Technical Memorandum

To: Linda Loomis, Administrator
Lower Minnesota River Watershed District

From: Steve Woods, PE
Della Schall Young, CPESC, PMP

Date: January 17, 2020

Re: Eden Prairie Area 3 and the Minnesota River—Meeting summary and recommendations

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Background

Area 3 occupies steep bluff lands adjacent to the Minnesota River southeast of Flying Cloud Airport or south of the intersection of Pioneer Trail and Flying Cloud Drive in Eden Prairie, Minnesota. The river has meandered adjacent to the north valley wall. Upland land use is split between a landfill and residential sites, though there is a strip of undeveloped land on the slope between the river and existing residential areas owned by Lakefront Properties, Inc. The Minnesota River Valley formed through the overtopping of Lake Agassiz, which created an outlet river (Glacier River Warren) that drained south and carved it.[1]

In 2008, the City of Eden Prairie (City) and the Lower Minnesota River Watershed District commissioned a project by SRF Consulting Group, Inc. (SRF) to study sites along the Minnesota River Valley that were experiencing flooding to determine the cause of the erosion and to provide recommendations for addressing the erosion and preventing future problems. See the enclosed study Area 3 location map. SRF's site investigation and analysis yielded the following results, which were presented in the 2008 report[2]:

[1] Minnesota River Valley Formation, *Minnesota River Basin Data Center,* visited 18 November 2019.
[2] SRF Consulting Group, Erosion Stabilization Study: Study Area 3 Final Report Prepared for the City of Eden Prairie, October 2008.

The analysis of bluff instability and erosion found causes and problems such as the following:

1. Low internal soil strength properties
2. Removal of vegetation
3. Frequent river flooding
4. Soil saturation due to flooding and the presence of springs
5. High velocities along the outside bend of the river during flood stage
6. Presence of steep slopes

It was further stated that erosion may be caused by “a combination of localized erosive velocities as the river flows around the bend and the permanent soil saturation that occurs near the springs that has accelerated bluff erosion, which would otherwise occur more slowly from flooding saturation/desaturation, low in-situ soil shear strength, steep slopes, and the removal of vegetation” (SRF 2008).

Recommendation: Using the causal information generated, SRF recommended two alternative solutions: 1) Regrade to a more gentle slope to balance driving and resistive forces, with a probable cost estimate (PCE) of approximately $434,000; and 2) Increase resistive forces of the soil through the use of constructed, stabilized slopes with a PCE of $414,000. Alternative 2 was recommended for its “technical” and cost advantages.

In 2010, the team of Wenck Associates, Inc. and Stanley Consultants, Inc. were retained to expand on the information produced by SRF. The Wenck team focused on the slope interface with the river (see enclosed existing conditions map). Additional data were collected, and the team completed hydrology, hydraulics slope stability and geotechnical analyses. The Wenck team’s conclusions were similar to SRF’s. They highlight that the meander is a natural process that has been accelerated by changes in hydrology and climate variability and increased erosion due to stormwater runoff concentrated on the surface and seepage flows (Wenck, 2010). The Wenck team concluded that if left as is, without stabilization, erosion will continue as the meander moves downstream. That said, they did note that the slope stability analyses showed the bluff had an acceptable safety factor for the residences and properties.

Recommendation: Based on the analysis completed and data collected, three alternatives for bank stabilization were identified: 1) riprap blanket with a PCE of $1.9 million, 2) bendway weirs with a PCE of $3.3 million, and 3) rock vanes with a PCE of $1.1 million. Alternative 3 was selected because of cost.

Because of the acceptable safety factor, the District commissioned the placement of inclinometers on the slope to monitor if movement occurs. Inclinometers have been monitored and reports submitted to the District since 2010 by Braun Intertec (Braun). In June 2019, Braun provided a report that showed slope movement. Alarmed, the District

and its technical consultants (Young Environmental Consulting Group, LLC and Barr Engineering Company) met to review the information and discuss a path forward. As the group reviewed the information, it was apparent there were problems with the information received. The problem spurred these questions:

- Is the information accurate?
- If it is accurate, what do we do with the information?
- If the information isn't accurate, what should we do to remedy the error?
- What does the District do with the data it collects?
- Should this data be collected by the LMRWD?
- Are there other activities, like work in the river to reduce the speed of encroachment, that LMRWD should invest in?

December 2019 Meeting

Young Environmental was instructed to contact Braun to have them review and validate the information provided and to convene a team of experienced professionals familiar with Area 3 to consider these questions and review past studies, collected data, and a range of options for future action.

The team was convened on Wednesday, December 18, 2019. Attendees were as follows:

Linda Loomis, LMRWD
Della Young and Steve Woods, Young Environmental
Joel Toso and Ed Matthiesen, Wenck
Bill Holman, Stanley Consultants
Bryan Ripp, Braun Intertec
Aaron Grosser, Barr

During the meeting the group converged on two overarching discussion topics: slope erosion and river meander movement. Below is a summary of those topics.

Slope Monitoring. Inclinometers were installed in 2010 to monitor slope erosion and/or movement. Braun has been collecting and analyzing data collected from the inclinometers on behalf of the District since installation. Until June 2019, the inclinometers had not shown any indication of movement. When this data appeared, LMRWD requested further analysis as there was some doubt as to its accuracy. Subsequent review by Braun identified a hardware calibration issue, and the data set was updated. Braun's revised data showed no movement.

This hardware issue initiated the gathering of professionals to consider whether further data collection was warranted by the District. Following a historic review of the area and consequent discussion, it was concluded that these data need to be collected with a few enhancements by the District and then shared with the City because they serve as an management information tool.

River Flow. As highlighted in the reports by SRF and the Wenck team, landslides in the area are a normal process that has been worsened by the increasing magnitude and frequency of flood flows in the Minnesota River. In addition, the meander bend apex continues to move toward the Area 3 embankment, resulting in downstream migration of the riverbank toward the City's stormwater pond, which currently is overtopped by high river flows. As the river continues to progress downstream, the backyards of properties along the bluff could be affected.

Because of the conditions exhibited by the Minnesota River over the past few years, it was concluded that the rock vane bank stabilization alternative recommended by the Wenck team should be reviewed and designed, while sources of funding are investigated and acquired to address the river's effects on the toe of the slope.

Recommendations

Based on the discussion, the LMRWD Board of Managers is asked to consider and approve the following recommendations:

1. Install a vibrating wire piezometer in the casing of an existing piezometer to record water levels in the embankment. If the existing piezometer cannot be located, a new vibrating wire piezometer will be installed in a soil boring withing the slope to monitor groundwater conditions.

2. Increase the frequency of data collection from the inclinometers to a minimum of twice per year—after snow melt in the spring and sustained high water in late summer or early fall. Provide the data analysis of the inclinometers and piezometers in monitoring memos to the LMRWD after each monitoring event summarizing the condition of the slope.

3. Update river cross-sections (i.e., soundings) taken for the 2010 report. This effort would update the location of the thalweg (a line that connects the lowest points in a valley or river channel, and thus the line of fastest flow or deepest water along a river's course) and allow for estimates of both scour and movement.

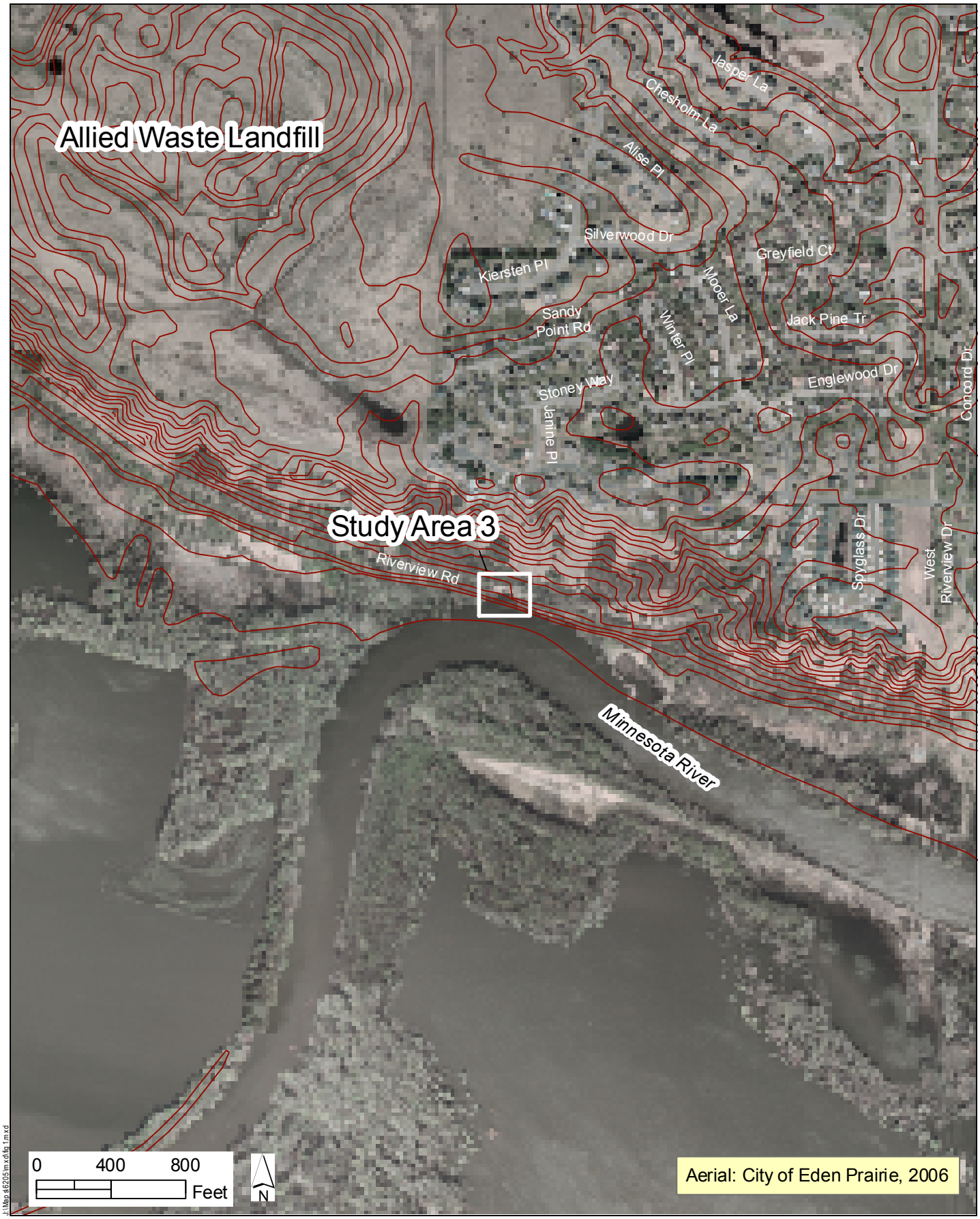
4. Conduct a field reconnaissance exercise with the City to verify where flows are still overtopping the bluff. In the Wenck team's 2010 report and review of aerial

photos, it appeared the bluff was taking overland flow. This has direct erosion potential, adds weight, and lowers soil cohesion.

5. Design and construct the Minnesota River rock vane bank stabilization alternative recommended in 2010 by the Wenck team (See enclosed Rock Vane Plan and Section). As presented, the alternative had a PCE of $1.1 million. To convert this estimate to 2020 dollars, we applied the Engineering News-Record cost index for Minneapolis, which advances the PCE to $1.4 million[3]. Engineering design and regulatory costs were not included in the Wenck team's PCE. However, those costs are estimated to be 10–15 percent of the PCE. This project represents a potential partnership with the City, area legislators, the US Army Corps of Engineers, and the river transport-based industry concerned with navigability of the Minnesota River. (Note: The LMRWD has no property or infrastructure in the project area.)

CC: Rod Rue and Leslie Stovring, City of Eden Prairie
Joel Toso, Wenck Associates
Ed Matthiesen, Wenck Associates
Bill Holman, Stanley Consultants
Bryan Ripp, Braun Intertec
Aaron Grosser, Barr Engineering

[3] Ed Matthiesen, Wenck Associates, personal communication, January 7, 2020



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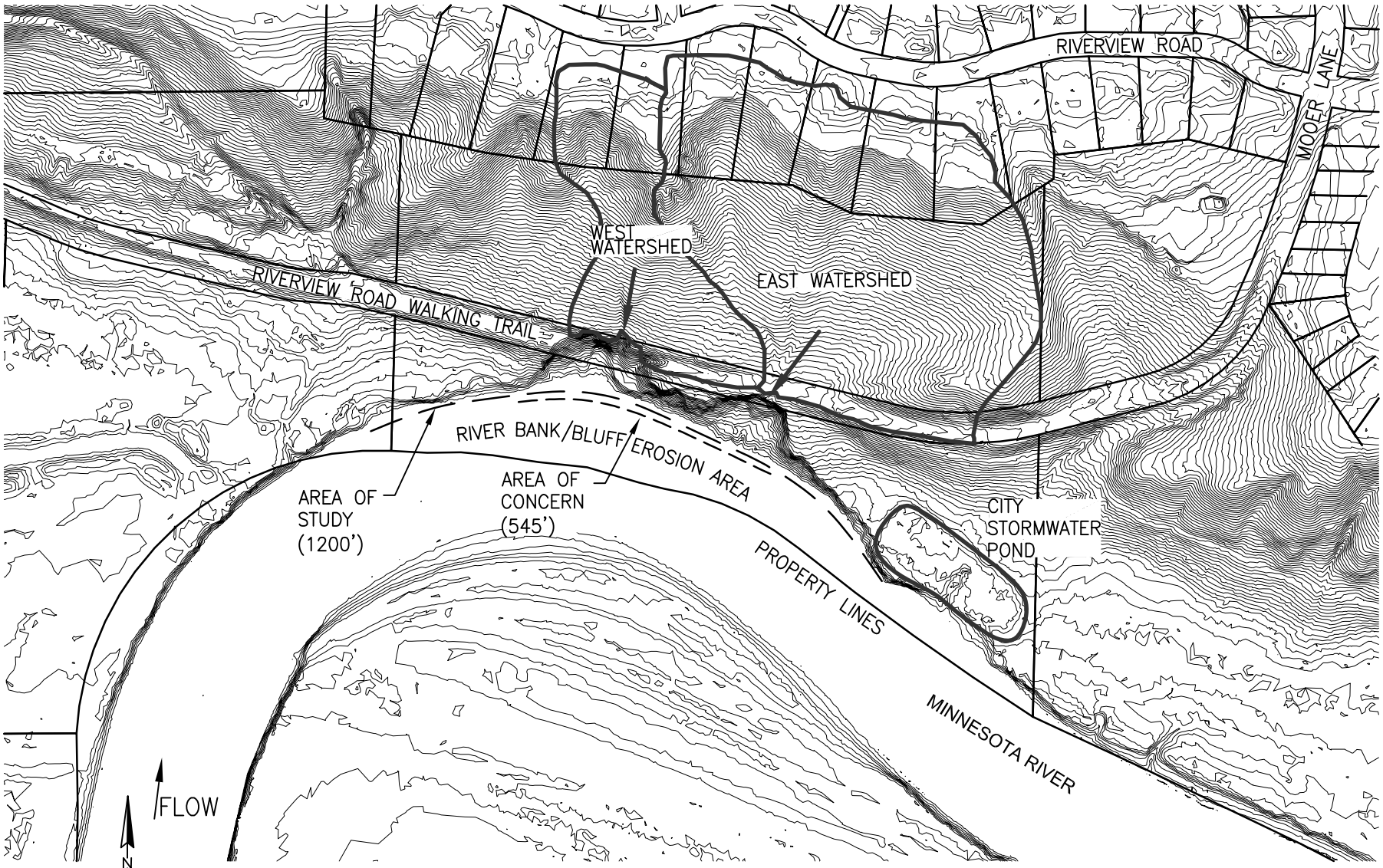
SRF Consulting Group, Inc.

06/10/08

Study Area 3 Location Map — ***Figure 1***

Eden Prairie Erosion Stabilization Study

Eden Prairie, MN



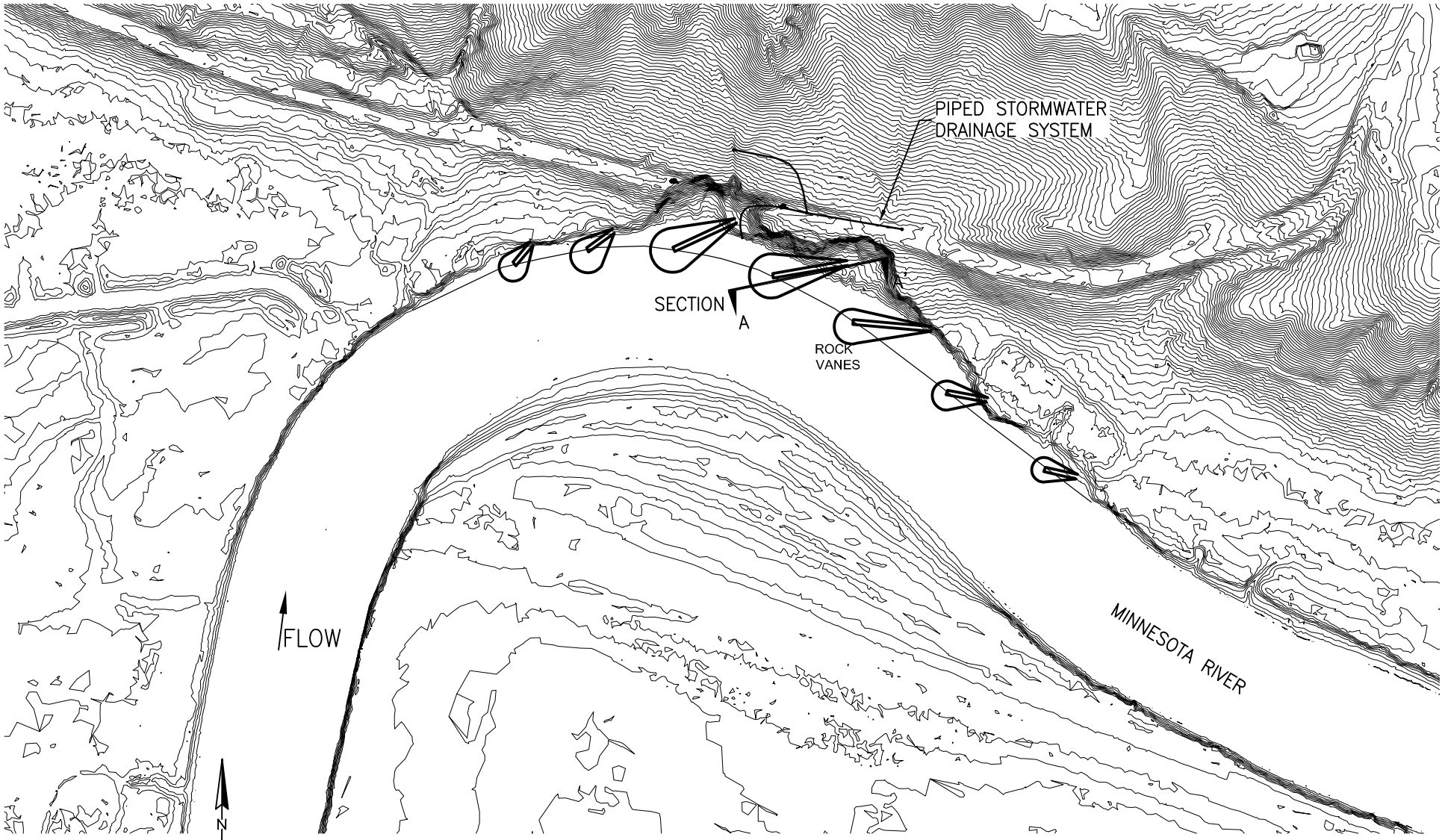
NOTE:
CONTOUR INTERVALS ARE AT 2'

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Exisitng Conditions

Wenck Associates, Inc.
Environmental Engineers
Wenck
1800 Pioneer Creek Center
Maple Plain, MN 55339

FIGURE 2



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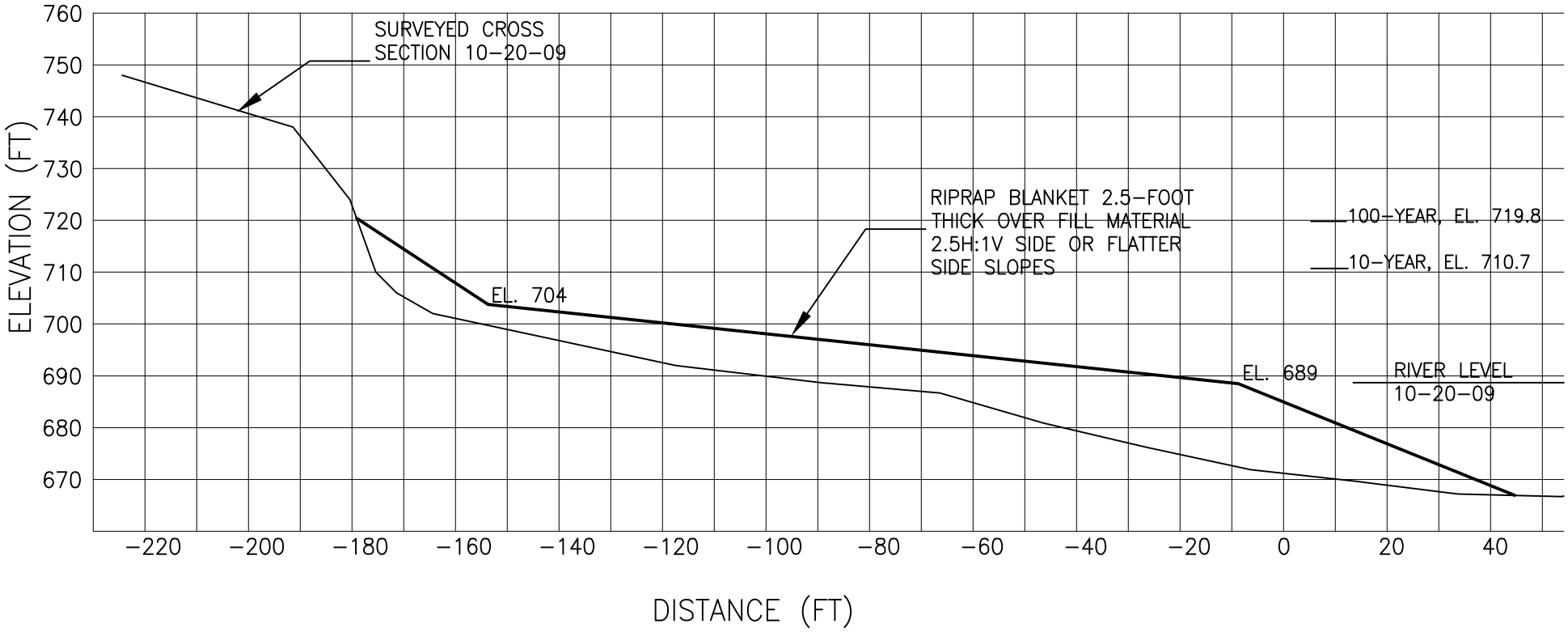
LOWER MINNESOTA RIVER WATERSHED DISTRICT

Rock Vane Plan

Wenck Associates, Inc.
Environmental Engineers
Wenck
1800 Pioneer Creek Center
Maple Plain, MN 55339

FIGURE 15



LOWER MINNESOTA RIVER WATERSHED DISTRICT

Rock Vane Section A-A'

Wenck Associates, Inc.
Environmental Engineers
1800 Pioneer Creek Center
Maple Plain, MN 55339

FIGURE 16