East Chaska Creek Restoration Project

Lower Minnesota River Watershed District & the City of Chaska

East Chaska Creek Restoration Project
Project No. 86550

February 2016

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Prepared for

Lower Minnesota River Watershed District &
the City of Chaska
East Chaska Creek Restoration Project
Chaska, MN

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Prepared by

Burns & McDonnell Engineering Company, Inc.
Bloomington, MN

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1.0 BACKGROUND INFORMATION

1.1 Introduction

The East Chaska Creek (Creek) Restoration Project (Project) is located in the City of Chaska within the Lower Minnesota Watershed District. In January 2014, the Strategic Resources Evaluation (SRE) identified East Chaska Creek as a necessary project. The SRE states that the Creek needs attention to prevent further erosion. The SRE designated the Creek as a "Category 2 Stream Feasibility Study" (Feasibility Study) which recommends several channel erosion countermeasures from Engler Street to Courthouse Lake Trail. Figure 1 in Appendix A shows an overview map of the Project area.

The SRE divided the Project into six segments (Reaches A, B, C, D, E, and F) and, when presented to the Technical Advisory Committee (TAC) in July 2015, it was agreed that the work for each segment should be combined. In addition, the Project has been added to the District's 3rd Generation Management Plan (Plan) in Table 4-4, "Capital Improvement Projects," as part of the 2015 Plan amendment.

At the June 17, 2015, Lower Minnesota River Watershed District (District) Board of Managers regular meeting, Managers approved a cost share agreement with the City of Chaska (City) for Task 1 of the East Chaska Creek Restoration Project. Task 1 includes data collection and review, refining priority sites and reaches, recommending channel stabilization improvements, and developing conceptual cost estimates. Burns & McDonnell Engineering Company (Burns & McDonnell) was selected to complete Task 1.

1.2 Objectives

The objectives of this report are to:

1. Identify channel maintenance activities.
2. Prioritize channel stabilization projects and provide conceptual design and cost estimates.
3. Identify other potential capital projects and studies.

1.3 Watershed Land Use

According to Carver County staff, the East Chaska Creek watershed covers approximately 9,841 acres of Carver County, including the eastern portion of the City of Chaska. In 2005, the dominant land uses in the watershed were natural areas at 37 percent and developed land at 31 percent of the total watershed area. The 2020 projected land use shows large increases in developed land (to 47 percent), with natural areas decreasing to 23 percent.

1.4 History of East Chaska Creek

The history of East Chaska Creek is important to address as it gives context for the decisions the City and District will make to implement the various maintenance activities, stabilization projects, and capital projects recommended later in this report. East Chaska Creek is unique relative to other streams in the region as (1) the channel within the Project area is likely completely manmade and (2) flow through the channel within the project area is controlled by an upstream diversion structure (See Appendix A, Figure 1).

Interviews with the City Engineer, examination of historic plat maps (Appendix A, Figure 2), and earliest available aerial photography (Appendix A, Figure 3) of the project area indicate that the channel was constructed at some point between 1851 and 1937, potentially to support clay mining and brickmaking operations. Field visits conducted for this study show evidence of the use of clay bricks to stabilize the channel banks in some reaches of the Creek.

To protect the City from Minnesota River flooding, the U.S. Army Corps of Engineers (USACE) began construction of a levee around the riverward side of the City in 1992. The East Chaska Creek channel passes through the levee at Courthouse Lake Trail through an 84-inch reinforced concrete pipe (RCP), and flow is controlled with a gate (Figure 1). To mitigate the potential for internal flooding from East Chaska Creek during river flood fighting and to alleviate regular flooding of downtown Chaska, a diversion channel and control structure were also constructed east of the intersection of Kelly and North Valley Roads (Appendix A, Figure 1) to route flow from upstream around the City directly to the Minnesota River. Construction of the levee and diversion channel were completed in 1998.

2.0 PREVIOUS ASSESSMENTS

2.1 MPCA Water Quality Assessment

The Minnesota Pollution Control Agency (MPCA) has identified and listed the Creek as an "impaired water." According to the MPCA, "impaired waters" are those waters that do not meet State water quality standards for one or more pollutants; thus, they are "impaired" for their designated uses. Table 1 summarizes the MPCA listed impairments on the Creek. These impairments are based on MPCA assessments of water quality monitoring data collected by Carver County at the monitoring locations indicated in Appendix A, Figure 1.

Table 5-1: East Chaska Creek Water Quality Impairments[1]

Beneficial Use	Assessment Year	Impairment Cause
Aquatic life	2009	Fish bio-assessments
		Turbidity
Aquatic recreation	2007	Fecal coliform

2.2 Strategic Resources Evaluation

A Feasibility Study for East Chaska Creek was performed by HDR, Inc. (HDR) as part of the District's SRE in 2012 (Appendix B). The Creek was one of four streams selected to determine potential best management practices (BMPs) to mitigate sources of erosion, thereby reducing turbidity in the streams within the District. HDR noted reaches of the stream that were actively eroding or had outside bend erosion during a field visit conducted on August 28, 2012. HDR recommended that debris and dead trees from the channel be removed and that localized problems at outfalls and crossings be addressed with grade control structures and bank stabilization measures.

[1] "Maps of Minnesota's impaired waters and TMDLs," Minnesota Pollution Control Agency, accessed October 14, 2015

3.0 CHANNEL ASSESSMENT SUMMARY

Burns & McDonnell conducted day-long field visits on two different days, August 26 and September 14, 2015, to visually assess the Creek and to determine initial improvement alternatives. Two cross sections were also surveyed immediately downstream and approximately 750 feet downstream of the Crosstown Boulevard bridge crossing to estimate bottom width, side slope, and bed slope. Overall, our assessment indicated that while the Creek has visible signs of previous bank and bed erosion, the stream was not actively eroding to the degree indicated in the HDR report or that is typically observed in urbanizing streams. In general, no active signs of bank erosion, such as exposed orange roots, were observed along the banks, and vegetation had begun to establish itself on point bars. This is likely because much of the channel forming flow that historically passed through the Creek is now being directed to the USACE diversion channel.

The field assessment did indicate the need to perform some channel maintenance and stabilization activities as a means to (1) mitigate sources of localized erosion at outfalls and debris jams and (2) prevent potential future damage to existing infrastructure. The assessment also identified other potential capital projects and studies the City and District may undertake to address MPCA water quality impairments on the Creek and sediment transport to the Minnesota River.

4.0 RECOMMENDED ACTIONS

Burns & McDonnell recommends the following actions, categorized into the following activities: (1) Maintenance, (2) Channel Stabilization Projects and (3) Other Potential Capital Projects and Studies. These three actions are discussed in the following sections.

4.1 Maintenance Activities

The following maintenance activities are recommended for the City to undertake. Since these activities will be undertaken by City staff, no cost estimates were prepared. Figure 4 (Appendix A) shows the locations of these activities, and Appendix C contains photographs of each location (Photographs A1 – A15). In general, these maintenance activities include:

- Removal of debris to maintain the channel capacity and to prevent larger debris jams at road crossings.
- Point repair of stormwater outfalls with riprap to prevent future erosion and to protect outfalls.
- Removal of consolidated sediment at most downstream area near the levee and reseeding of the area to stabilize the lower end of the stream.

These maintenance activities should be done as soon as possible to prevent more costly future improvement caused by lack of maintenance. The lower end of the Creek should be checked routinely for signs of sedimentation upstream of the 84-inch RCP through the levee. Following any flood fighting activities, the sediment and debris removed from the creek should be hauled away from the site and the overbanks reseeded.

4.2 Channel Stabilization Projects

The following channel stabilization projects are recommended primarily to protect City infrastructure and secondarily to reduce future Creek bank and bed erosion. Figures 5 and 6 (Appendix A) show the locations of these activities, and Appendix C contains photographs of each location. Appendix D contains cross section survey information.

4.2.1 Repair Scour Hole Downstream of Crosstown Boulevard Bridge

This recommended creek improvement consists of repairing the scour hole downstream of Crosstown Boulevard Bridge; the scour hole has been caused by the creek downcutting to this point (Appendix A, Figure 5). The scour hole is approximately 30 feet wide, 10 feet long, and 3 feet deep (Photographs B1 – B9). Repair would consist of salvaging existing riprap, re-grading the channel downstream of the structure apron, and re-installing filter fabric and riprap.

4.2.2 Install Bank Armoring, Toe Protection, and Grade Control Structure behind Lenzen Chevrolet

This project consists of repairing bank erosion which threatens the City's paved trail as well as two large cottonwood trees behind Lenzen Chevrolet (Appendix A, Figure 5). The channel through this reach is approximately 6 to 7 feet deep. Two temporary asphalt repairs have been implemented in this location, but the repairs have subsequently failed (Photographs B10 – B14). A grade control structure would also be installed to prevent potential channel downcutting upstream to Crosstown Boulevard. Repairs would consist of removal of temporary asphalt repairs, complete bank hard armoring for approximately 320 linear feet along the left bank, toe protection for approximately 340 linear feet on the left and right banks, and a grade control structure.

4.2.3 Install Toe Protection on Right Bank East of Oak Street

This project consists of installing toe protection for approximately 120 linear feet on the right bank of the channel east of Oak Street (Appendix A, Figure 6). There are houses located in close proximity to this outside bend, and the houses could potentially be threatened if the bank continues to erode (Photograph B15).

4.2.4 Cost Estimate

A rough, planning-level cost estimate was developed for the recommended channel stabilization projects and is summarized in Appendix E. For cost estimation purposes, Burns & McDonnell has assumed that (1) the projects will be implemented simultaneously, 2) toe protection will consist of rock or riprap revetment, and (3) and the grade control structure will consist of a rock weir. Costs could be reduced if salvaged woody debris collected from maintenance activities were used in place of riprap toe protection. The cost to implement the recommended channel stabilization projects totals approximately $168,500.

4.3 Other Potential Capital Projects and Studies

Burns and McDonnell has identified other potential capital projects and studies for the District and City to consider to:

1. Address the various impairments on the Creek.
2. Mitigate sediment transport to the Minnesota River.

Figure 7 (Appendix A) shows the location of these potential capital projects, and Appendix C shows photographs of each location.

4.3.1 Constructed Wetland along Chaska Boulevard

There is a potential site to construct a treatment wetland south of the Creek within two vacant lots along Chaska Boulevard. Currently, the majority of the lots are paved right up to the edge of the Creek bank (Photographs C1 – C3). As shown in Figure 7 (Appendix A), flow could be diverted from the Creek channel into a wetland system to provide for sediment removal, flood storage, and bacteria treatment. The channel bottom adjacent to the vacant lots is approximately 5 feet deep from the top of the pavement, making flow diversion easy to accomplish and minimizing the amount of excavated material. Potential pitfalls would be soil conditions beneath the existing paved lots and the potential for contaminated soils. The feasibility of a wetland bank could also be explored. The existing trail system to the north could be tied into the wetland, enhancing the trail system and providing a public education opportunity. In addition, the remaining frontage portion of the lots could be resold as higher valued parcels for future redeveloping, helping offset the cost of the project.

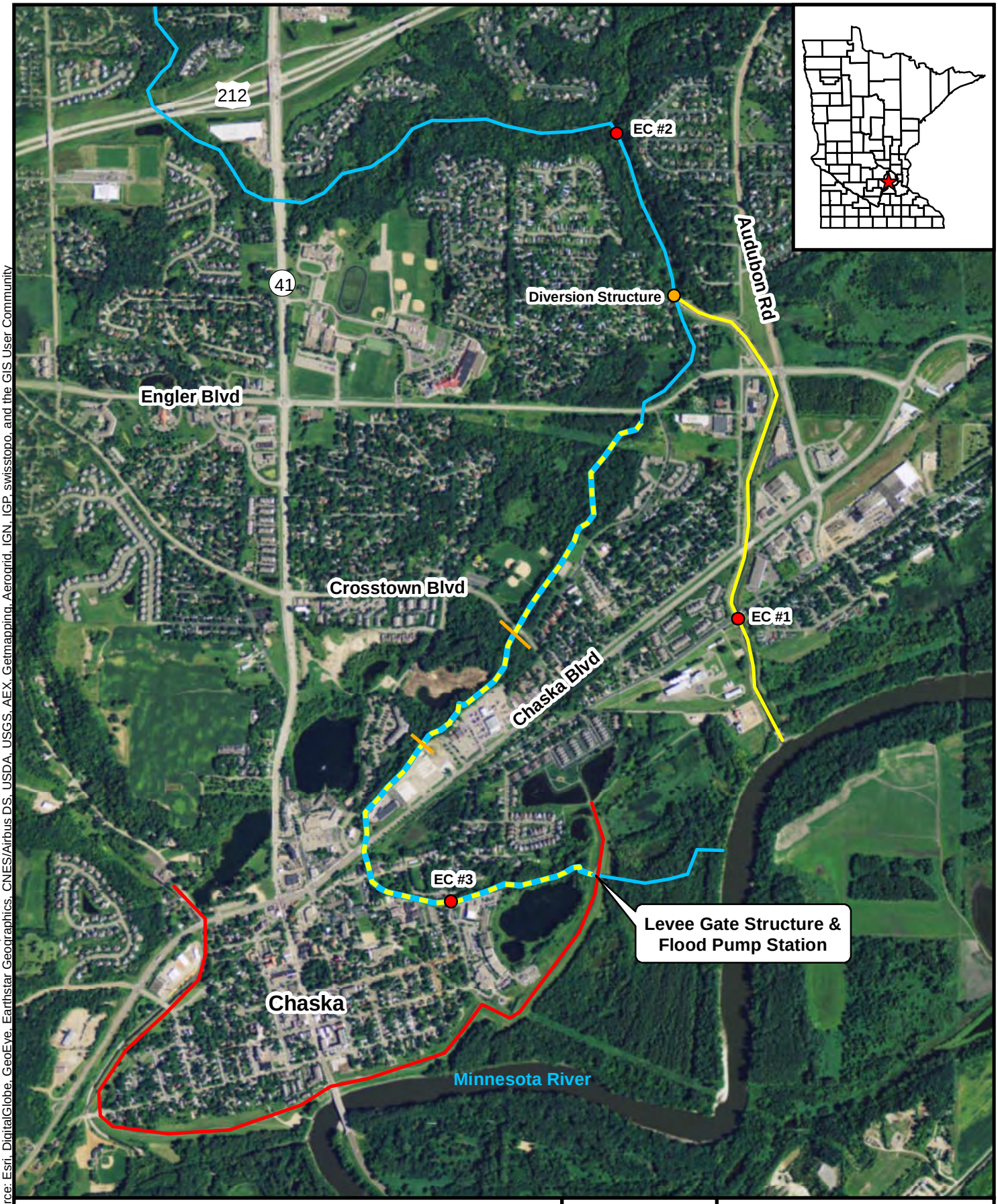
4.3.2 Settling Basin Upstream of Creek Levee Crossing

Field visits to this location indicate prior sedimentation and excavation during Minnesota River flood fighting (Photographs C4 – C6). Constructing a baffled settling basin in this location would allow for efficient trapping of sediment prior to build up at the levee and easier removal of sediment after internal flooding. Constructing a designed settling basin would reduce sediment to the Minnesota River, provide easier maintenance, and improve the efficiency of the flood pump inflow.

4.3.3 Sanitary / Septic Connection Source Identification

White foam was also observed in a few locations throughout the reach during the field visit on September 14, 2015 (Photographs C7 – C9). These observations coupled with dry weather the preceding 4 days and the MPCA bacteria impairment indicate a potential anthropogenic source (sanitary or septic connection). The District, in cooperation with Carver County and the City of Chaska, could explore the possibility of identifying the flow connection to the Creek from sanitary sources or septic systems that are adversely impairing water quality in the Creek.

APPENDIX A - FIGURES



NORTH

0 750 1,500 Feet

Scale: 1 Inch = 1,500 Feet

Legend

- Project Area
- CCWMO Monitoring Location
- Diversion Structure
- East Chaska Creek
- Diversion Channel
- Levee
- Surveyed Cross Section

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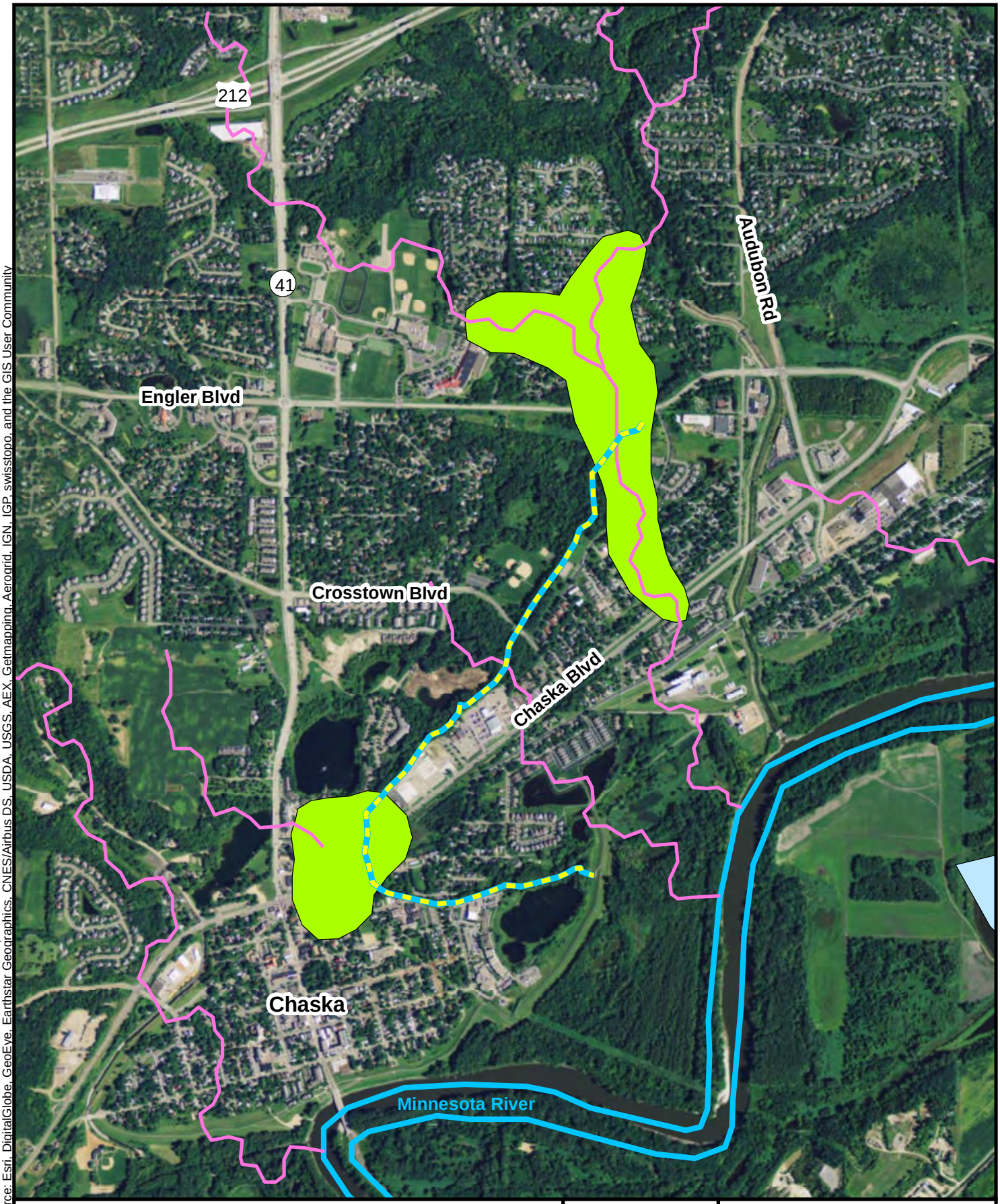
Figure 1
Project Overview Map

East Chaska Creek Project
Chaska, Minnesota

Source: Burns & McDonnell

Issued: 10/16/2015



NORTH

0 750 1,500 Feet

Scale: 1 Inch = 1,500 Feet

Legend

Project Area

1855 Historical Data:

Stream

River

Wetland

Lake

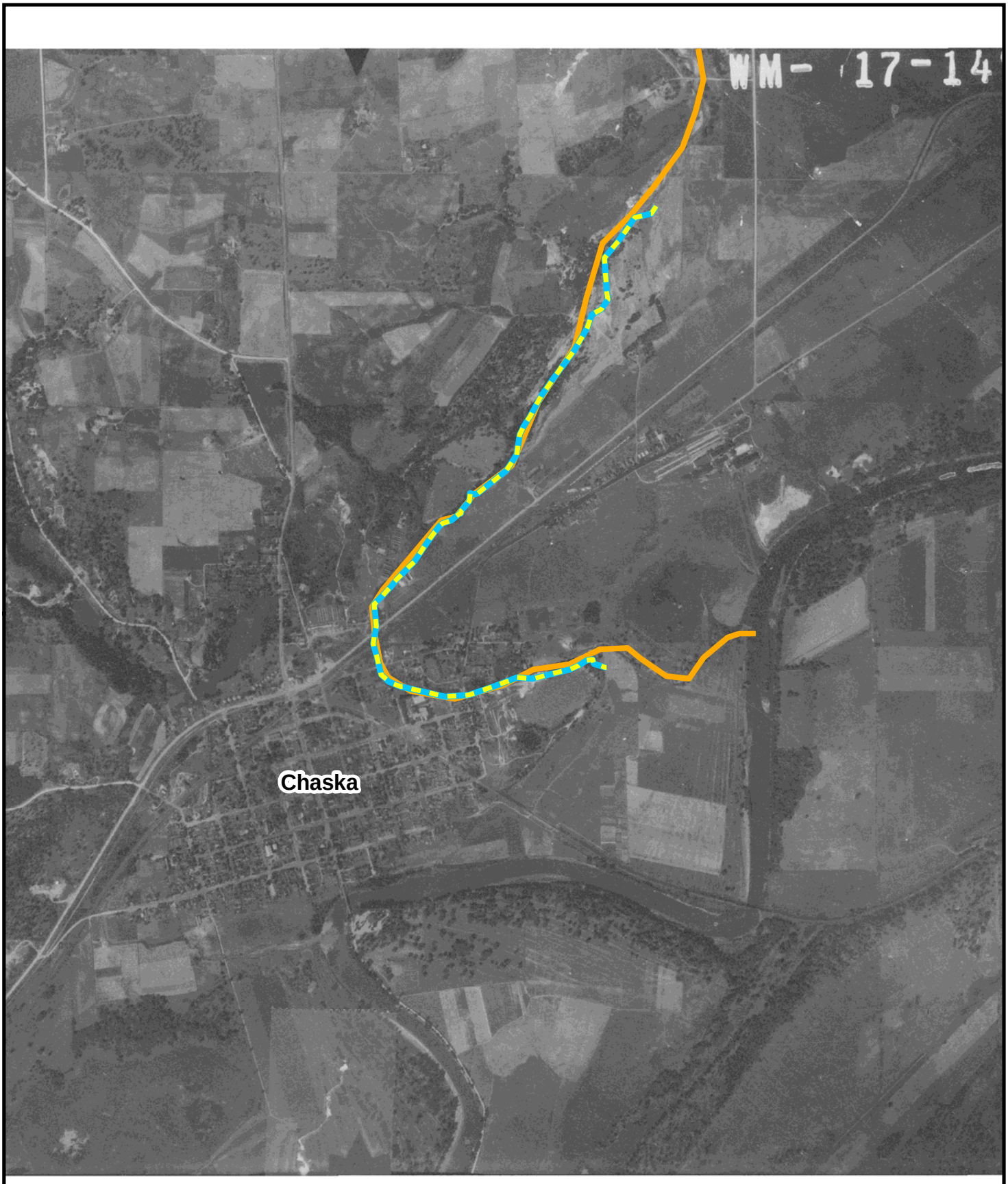
BURNS McDONNELL

Figure 2
1855 Waterbodies Map

East Chaska Creek Project
Chaska, Minnesota

Source: Burns & McDonnell

Issued: 10/16/2015



NORTH

0 750 1,500 Feet

Scale: 1 Inch = 1,500 Feet

Legend

- Project Area
- Approximate Location of East Chaska Creek in 1937

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Figure 3
1937 Aerial Map

East Chaska Creek Project
Chaska, Minnesota

Source: University of Minnesota and Burns & McDonnell

Issued: 10/16/2015

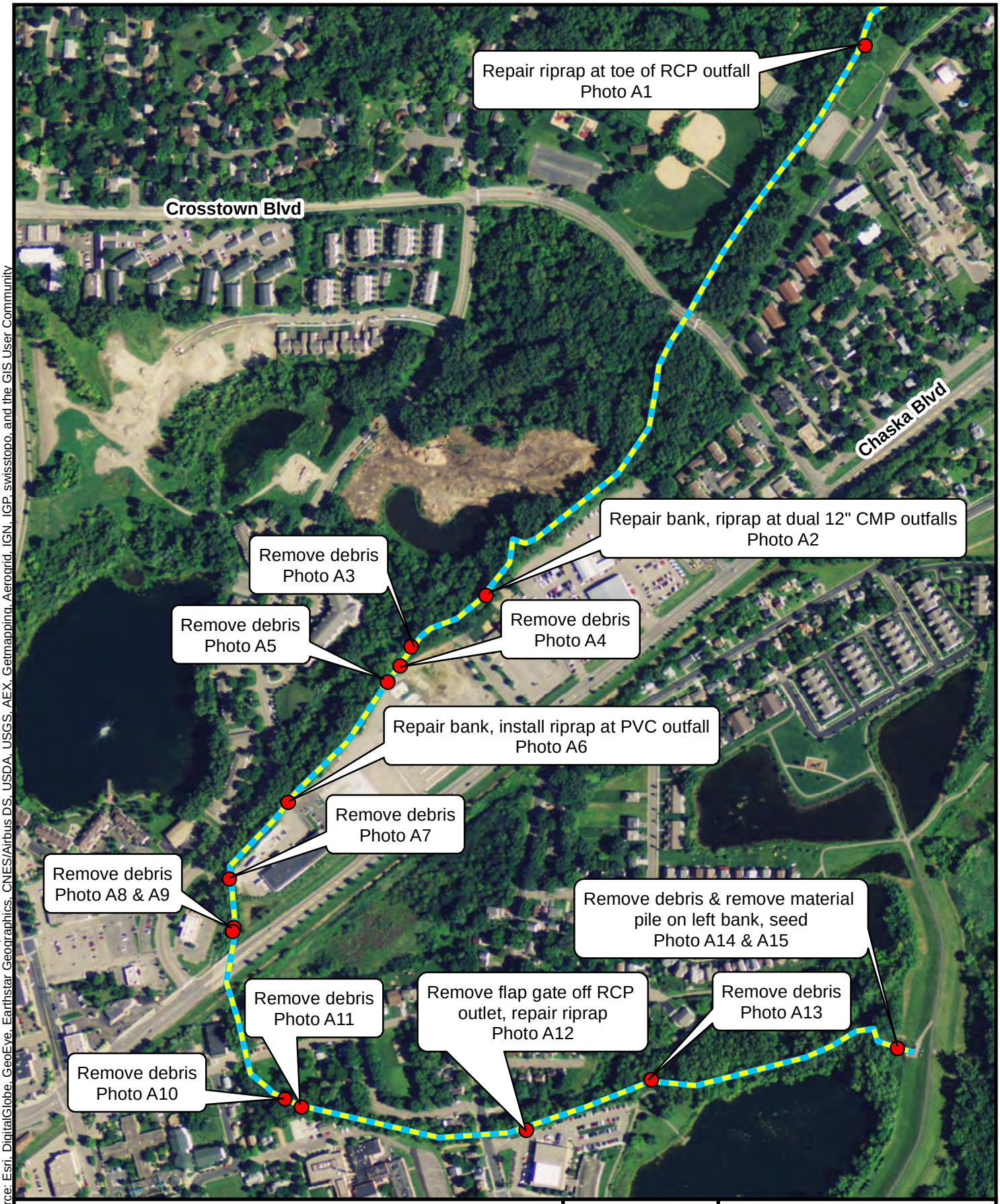
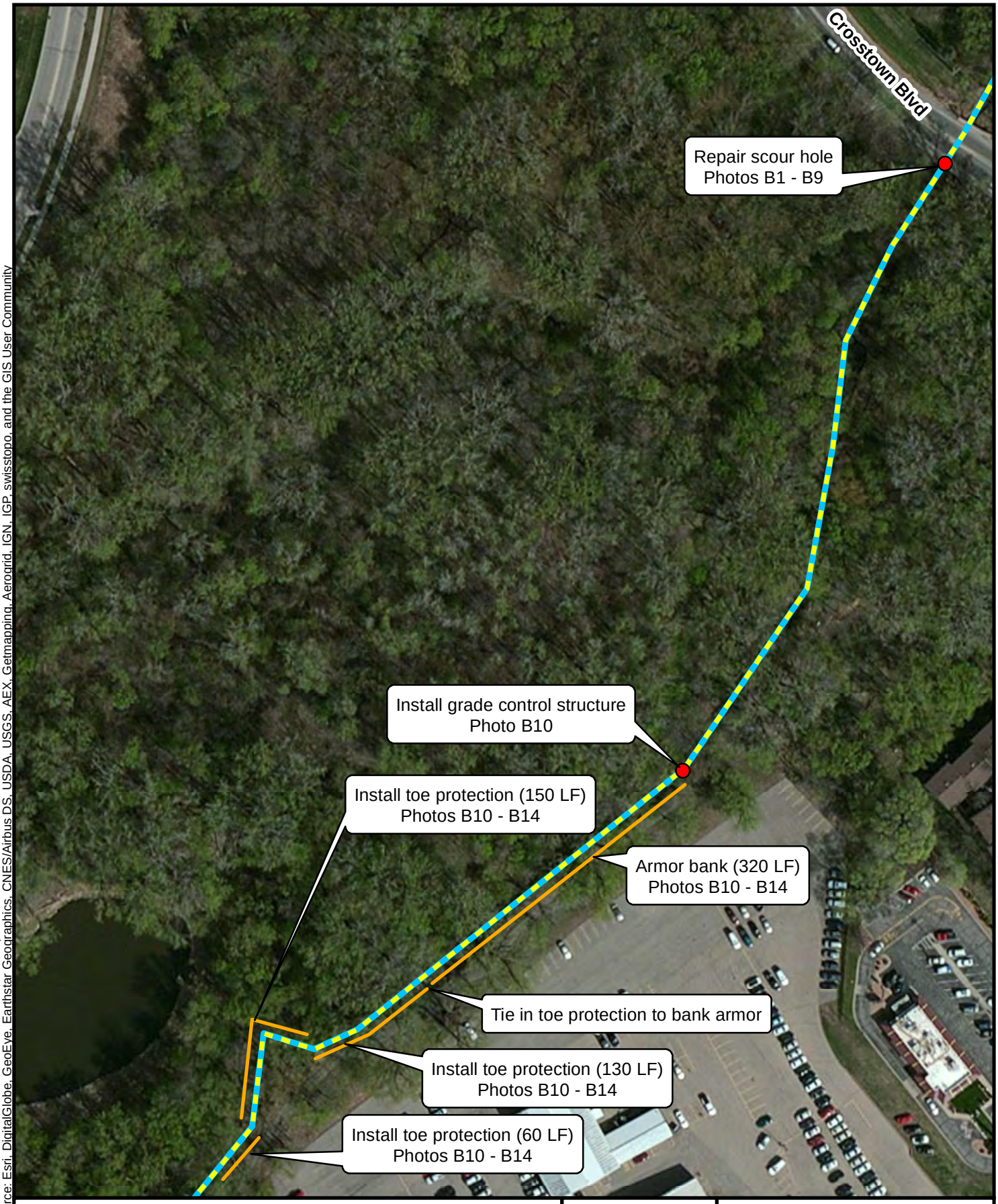


Figure 4
Recommended Maintainence Activities

East Chaska Creek Project
Chaska, Minnesota

Source: Burns & McDonnell

Issued: 10/12/2015



NORTH

0 60 120 Feet

Scale: 1 Inch = 120 Feet

Legend

- Project Area
- Recommended Channel Stabilization Project (Stream Bank)
- Recommended Channel Stabilization Project (Single Location)

BURNS McDONNELL

Figure 5
Recommended Channel Stabilization Projects

East Chaska Creek Project
Chaska, Minnesota

Source: Burns & McDonnell

Issued: 10/12/2015

NORTH

0 60 120 Feet

Scale: 1 Inch = 120 Feet

Legend

- Project Area
- Recommended Channel Stabilization Project (Stream Bank)
- Recommended Channel Stabilization Project (Single Location)

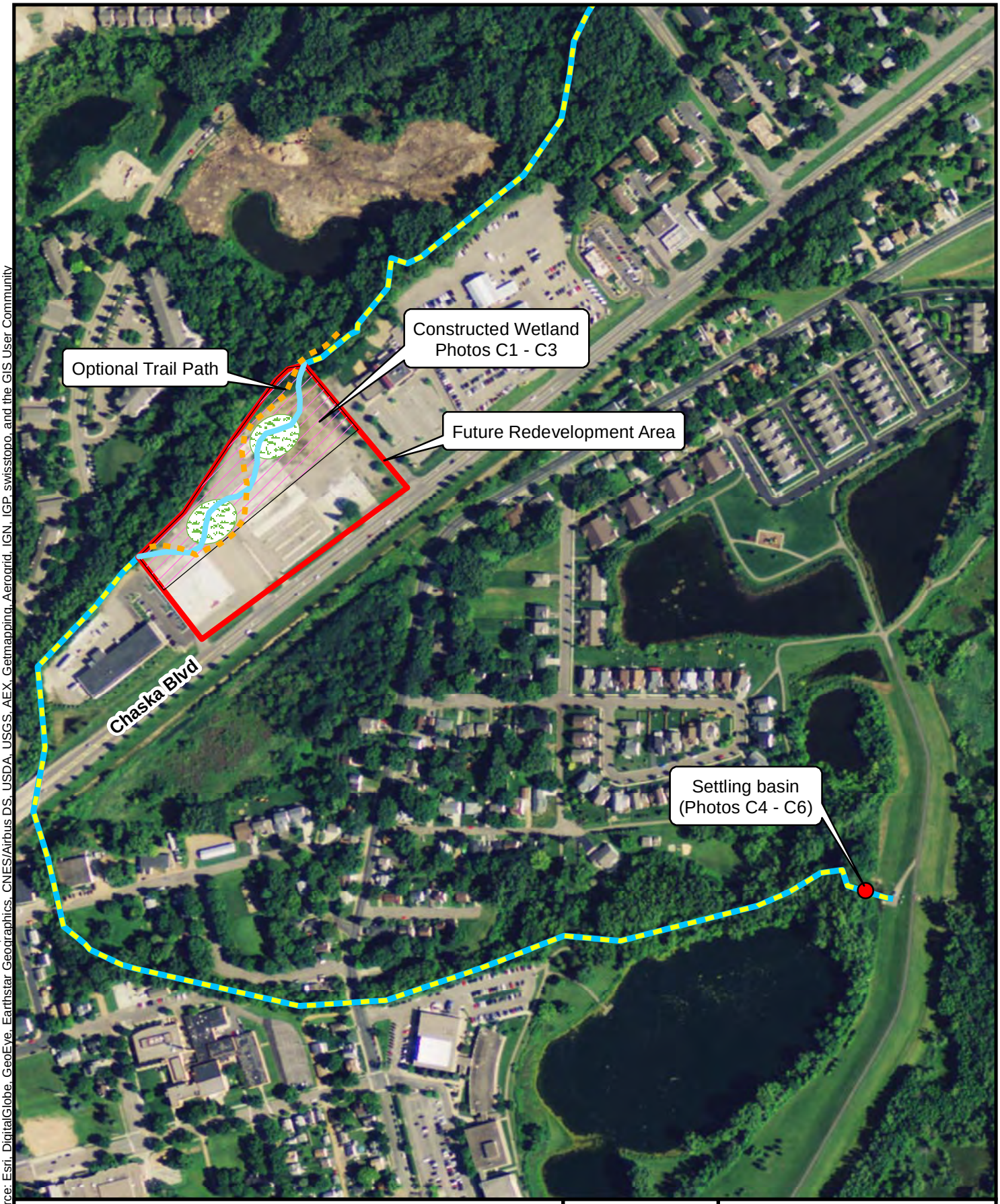
BURNS McDONNELL

Figure 6
Recommended Channel Stabilization Projects

East Chaska Creek Project
Chaska, Minnesota

Source: Burns & McDonnell

Issued: 10/12/2015



NORTH

0 200 400 Feet

Scale: 1 Inch = 400 Feet

Legend

- Project Area
- Other Potential Capital Projects (Constructed Wetland)
- Other Potential Capital Projects (Settling Basin)

BURNS McDONNELL

Figure 7
Other Potential Capital Projects

East Chaska Creek Project
Chaska, Minnesota

Source: Burns & McDonnell

Issued: 10/16/2015

APPENDIX B - STRATEGIC RESOURCES EVALUATION

Appendix E – CATEGORY 2 STREAM FEASIBILITY STUDY

Contents

Feasibility Study for Category 2 Streams

Four streams in the Lower Minnesota River Watershed District (District) are on the 2012 303(d) as being impaired for turbidity (Bluff Creek, Riley Creek, Carver Creek, and East Chaska Creek; see **Error! Reference source not found.**, Figure 2,

Figure 3. East Chaska Creek Priority Sites and Reaches

, below. These streams were selected for a feasibility study to determine potential best management practices (BMPs) to mitigate sources of erosion, thereby reducing turbidity in the streams in areas within the District. This feasibility study also provides costs for the BMPs.

An initial desktop analysis of the streams consisted of examining aerial photos, geographic information system (GIS), and the District gully inventory (Appendix H in the District's Third Generation Plan). Adequate visual detail for BMP recommendation was not possible using only a desktop analysis, so a field reconnaissance trip to these streams took place August 28th, 2012, to examine erosion areas in greater detail. The following sections describe each of the four stream visits, present suggested BMPs to address erosion problem areas, and provide costs associated with implementation.

Bluff Creek

Bluff Creek (
Figure 2) is in Chanhassen near the intersection of County Road 61 (Flying Cloud Drive) and County Road 101 (Great Plains Boulevard). The District section of the creek begins at the southern edge of Bluff Creek Park, emerging from a tunnel underneath a gravel bike trail. A Watershed Outlet Monitoring Program (WOMP) monitoring station, operated by the Metropolitan Council Environmental Services (MCES), is on Bluff Creek at North Highway 101 (Flying Cloud Drive). Streambank erosion was observed below the tunnel exit (Photo 1). Active erosion was observed at the bridge abutments approximately 100 feet downstream at the North Hwy 101 crossing. Active erosion was observed on outer stream bends, where near vertical banks exist. However, the overall channel seemed stable. In sum, excessive active erosion was not observed in Bluff Creek.

Suggested actions for Bluff Creek include providing an energy dissipation structure at the tunnel exit, bank stabilization measures along outside creek bends, re-directing runoff coming off of the North Hwy 101 Bridge, and stabilizing the areas around the bridge abutments.

Riley Creek

Riley Creek (
Figure 2) is in Eden Prairie near the intersection of County Road 61 (Flying Cloud Drive and County Road 4 (Spring Road). The District section of the creek begins at Flying Cloud Drive near the Riley Creek WOMP monitoring station. The creek travels 1.3 miles from there to the Minnesota River, passing through Grass Lake. This study examined the reach immediately below the WOMP station.

Streambank erosion was observed at the concrete apron near the WOMP station (
Photo 2. Riley Creek WOMP station downstream of Flying Cloud Drive (Eden Prairie)

). Erosion was particularly evident at outside bends where undercut banks and exposed tree roots were observed. The right bank wingwall was also noticed to be broken from the apron structure. In sum, excessive active erosion was not observed in Riley Creek near the WOMP station.
Suggested actions for Riley Creek include providing energy dissipation structures below County Road 61 and/or redirecting flows away from outside creek meanders to prevent future erosion during runoff events.

Carver Creek

Carver Creek (
Figure 2) is in Carver south of County Road 40 (Main Street W) near downtown Carver. The District section of the creek begins near a trail crossing approximately 1,000 feet above the confluence with the Minnesota River.
The meandering creek had near vertical banks at outer creek bends showing active erosion (bank sloughing). However, the channel banks seem to be held in place by debris jams and not mobilizing downstream (**Error! Reference source not found.**). Approximately 150 feet upstream of the trail crossing there was active gully erosion depositing sediment into the channel (**Error! Reference source not found.**). Further upstream there was similar outer creek bend erosion but debris jams were absent (**Error! Reference source not found.**). In sum, active erosion was observed in Riley Creek at several locations.
Suggested actions for Carver Creek include stabilizing outer bends with toe protection and grading banks to a more stable slope, and stabilizing the gully to prevent future sediment from being transported downstream.

East Chaska Creek

East Chaska Creek (

Figure 3. East Chaska Creek Priority Sites and Reaches

) is in downtown Chaska. The District section of the creek begins below County Road 10 (Engler Boulevard) and continues downstream to the confluence with the Minnesota River. For assessment, the creek was divided into five reaches, A through E, starting from the upstream most point within the District. Recommendations for the different reaches are presented in the text .

Reach A: Engler Boulevard to Crosstown Boulevard

Reach A was heavily vegetated, had some coarse sediment in the channel bed, and as generally stable. There was some localized erosion caused by debris jams in the channel (
*). The culvert outfall at Engler Boulevard was relatively stable, with energy dissipation provided by riprap (**Error! Reference source not found.**). Suggestions for Reach A include removal of channel debris and dead trees.*

Reach B – Crosstown Boulevard to County Road 61

In this stream section, the entire reach was downcut approximately two feet, which was especially evident at the downstream apron at the Crosstown Blvd bridge. There was little to no coarse sediment in channel, consisting mainly of silty sands. The left bank (approximately six feet high, vertical) was problematic, with the majority of the reach having actively eroding banks. The worst area was approximately 720 feet long, beginning at 902 Yellow Brick Road.

*Right bank erosional problems were generally confined to outfall locations (one buried outfall and two hanging outfalls). Outfall A (**Error! Reference source not found.**) consisted of a 24-to-30-inch RCP with apron, and was nearly buried. There was a log jam immediately downstream with eroding stream banks. Sediment was accumulating upstream of the outfall,with the right bank sloughing into channel. Outfall B (**Error! Reference source not found.**) is a 12-inch PVC pipe hanging 2.5 feet above the channel bed. Outfall C (**Error! Reference source not found.**) is a 12-inch CMP hanging six inches above the channel bed.*

At the pedestrian bridge (

Figure 3. East Chaska Creek Priority Sites and Reaches

*, **Error! Reference source not found.**) there was active erosion present, but the upstream reach appeared relatively stable. Near the Crosstown Boulevard Bridge (*

Figure 3. East Chaska Creek Priority Sites and Reaches

*, **Error! Reference source not found.**) the downstream apron channel was downcut approximately two feet. Riprap was present in the channel along with debris jams. The upstream bridge banks and channel were stable.*

Suggestions for Reach B include removing debris and dead trees from the channel and addressing localized problems at outfalls and crossings. Specific suggestions are as follows:

- *Outfall A – remove the log jam, stabilize the right bank at the outfall, revegetate the bank, remove the sediment deposit.*
- *Outfall B – stabilize outfall with rock, step down the outfall, provide toe protection 10 feet upstream and 40 feet downstream.*
- *Outfall C – stabilize outfall with rock, step down the outfall, toe protection 10 feet upstream and 40 feet downstream.*
- *Pedestrian Bridge – redirect runoff from the bridge to the channel bed, stabilize abutments five feet upstream and 15 feet downstream.*
- *Crosstown Boulevard Bridge – grade control/energy dissipation structures to step the channel down and dissipate energy away from the bridge and vulnerable banks; re-direct runoff from bridge.*

Reach C – County Road 61 to East Sixth Street

Overall, the channel seemed to be down-cutting through a large sediment deposit. Two outfalls (42-inch concrete apron & trash grate, 42-inch HDPE) were discharging into a wetland-type feature immediately downstream CR-61 (**Error! Reference source not found.**). The banks were vegetated and relatively stable. Suggestions for Reach C include removal of debris and dead trees in the channel where possible, and insertion of grade control structures.

Reach D – East Sixth Street to Beech Street

*In general the channel in Reach D was downcut approximately two feet from the 50 feet upstream bridge (**Error! Reference source not found.**) to downstream of Beech Street. The left bank appears to be more of a risk for further erosion. Both larger boulders/riprap deposits in the channel and lack of vegetation on channel banks were identified. Upstream of the E. Sixth Street*

*Bridge left bank erosion persists (**Error! Reference source not found.**). The right abutment has been grouted and has been downcut. Power lines cross the channel and are threatened by continued erosion of both banks. The outfall is buried by vegetation and sediment on the right bank upstream of the bridge.*

Suggestions for Reach D include removal of debris and dead trees in the channel, and addressing localized problems at outfalls and crossings. Specific suggestions include:

- *Near Beech Street Bridge – apply grade control throughout the reach, along with toe protection and left bank stabilization.*
- *Upstream of E.Sixthth Street Bridge – repair the left bank abutment (currently presents a safety hazard).*

Reach E – Beech Street to Courthouse Lake Trail

*In Reach E the channel was much wider and deeper than the other reaches (**Error! Reference source not found.**). Near vertical banks existed at outside channel bends and localized erosion of banks was occurring because of debris jams in the channel. In all other aspects Reach E is similar to other reaches. Suggestions for Reach E include removal of debris and dead trees in the channel and addressing localized problems at outfalls.*

East Chaska Creek Summary

With the exception of Reach A, the creek needs attention to prevent further erosion. The majority of Reach B is actively eroding, especially along the left bank (with respect to the downstream direction) and at blockages in the channel. The reach appears to be actively downcutting and is stabilized by two bridges. A systemic approach to the reach is suggested. That would include looking at channel slope and stability and using grade control structures throughout the reach. An alternate suggestion, which would apply from Reach B to Reach E, would be to focus on localized solutions and include stabilizing the worst of the left bank erosion, pruning canopy, removing debris and log jams, and focusing on outfalls and bridge crossings.

Conclusions

The suggested actions to address erosion in each of the four creeks examined in this study are summarized in the following table.

Table 1. Lower Minnesota River Watershed District: Category 2 Stream Resources - Suggested Actions

Resources	Suggested Action
Bluff Creek	1. Provide an energy dissipation structure at the tunnel exit. 2. Apply bank stabilization measures along outside creek bends. 3. Re-direct runoff coming off of the North Hwy 101 Bridge. 4. Stabilize the areas around the bridge abutments.
Riley Creek	1. Provide an energy dissipation structure below CR 61. 2. Redirect flows away from outside creek meanders to prevent future erosion during runoff events.
Carver Creek	1. Stabilize outer bends with toe protection. 2. Grade banks to a more stable slope.

Resources	Suggested Action
	3. Stabilize the gully to prevent future sediment from being transported downstream.
East Chaska Creek Overall Suggestions	1. Remove debris and dead trees from the channel. 2. Address localized problems at outfalls and crossings.
East Chaska Creek Reach A and Reach B	*General: remove debris and dead trees from the channel, address localized problems at outfalls and crossings.* *Specific suggestions:* 1. *Outfall A – remove log jam, stabilize right bank at outfall, revegetate bank, remove sediment deposit.* 2. *Outfall B – stabilize outfall with rock, step down the outfall, toe protection 10-ft upstream & 40-ft downstream.* 3. *Outfall C – stabilize outfall with rock, step down the outfall, toe protection 10-ft upstream & 40-ft downstream.* 4. *Pedestrian Bridge – re-direct runoff from bridge to channel bed, stabilize abutments 5-ft upstream and 15-ft downstream.* 5. *Crosstown Blvd. Bridge – grade control/energy dissipation structures to step the channel down and dissipate energy away from the bridge and vulnerable banks; re-direct runoff from bridge.*
East Chaska Creek Reach C	1. *Remove debris and* dead *trees in the channel where possible.* 2. *Insert grade control structures.*
East Chaska Creek Reach D	*General: remove debris and dead trees in the channel, and address localized problems at outfalls and crossings. Specific suggestions include:* 1. *Near Beech Street Bridge – apply grade control throughout the reach, along with toe protection and left bank stabilization.* 2. *Upstream of E. Sixth Street Bridge – repair the left bank abutment (currently presents a safety hazard).*
East Chaska Creek Reach E	1. *Selective clearing, excavation, toe protection, erosion control (jute mesh), topsiol replacement and grading for approximately 2,000 feet*

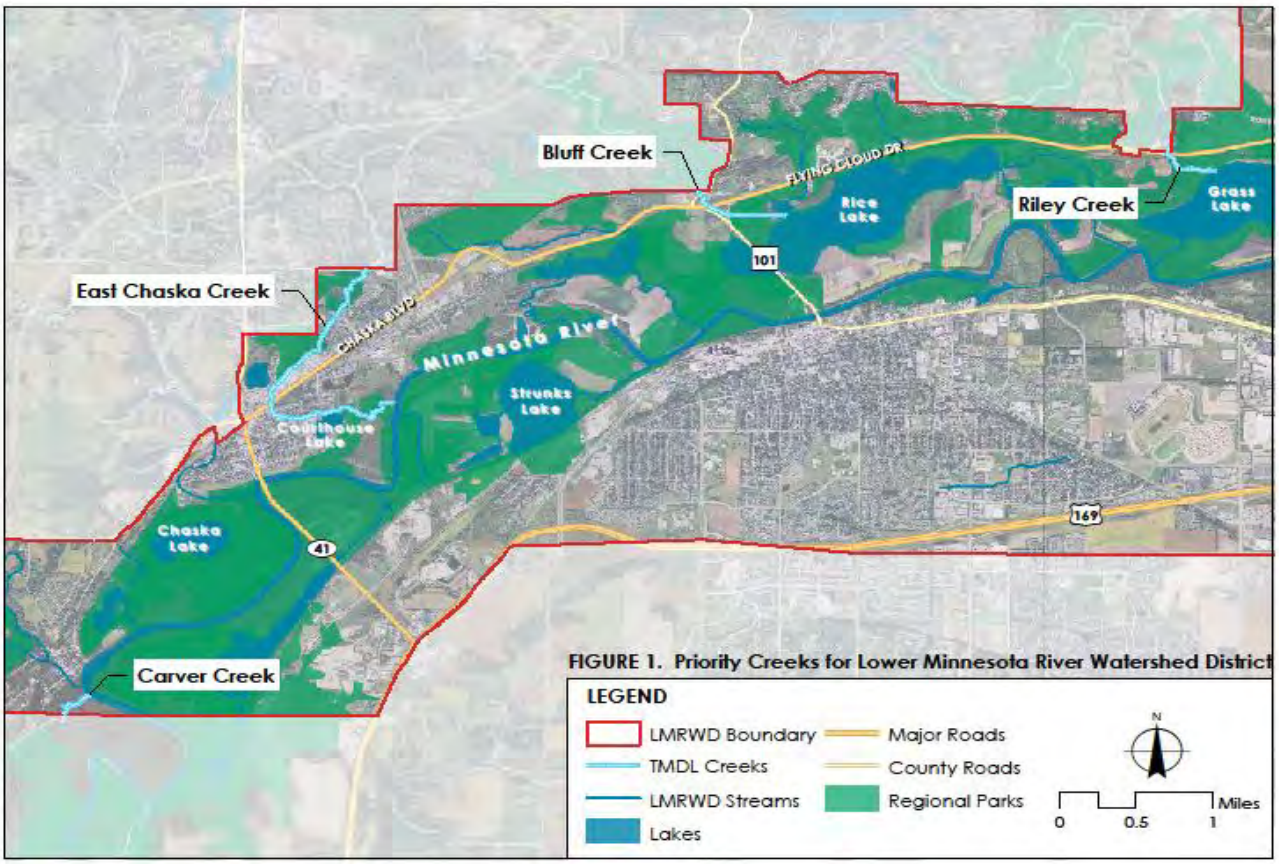


Figure 1. Priority Creeks for Lower Minnesota River Watershed District

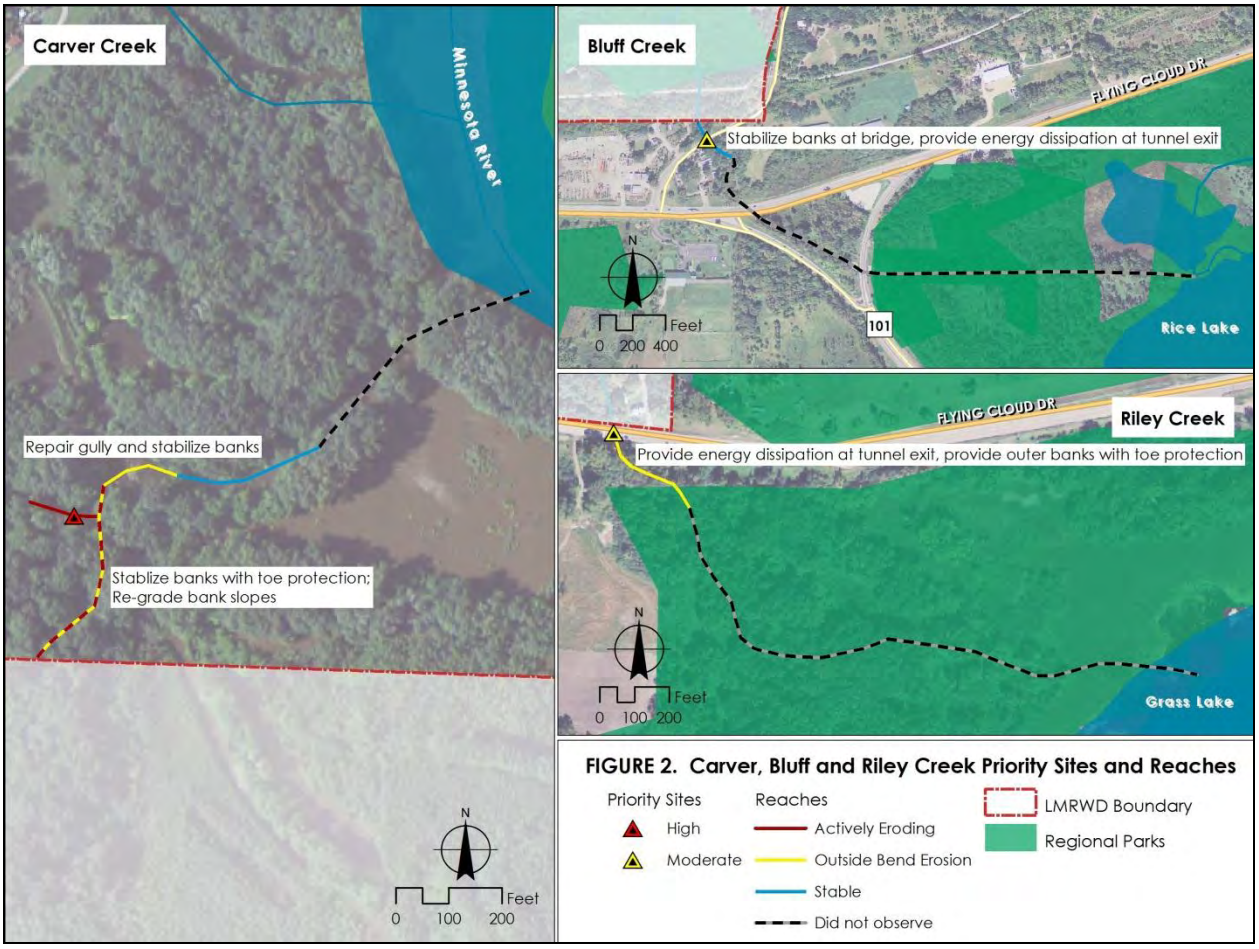


Figure 2. Carver, Bluff, and Riley Creek Priority Sites and Reaches

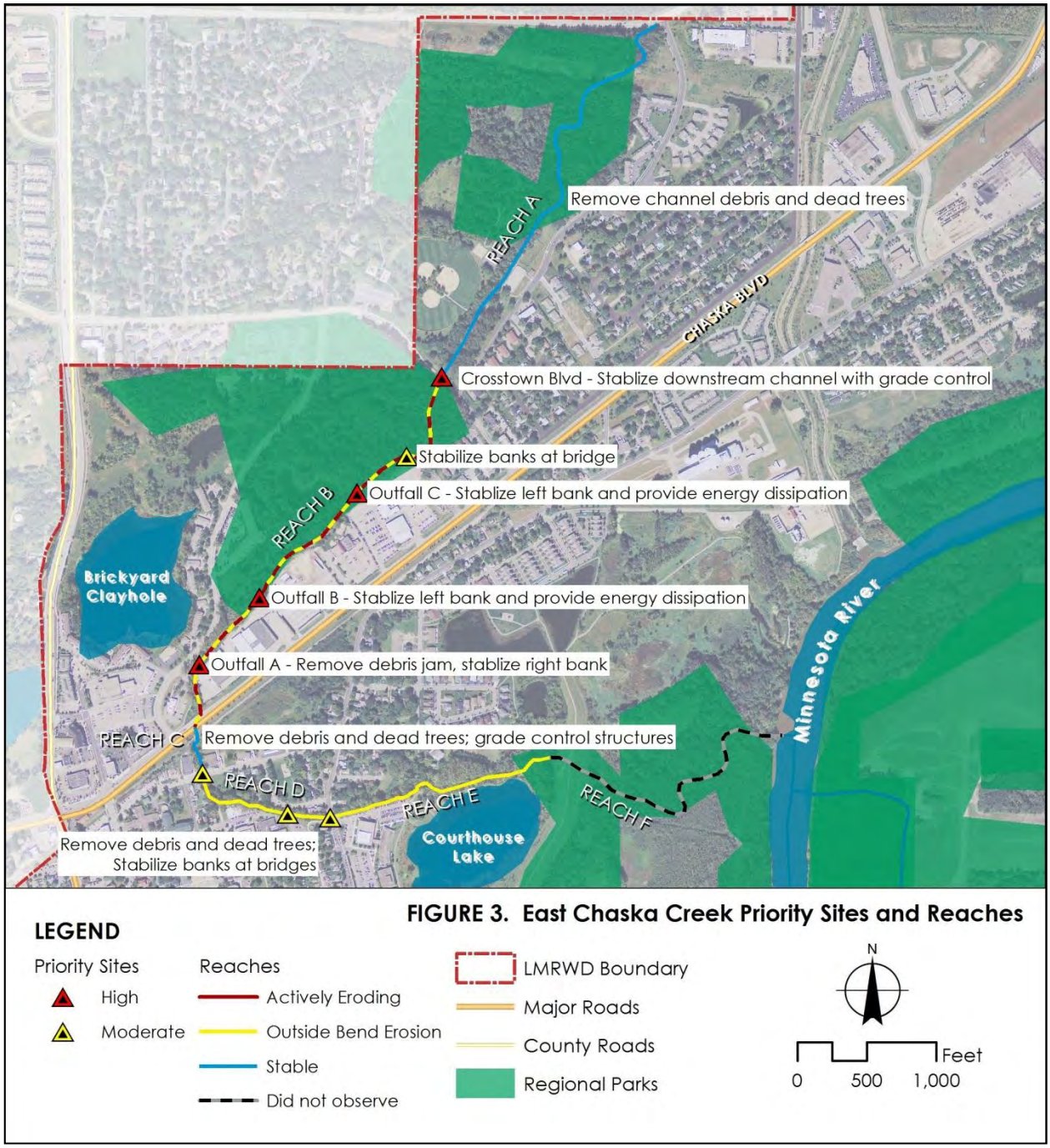


FIGURE 3. East Chaska Creek Priority Sites and Reaches

Figure 3. East Chaska Creek Priority Sites and Reaches

Photo 1. Bluff Creek below Flying Cloud Drive (Eden Prairie) and downstream erosion

Photo 2. Riley Creek WOMP station downstream of Flying Cloud Drive (Eden Prairie)

Photo 3. Carver Creek downstream of trail crossing

Photo 4. Carver Creek gully approximately 150 feet upstream of trail crossing

Photo 5. Carver Creek approximately 200 feet upstream of trail crossing

Photo 6. East Chaska Creek log jam northeast of Lions Park

Photo 7. East Chaska Creek riprap effectively dissipating stream velocity (Downstream of Engler Blvd)

Photo 8. East Chaska Creek Outfall A (just downstream of Arby's parking lot)

Photo 9. Outfall B, East Chaska Creek

Photo 10. Outfall C, East Chaska Creek

Photo 11. Pedestrian bridge north of CR 61 and downstream, East Chaska Creek

Photo 12. Downstream of Crosstown Bridge, East Chaska Creek

Photo 13. Downstream of County Road 61, East Chaska Creek

Photo 14. Downstream of bridge near intersection of Oak St and E. Sixth St., East Chaska Creek

Photo 15. Upstream of bridge near intersection of Oak St and E Sixth St., East Chaska Creek

Photo 16. Upstream of Courthouse Lake, East Chaska Creek

APPENDIX C - FIELD VISIT PHOTOGRAPHS

Photograph A-1: View east of RCP outfall.

Photograph A-2: View east of dual 12” CMP outfalls.

Photograph A-3: View south of debris.

Photograph A-4: View south of debris.

Photograph A-5: View south of debris.

Photograph A-6: View east of PVC outfall.

Photograph A-7: View north of debris.

Photograph A-8: View south of debris.

Photograph A-9: View south of debris.

Photograph A-10: View east of debris.

Photograph A-11: View east of debris.

Photograph A-12: View east of RCP outlet.

Photograph A-13: View east of debris.

Photograph A-14: View east of debris at RCP.

Photograph A-15: View west of debris and RCP.

Photograph B-1: View northwest of scour hole.

Photograph B-2: View northeast of bridge crossing.

Photograph B-3: View southeast of bridge crossing and scour hole.

Photograph B-4: View southwest of scour hole.

Photograph B-5: View northwest of scour hole.

Photograph B-6: View southwest of bridge crossing and scour hole.

Photograph B-7: View southwest of debris and scour hole.

Photograph B-8: View north of bridge crossing and scour hole.

Photograph B-9: View southwest of debris.

Photograph B-10: View east of bank erosion.

Photograph B-11: View south of eroded bank.

Photograph B-12: View south of eroded bank.

Photograph B-13: View north of eroded bank.

Photograph B-14: View south of eroded bank.

Photograph B-15: View south of eroded bank.

Photograph C-1: View northeast of vacant lot for potential constructed wetland.

Photograph C-2: View west of vacant lot for potential constructed wetland.

Photograph C-3: View south of vacant lot for potential constructed wetland.

Photograph C-4: View north of potential settling basin.

Photograph C-5: View south of debris and potential settling basin.

Photograph C-6: View east of debris, creek levee crossing, and potential settling basin.

Photograph C-7: View south of foam from potential sanitary/septic source.

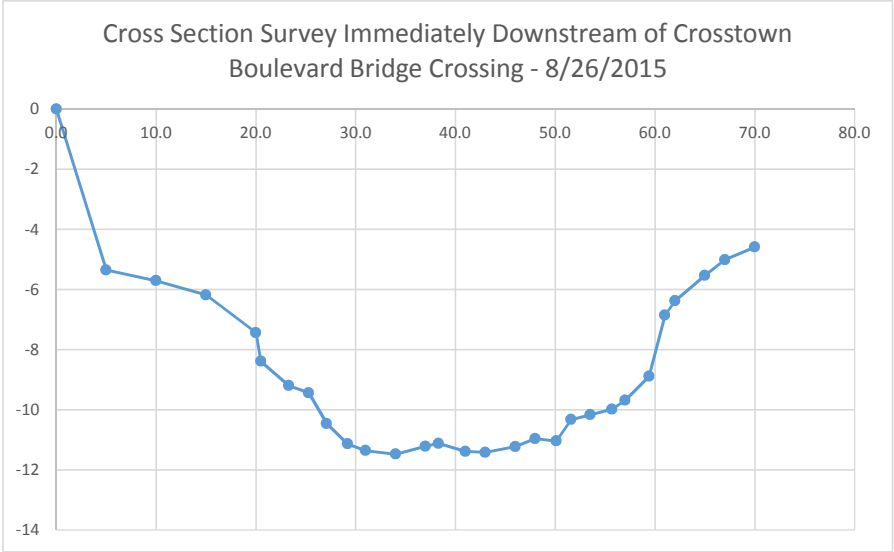
Photograph C-8: View west of foam from potential sanitary/septic source.

Photograph C-9: View east of foam at levee from potential sanitary/septic source.

APPENDIX D - CROSS SECTION SURVEY INFORMATION

East Chaska Creek Cross Section Survey - August 26th, 2015
Immediately Downstream of Crosstown Boulevard Crossing

STA	ROD	Comment	Elevation Relative to Right Bank
0.0		Right Bank	0
5.0	5.35		-5.35
10.0	5.71		-5.71
15.0	6.18	Asphalt	-6.18
20.0	7.44	Asphalt	-7.44
20.5	8.39	Sand, start of riprap, jagged rock 2' diameter	-8.39
23.3	9.2	Sand	-9.2
25.3	9.44	Riprap	-9.44
27.1	10.46	Sand	-10.46
29.2	11.14	Edge of water, sandy	-11.14
31.0	11.36	Water depth 0.48	-11.36
34.0	11.48	Sand/water	-11.48
37.0	11.22	Sand deposit	-11.22
38.3	11.12	Top of sand deposit	-11.12
41.0	11.39		-11.39
43.0	11.42		-11.42
46.0	11.23		-11.23
48.0	10.96		-10.96
50.1	11.04	Start of riprap, left bank	-11.04
51.6	10.33		-10.33
53.5	10.17		-10.17
55.7	9.98		-9.98
57.0	9.69		-9.69
59.4	8.89	End of riprap	-8.89
61.0	6.86		-6.86
62.0	6.38		-6.38
65.0	5.53		-5.53
67.0	5.01		-5.01
70.0	4.59	Left Bank	-4.59

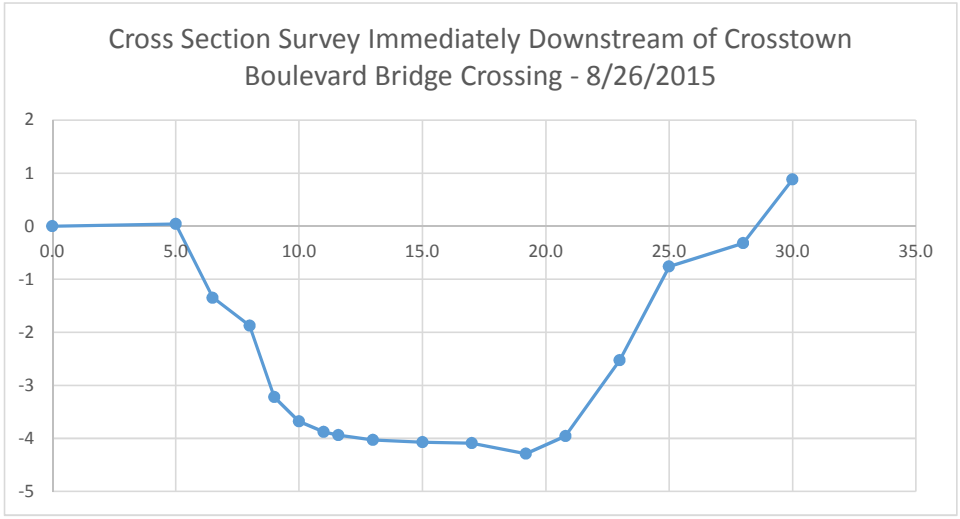


Additional Notes

Backsight is center of bridge at railing invert = 9.24 and 9.22
At STA 57.8, left corner of wing wall
At STA 41.5, center of boxes
Wing wall to wing wall is approx 32'
Structure is 2 concrete boxes, 12.5' wide by 4.15' high
Apron length is 6'
Scour hole 10' wide by 30' wide by 2.5' deep
Flat slope, sandy bed

East Chaska Creek Cross Section Survey - August 26th, 2015
Approx. 750' Downstream of Crosstown Boulevard Crossing

STA	ROD	Comment	Elevation Relative to Right Bank
0.0	5.46		0
5.0	5.42		0.04
6.5	6.81		-1.35
8.0	7.34		-1.88
9.0	8.68		-3.22
10.0	9.14		-3.68
11.0	9.34		-3.88
11.6	9.4	Edge of water, right bank	-3.94
13.0	9.49	water depth 0.05"	-4.03
15.0	9.53	Stream centerline, depth 0.11"	-4.07
17.0	9.55		-4.09
19.2	9.75	Center of thalweg	-4.29
20.8	9.42	Edge of water, left bank	-3.96
23.0	7.99	Old concrete armory	-2.53
25.0	6.22		-0.76
28.0	5.78		-0.32
30.0	4.58		0.88



Additional Notes

Backsight is path, = 5.35 and 5.36

APPENDIX E - BANK STABILIZATION PROJECTS COST ESTIMATE

EAST CHASKA CREEK BANK STABILIZATION COST ESTIMATE

10/19/2015

Task	*Description*	*Units*	*Quantity*	*Unit Price*	*Total*
1.0	**Repair scour hole**				
1.1	Salvage existing riprap	CY	30	$20	$600
1.2	Backfill and grade granular material	CY	105	$50	$5,250
1.3	Install filter fabric	SY	350	$8	$2,800
1.4	Replace salvaged riprap	CY	30	$20	$600
1.5	Install additional riprap (MnDOT Class IV Riprap)	CY	50	$110	$5,500
				TASK TOTAL	$14,750
2.0	**Install bank armoring, toe protection and grade control structure**				
2.1	Remove asphalt bank repairs	SF	140	$6	$840
2.2	Install filter fabric	SY	250	$8	$2,000
2.3	Armor bank with MnDOT Class III Riprap	LF	320	$150	$48,000
2.4	Install riprap toe protection (MnDOT Class III)	LF	340	$95	$32,300
2.5	Install grade control structure	LS	1	$7,500	$7,500
				TASK TOTAL	$90,640
3.0	**Install toe protection**				
3.1	Install toe protection	LF	120	$95	$11,400
				TASK TOTAL	$11,400
				TASKS 1-3 TOTAL	$116,790
4.0	Mobilization (5% Task 1-3 Total)			5%	$5,840
5.0	Surveying	LS	1	$5,000	$5,000
6.0	Engineering (15% Task 1-3 Total)			15%	$17,519
7.0	Contingency (20% Task 1-3 Total)			20%	$23,358
				TASKS 4-7 TOTAL	$51,716
				PROJECT TOTAL COST	**$168,506**

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