost Estimate[1]	**$122,200**	**$96,850**

1 – Includes 30% construction contingency.

Based on Barr's cost assumptions and the assessment completed by Barr and Young Environmental, the alternative recommendations for stabilizing this reach have the potential to have a lower cost than those included in the original recommendation in 2016. A full cost estimate summary, including estimated engineering fees, is included at the end of this section.

2.3.3 Site S7: Install toe protection on right bank east of Oak Street

The original recommendation included installing toe protection for approximately 120 feet of the right bank (Figure 3). The 2018 assessment found that the City had recently completed some stabilization work

on this site, including grading and revegetating the bank. As a result, Barr recommends not completing additional stabilization work in this area.

2.4 Cost Estimate

Table 3 summarizes the cost estimate for the stabilization projects summarized in this memorandum. We assumed larger percentages for some items, such as mobilization, construction contingency, and engineering compared to those used in the 2016 report. The percentages used are those that Barr typically uses for a feasibility-level cost estimate on projects of this order of magnitude. Detailed cost estimates are included in Attachment B.

Table 3 Cost Estimate Summary

Site No.	Description	Estimated Cost
S1	Repair erosion downstream of Crosstown Boulevard	$14,600
S2-S6	Stabilize bank erosion near Lenzen Chevrolet	$74,500
S7	No recommended action	$0
	Subtotal	$89,100
	Contingency (30%)	$26,730
	Construction Subtotal	**$115,830[a]**
	Survey	$10,000
	Engineering (30% of Construction Subtotal)	$34,750
	Project total	**$150,580[b]**

a – includes the subtotal plus contingency
b – includes the Construction Subtotal, Survey, and Engineering

The current cost estimate represents a decrease of approximately $17,900 under the 2016 cost estimate of $168,506. Some items were assumed to cost less with the current estimate while other items were added or assumed to cost more. Some key differences include:

1) Barr assumed mobilization costs 10% of remaining construction costs, whereas the 2016 report assumed 5% for mobilization. Mobilization percentages in bids can vary widely, and Barr typically assumes 10% in cost estimates.
2) Barr included a 30% contingency instead of 20%. Barr typically assumes a 30% contingency at a feasibility level cost estimate. Furthermore, since this is a relatively small project, the contingency amount could be consumed quickly by one or two additions, so the larger contingency provides some additional funds for unforeseen items or sites.

3) Barr assumed $10,000 for surveying instead of $5,000 because some sites could prove to be challenging to survey, depending on the time of year.
4) Barr assumed 30% of the construction subtotal for engineering and design, rather than 15%. This percentage is often near 15% for larger projects; however, Barr feels 30% is a realistic percentage for this size of project.

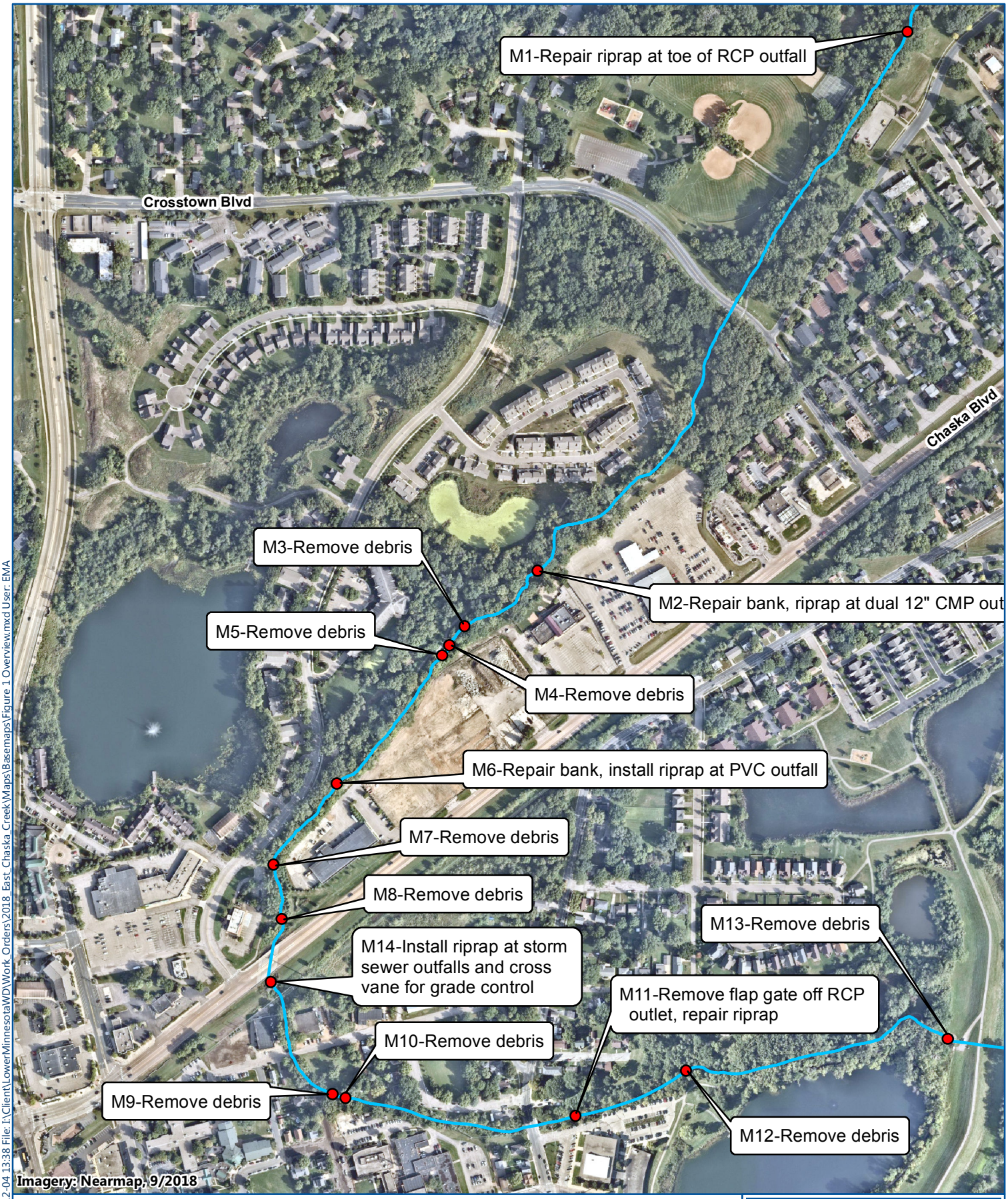
Despite these differences that typically added costs, the overall cost estimate is similar to the original estimate in 2016.

3.0 Recommendations

Barr recommends that LMRWD move forward with planned maintenance and stabilization projects with the following recommendations:

1) Add Site M16 to the recommendation maintenance items
2) Coordinate with the city of Chaska to save money by completing maintenance and stabilization projects at the same time.

Figures



Legend

- East Chaska Creek
- Recommended Maintenance Activity Location

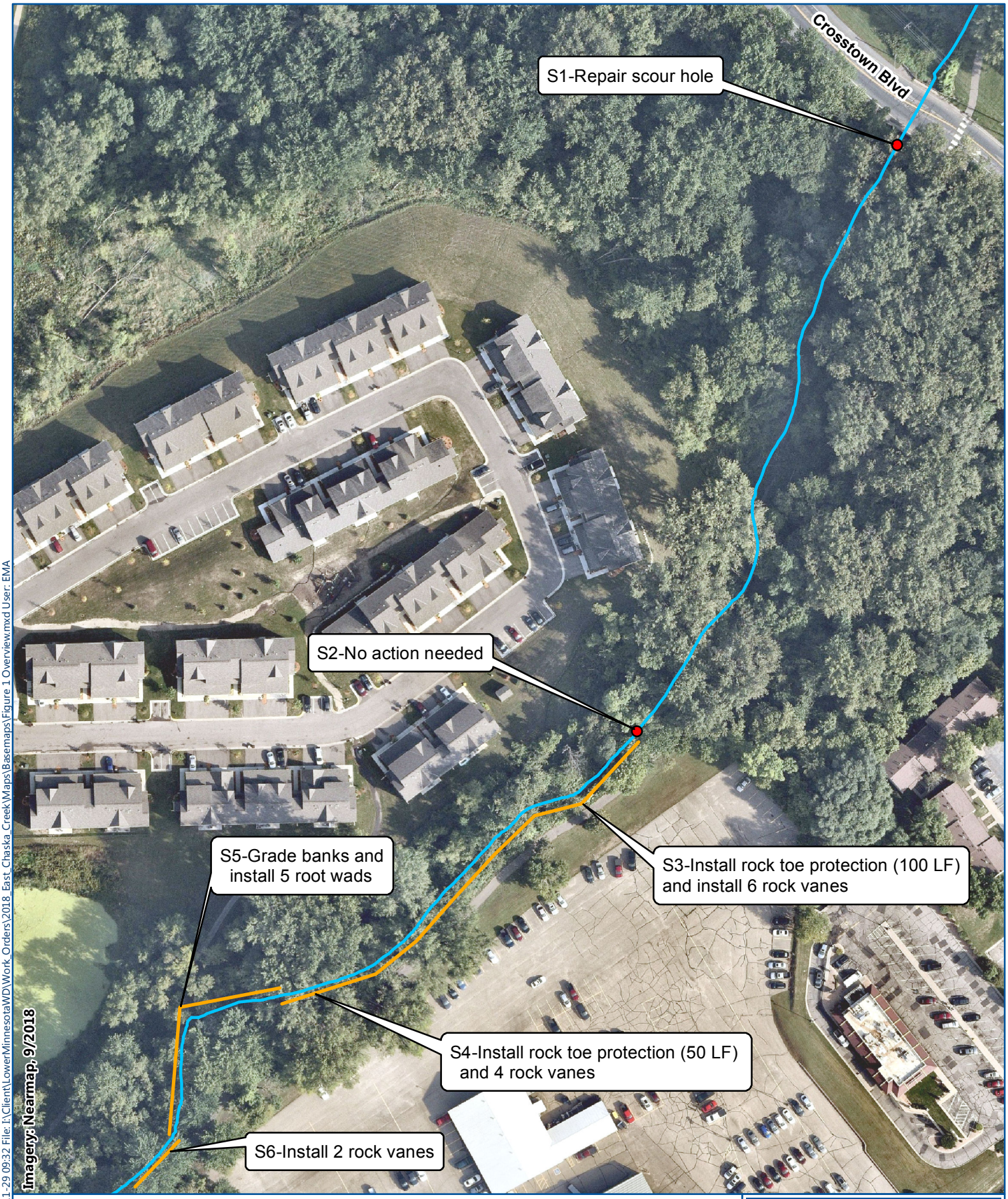
0 250 500

Feet

1 inch = 494 feet

RECOMMENDED MAINTENANCE ACTIVITIES
East Chaska Creek Project
Chaska, MN

FIGURE 1



Legend

- East Chaska Creek
- Recommended Channel Stabilization Project (Stream Bank)
- Recommended Channel Stabilization Project (Single Location)

N

0 60 120

Feet

1 inch = 120 feet

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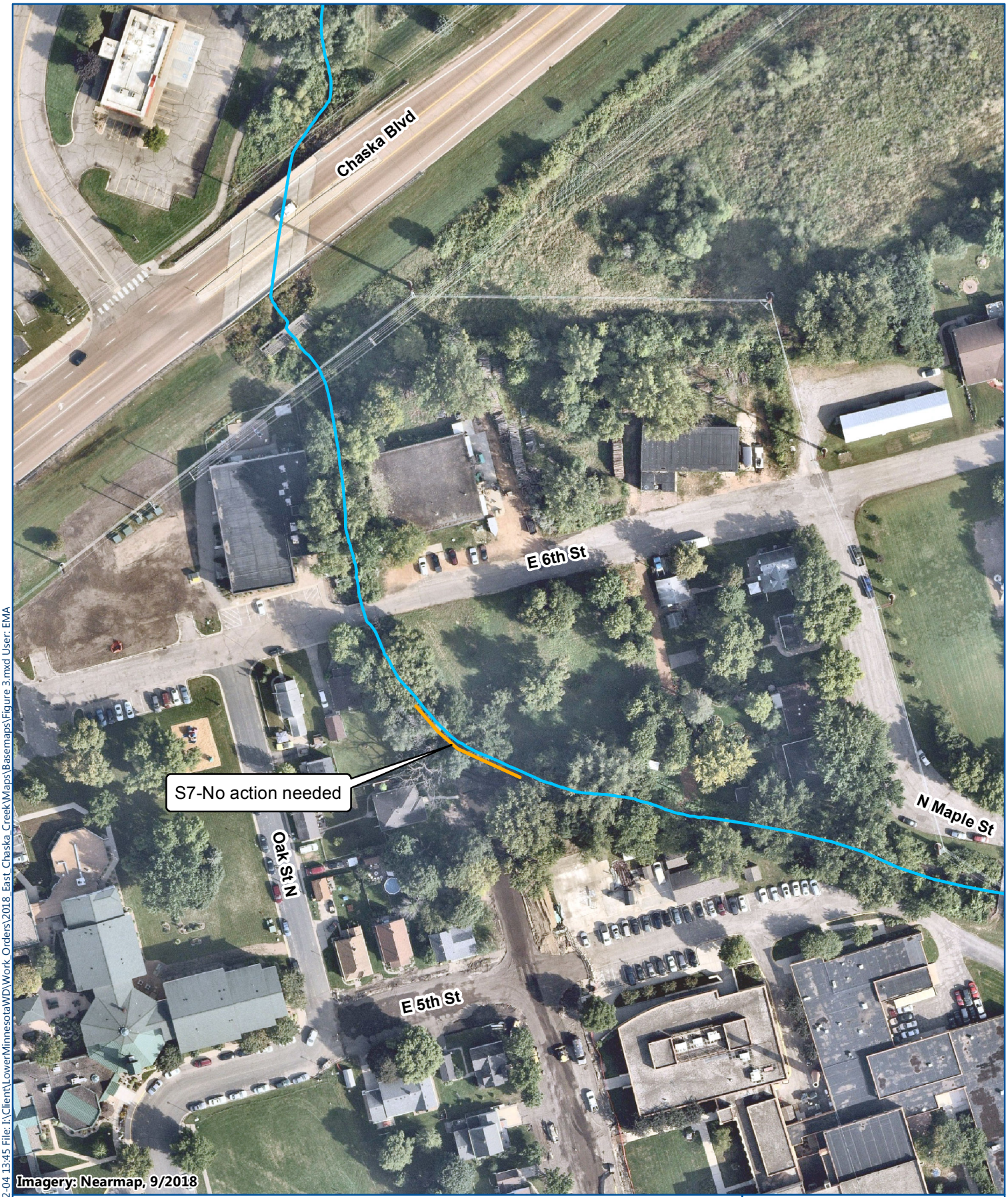
RECOMMENDED CHANNEL STABILIZATION PROJECTS
East Chaska Creek Project
Chaska, MN

FIGURE 2

Barr Footer: ArcGIS 10.6, 2018-11-29 09:32 File: I:\Client\LowerMinnesotaWD\Work_Orders\2018_East_Chaska_Creek\Maps\Basemaps\Figure 1 Overview.mxd User: EMA



Legend

- East Chaska Creek
- Recommended Channel Stabilization Project (Stream Bank)
- Recommended Channel Stabilization Project (Single Location)

N

0 60 120

Feet

1 inch = 120 feet

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RECOMMENDED CHANNEL STABILIZATION PROJECTS

East Chaska Creek Project
Chaska, MN

FIGURE 3

Attachment A

Site Photos

Chaska Creek Site Photos, November 8, 2018

Photo 1: Site M2 –erosion around culvert outfalls.

Photo 2: Site M3 – debris in channel creating blockage and minor erosion

Photo 3: Site M6 – bank erosion adjacent to a PVC outfall

Photo 4: Site M7 – debris in channel causing blockage

Photo 5: Site M8 – debris in channel

Photo 6: Site M9 – debris in channel upstream of site repaired by city of Chaska

Photo 7: Site M10 – debris in channel downstream of site repaired by city of Chaska

Photo 8: Site M11 – flap on RCP outlet and minor bank erosion

Photo 9: Site M12 – debris jam causing blockage and backwater

Photo 10: Site M13 – culvert outlet through the levee.

Photo 11: Site M14 – eroding banks and headcuts near Chaska Boulevard

Photo 12: Site S1 – scour hole and erosion downstream of Crosstown Boulevard

Photo 13: Channel near site S2

Photo 14: Site S3 – eroding bank between channel and paved trail near Lenzen Chevrolet

Photo 15: Site S4 – eroding bank and debris in the channel

Photo 16: Site S5 – eroding bank and undercut trees

Photo 17: Site S6 – minor bank erosion downstream on Lenzen Chevrolet

Photo 18: Site S7 – recent repairs made by city of Chaska

Attachment B

Detailed Cost Estimates

EAST CHASKA CREEK STABILIZATION SITES
COST ESTIMATE
January 18, 2018

Site S1: Repair Scour Hole Downstream of Crosstown Boulevard

Item	Description	Units	Quantity	Unit Price	Extension
1.01	Mobilization (10%)	Lump Sum	1	$ 1,400.00	$ 1,400.00
1.02	Erosion Control	Lump Sum	1	$ 300.00	$ 300.00
1.03	Clearing and grubbing	Lump Sum	1	$ 1,000.00	$ 1,000.00
1.04	Salvage existing riprap	CY	30	$ 25.00	$ 750.00
1.05	Grading	CY	100	$ 50.00	$ 5,000.00
1.06	Granular filter material	Ton	15	$ 60.00	$ 900.00
1.07	Replace salvaged riprap	CY	30	$ 25.00	$ 750.00
1.08	install new riprap	Ton	50	$ 80.00	$ 4,000.00
1.09	Site restoration	Lump Sum	1	$ 500.00	$ 500.00
				Subtotal	**$ 14,600.00**
				Contingency	30%
				Total	**$ 18,980.00**

Site S2-S6: Repair Eroding Banks by Lenzen Chevrolet

Item	Description	Units	Quantity	Unit Price	Extension
1.01	Mobilization (10%)	Lump Sum	1	$ 6,800.00	$ 6,800.00
1.02	Erosion Control	Lump Sum	1	$ 1,400.00	$ 1,400.00
1.03	Clearing and grubbing	Lump Sum	1	$ 5,000.00	$ 5,000.00
1.04	Remove asphalt stabilizat	CY	15	$ 30.00	$ 450.00
1.05	Grading	CY	750	$ 15.00	$ 11,250.00
1.06	granular filter	Ton	100	$ 60.00	$ 6,000.00
1.07	Riprap - toe protection	Ton	250	$ 80.00	$ 20,000.00
1.08	Rock vanes	LF	140	$ 120.00	$ 16,800.00
1.09	Root wads	Each	6	$ 800.00	$ 4,800.00
1.10	Site restoration	Lump Sum	1	$ 2,000.00	$ 2,000.00
				Subtotal	**$ 74,500.00**
				Contingency	30%
				Total	**$ 96,850.00**