Henderson Flood Feasibility Study

Prepared for Minnesota Department of Transportation – District 7

City of Henderson, Sibley County, Scott County & LeSueur County, Minnesota

S.P. No. 4004-124

MNT07 139855 | August 21, 2017

SEH

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Executive Summary

The Minnesota Department of Transportation (MnDOT), in cooperation with the City of Henderson, Sibley County, Scott County, and Le Sueur County, has conducted a feasibility study to investigate transportation improvements in the Minnesota River Valley that would minimize roadway closures due to flood events. MnDOT hired Short Elliott Hendrickson, Inc. (SEH) to assist the study partners with the technical and public involvement elements of the study.

The Henderson Flood Feasibility Study focused on the bridges and approach roadways for state Highway 19, Highway 93, and Sibley County Road 6. The Highway 93 and County Road 6 alternatives considered elevating the roadway profiles above the 100-year flood elevation and the Highway 19 alternatives focused on raising the bridge and roadway approaches above the flood elevation.

The goal of the study was to identify a safe and accessible, 10-ton route into and out of Henderson to limit the length of detours and impacts to businesses during high water events.

The feasibility study took place in 2017 and included the following key elements:

- Public and agency involvement
- Hydraulic model development and analysis (including bridge analysis)
- Traffic modelling and analysis
- Benefit-Cost analysis
- Development and screening of conceptual design alternatives
- Feasibility report with findings

Flooding in the Minnesota River Valley has created traffic and mobility challenges for MnDOT and local communities for decades. The roadways leading into and out of the City of Henderson (Highways 19 and 93 and County Road 6) have been hit especially hard in recent years, with closures due to flooding reaching an all-time high. During seasonal flooding events, residents' commuters and commercial vehicles travelling through the area have had to resort to detours that take them miles out of their way, costing them both time and money. The lengthy detours and restricted access to the Henderson Area can substantially impact local businesses and regional traffic patterns.

When Highways 19, 93 and County Road 6 are all closed due to flooding along the Minnesota River, the value of the additional time and miles traveled (using MnDOT's Collar County Travel Demand Model) is calculated to have a daily cost of closure of $87,000 per day (2017 dollars).

The preferred concept for each of the three roadways is described below and the key study findings are summarized in Table 1 (on the following page).

Highway 19 Alternative

The preferred concept for the Highway 19 alternative is to reconstruct the existing Highway 19 bridge structure to span the majority of the flood area, an approximately 2,680 foot long bridge structure with roadway approaches for a total project length of approximately 4,500 feet. The existing Highway 19 roadway grade will be raised up to 8 feet higher than the existing roadway elevation. An additional 2 acres of right-of-way would need to be acquired. This alternative includes two options for the proposed bridge width; one with a proposed trail and one without a trail. The

total estimated cost for the Highway 19 Alternative with trail is $40.0 million (2017 dollars) and the total estimated cost without trail is $33.5 million (2017 dollars). The conceptual layout and proposed typical section for the Highway 19 Alternative is shown in Appendix F.

Highway 93 Alternative

The preferred concept for the Highway 93 alternative is to raise the existing roadway above the flood elevation for approximately 3.25 miles; there is a small bridge structure spanning Rush River that would also need to be reconstructed. The proposed roadway elevation will be raised up to 8 feet higher than the existing roadway. This alternative requires an additional 25 acres of right-of-way to be acquired. The total estimated cost of the Highway 93 Alternative is $14.9 million (2017 dollars). See Appendix F for the conceptual layout and proposed typical section for this alternative.

Sibley County Road 6 Alternative

The preferred concept for the Sibley County Road 6 alternative is to raise the existing roadway above the flood elevation for approximately 4.2 miles; there is a small bridge structure spanning High Island Creek that will also be reconstructed. The proposed roadway elevation will be raised up to 8' higher than the existing roadway. This alternative requires an additional 11 acres of right-of-way to be acquired. The total estimated cost of the County Road 6 Alternative is $15.7 million (2017 dollars). See Appendix F for the conceptual layouts and proposed typical section for the County Road 6 Alternative.

Since this was a feasibility level study, further refinement of the concepts and estimated costs to a more developed design level should be undertaken to minimize any potential adverse impacts, while retaining the benefits of reduced frequency and reduced duration of roadway flooding and closure. Findings of this study will be used by MnDOT, the City of Henderson and other project partners to pursue funding. Once a project is identified and programmed for implementation, it will move forward into the preliminary design and environmental documentation phase of project development.

Table 1 – Alternative Summary

Alternative	TH 19 (with Trail)	TH 93	County Highway 6
Cost	$40	$14	$16
Benefit-Cost Ratio	0.19	0.45	0.12
Traffic effectiveness	Serves the most trips	Serves the second most trips	Serves the fewest trips
Feasibility to Implement	Permitting agency support	Lowest cost	Most challenging
Property Acquisition	2 acres	25 acres	11 acres
Wetlands Impacted	2 acres	5 acres	8 acres

Contents

Contents (continued)

List of Tables

List of Figures

List of Appendices

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1 Introduction

The Minnesota Department of Transportation (MnDOT), in cooperation with the City of Henderson, Sibley County, Scott County, and Le Sueur County, has conducted a feasibility study to investigate transportation improvements in the Minnesota River Valley that would minimize roadway closures due to flood events. MnDOT hired Short Elliott Hendrickson, Inc. (SEH) to assist the study partners with the technical and public involvement elements of the study.

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1.1 Background

Flooding in the Minnesota River Valley has created traffic and mobility challenges for MnDOT and local communities for decades. The roadways leading into and out of the City of Henderson (Highways 19 and 93 and County Road 6) have been hit especially hard in recent years, with closures due to flooding reaching an all-time high. During seasonal flooding events, residents, commuters and commercial vehicles travelling through the area have had to resort to detours that take them miles out of their way, costing them both time and money. The lengthy detours and restricted access to the Henderson Area can substantially impact local businesses and regional traffic patterns.

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As noted in the 2016 Henderson Comprehensive Plan, "every spring when the annual flooding of the Minnesota River begins, and every time a large rain storm is predicted in the summer, the level of concern rises with the water levels as townspeople ask themselves if this will be the next time that the roads into town are flooded or washed-out again and the community becomes stranded with only one way out."

The study area, shown in Figure 1, is located southwest of the Twin Cities Metropolitan Area and encompasses portions of Sibley, Le Sueur and Scott Counties. Individual municipalities either partially or fully within the study area include the Cities of Henderson and Le Sueur and the town of Blakely.

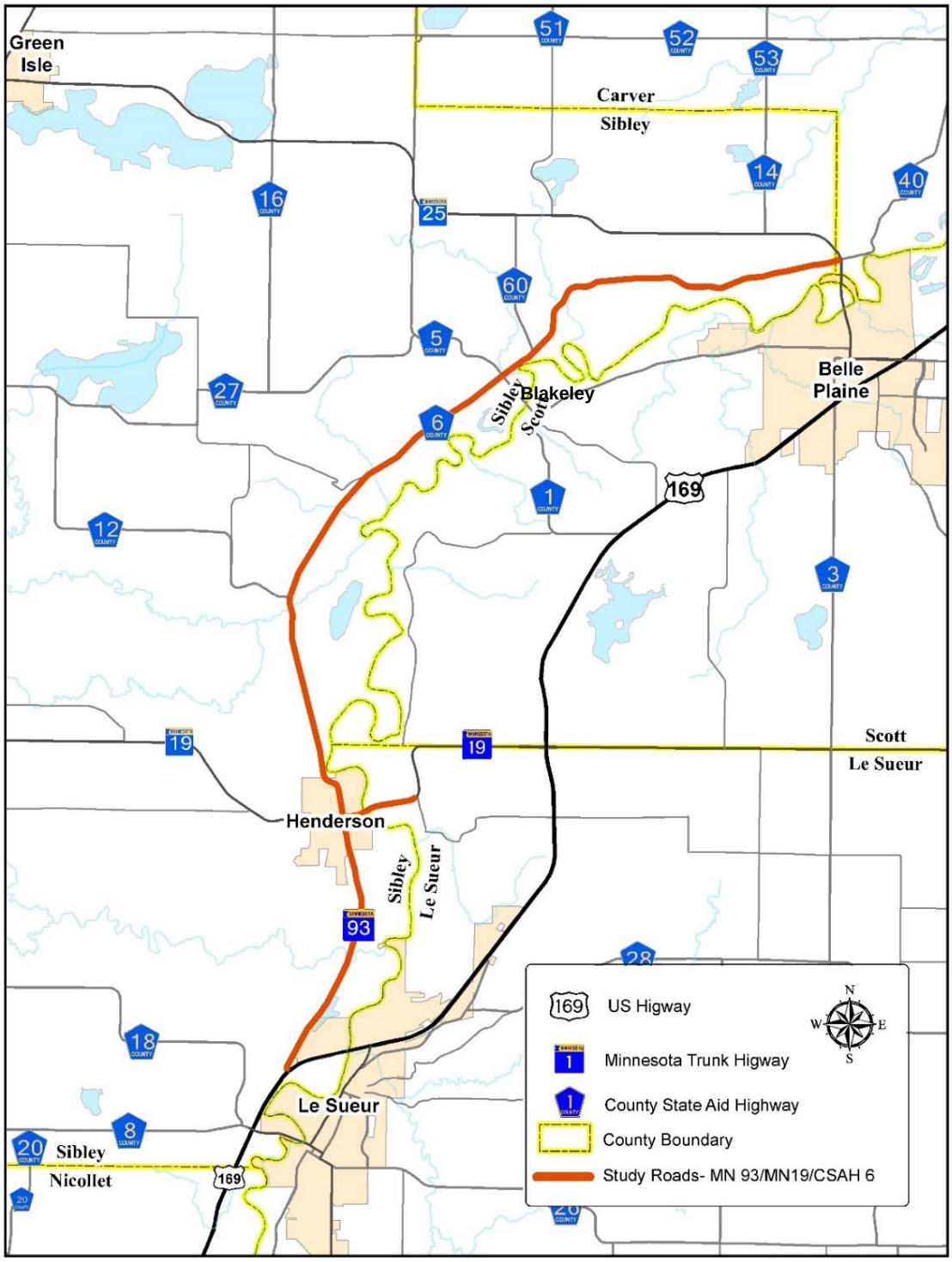
The Minnesota River is a tributary of the Mississippi River, approximately 332 miles long. The Minnesota River drains a watershed of nearly 17,000 square miles, with nearly 15,000 square miles in Minnesota and the remaining area in South Dakota, North Dakota and Iowa. It flows through the study area and joins the Mississippi River in the Twin Cities near historic Fort Snelling.

Levee opening at TH 19 entrance to Henderson looking east.

TH 93 south of Henderson at 316th Street looking north. This section of road is 4 feet below 100 year flood.

1965 high-water level over County Road 6 looking north.

Figure 1 – Study Area



2 Study Guidance and Public Involvement

The Henderson Flood Feasibility Study process included a public and agency involvement program that was initiated at the beginning of the study. There were several elements to the involvement program, which are detailed below.

2.1 Project Management Team (PMT)

The PMT was formed to establish a communication link to constituents and elected officials regarding the study. PMT members include:

- City of Henderson
- Le Sueur County
- Sibley County
- Scott County
- MnDOT

To date, the PMT has met five times. The PMT members have guided the study process, reviewed technical products, and served as a conduit between the study team and the organizations and constituents they represent. A summary of each PMT meeting is included in Appendix A.

Other topics were raised by the PMT and discussed that were outside the scope of this study, these included:

- The slope failure history along TH 93 and TH 19
- The flooding from the Rush River which can also cause closure of TH 93
- Improving TH 19 to a 10 ton route east of the RR bridge where it climbs the bluff
- The City of Henderson needing to recertify the flood levee in the near future
- Sibley County is studying flood mitigation near the County Road 5/County Road 6 intersection

2.2 Public and Agency Involvement Activities

Early Coordination with Environmental Review and Permitting Agencies

The following environmental review and permitting agencies were invited to a meeting on May 23, 2017:

- U.S. Army Corps of Engineers (USACE)
- U.S. Fish and Wildlife Service (USFWS)
- Minnesota Department of Natural Resources (DNR)
- Sibley County Soil and Water Conservation District

The purpose of the meeting was to share preliminary study findings with the agencies and to discuss the pros and cons of each of the conceptual alternatives. A meeting summary is included in Appendix A.

Public Open House Meeting

A public open house meeting was held on May 17, 2017 at the Henderson RoadHaus Event Center. Over 50 people attended the open house. The purpose of the meeting was to introduce the study to the public and gather input on study area issues and concerns. A public open house summary is included in Appendix A.

Study Newsletters

During the course of the study process, two newsletters were published to notify the public of the study purpose and to announce the May 17th open house meeting. Newsletters have been posted on the project's website and have been electronically distributed to the local units of government for dissemination. Copies of the newsletters are included in Appendix A. A final newsletter will be distributed upon completion of the study, which will summarize the findings contained in this report.

Study Website

A study website was developed and maintained by MnDOT at http://www.dot.state.mn.us/d7/projects/hwy19study/index.html. The site provided an additional means of distributing information and gathering input with an e-mail reply feature. Throughout the study process technical and public involvement materials have been posted on the study website.

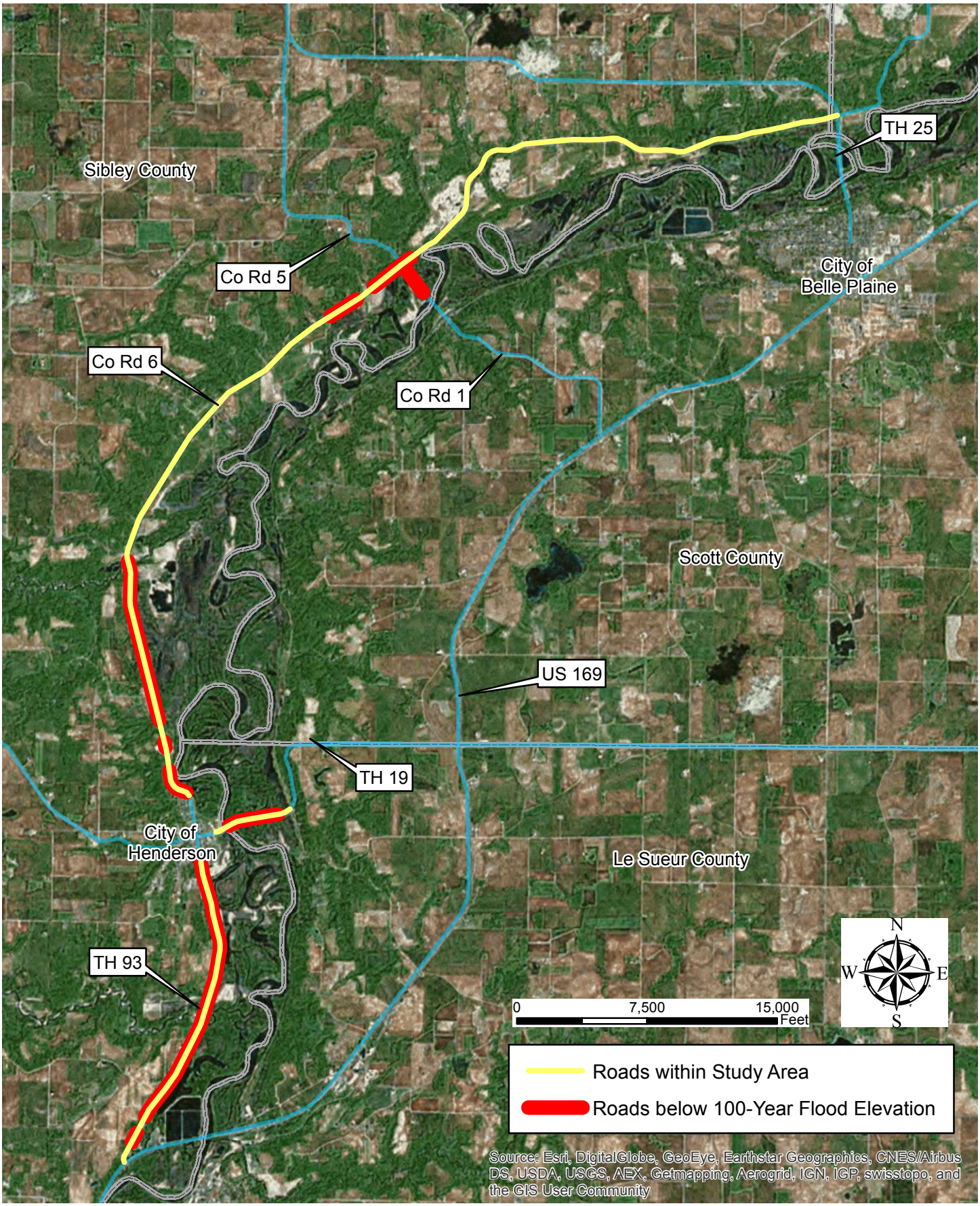
3 Hydraulic Analysis

As part of the study, a hydraulic analysis and review of the flooding history of the Minnesota River at Henderson was completed by SEH. The limits of the study, and the portions of the roadways which are below the 100-year flood elevation are shown in Figure 2.

3.1 Available River Gage Data

Available stream gage data for the Minnesota River was reviewed with the primary goal of determining the flood frequency and average closure duration for each of the roadways in the study area. Data was collected from the U.S. Geological Survey (USGS), the Minnesota Department of Natural Resources (MnDNR), and the National Weather Service (NWS). The MnDNR currently maintains a gage on the Minnesota River at Henderson (Gage No. 33032001), however, data is only readily available dating back to 2014. Upon request, additional data dating back to 2008 was provided by the MnDNR for this analysis. However, the additional data did not provide a continuous record for the period. A more complete and extensive record of river discharges and/or stages was desired in order to estimate roadway closure frequency and average closure duration.

The USGS has a gage on the Minnesota River at Jordan (approximately 30 miles downstream) with discharge records dating back to 1934. The USGS also has a gage at Mankato (approximately 35 miles upstream) with discharge records dating back to 1903. The discharge records for these two gages were compared, and it was determined that the discharges from the Jordan gage data could be used with a rating curve for the Henderson location in order to develop a longer river stage record. The rating curve for Henderson was developed using the discharge and stage data available from the MnDNR gage at Henderson. Once applied to the available discharge rates from the Jordan gage, the calculated river stages at Henderson were adjusted to fit instantaneous high water levels which were recorded by the NWS during 32 historic flood events, and to match the available recent data collected by the MnDNR gage. The resulting hydrograph for the Minnesota River showing the historic river levels at Henderson is illustrated in Figure 3.



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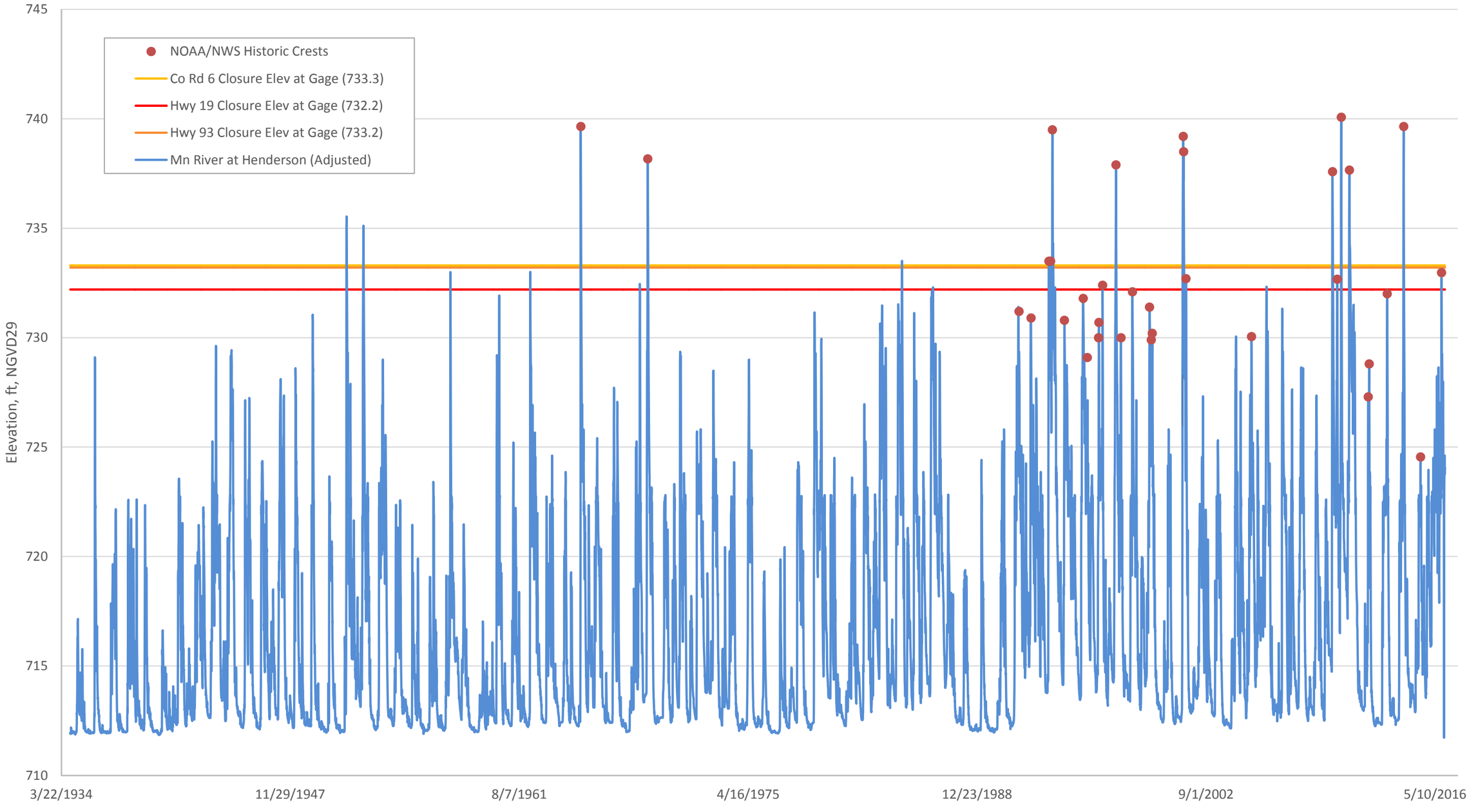
Project Number: MNT07 137843
Print Date: 3/7/2017

Map by: rpichelmann
Projection: UTM 15N
Source: MnTOPO, ESRI, SEH

MnDOT Flood Feasibility Study
Henderson, MN

FIGURE 2
Flood-Prone Roadways

Figure 3 - Historic Minnesota River Levels at Henderson



3.2 Road Closure Frequency and Duration

The data presented in Figure 3 was used to estimate the roadway closure frequency and average closure duration for the economic analysis conducted for the study. Prior to estimating these values, LiDAR data available from the MnDNR's MnTOPO website was used to estimate the current roadway elevations and the associated closure elevations. Preliminary closure frequency and duration numbers were estimated based on the periods when the river stage exceeded the assumed closure elevations for each roadway.

Historical closure dates were provided by the MnDOT area maintenance supervisor for several recent flood events. Those closure dates were cross referenced with the preliminary closure frequency and duration numbers, and were refined to better match the MnDOT closure data. Through discussions with PMT members, it was decided that a period of 25 years (1991-2016) would be used to establish the closure frequency and duration. This period includes seven flood events which caused closures of Highway 19, Highway 93, and County Road 6, and two additional floods which caused closure of Highway 19 only. The closure data used for the economic analysis is summarized in Table 2.

Table 2 – 25-Year Closure History – Minnesota River at Henderson

Event	# Days Water Higher than Closure Level	MnDOT Reported Days Closed
Highway 19 Closure Summary		
Spring/Summer 1993*	40	40
April 1997*	21	21
April 2001	36	37
March 2010	20	20
September 2010	14	13
March 2011	31	31
June 2014*	15	15
Average	*25.3*	*25.3*
Highway 19 Short Duration Event Summary		
June 2001	3	3
July 2010	4	4
Highway 93 Closure Summary		
Spring/Summer 1993*	31	31
April 1997*	14	14
April 2001	32	30
March 2010	16	18
September 2010	12	13
March 2011	27	26
June 2014*	12	12
Average	*20.6*	*20.6*

* Gage data used in lieu of MnDOT data.

Table 2 (Continued) – 25-Year Closure History – Minnesota River at Henderson

Event	# Days Water Higher than Closure Level
County Road 6 Closure Summary	
Spring/Summer 1993*	32
April 1997*	13
April 2001	32
March 2010	16
September 2010	11
March 2011	26
June 2014*	12
Average	*20.3*

Frequency for Hwy 93 & CR 6: 7 floods in 25 years (1 per 3.57 yrs)

Frequency for Hwy 19: 9 floods in 25 years (1 per 2.78 yrs)

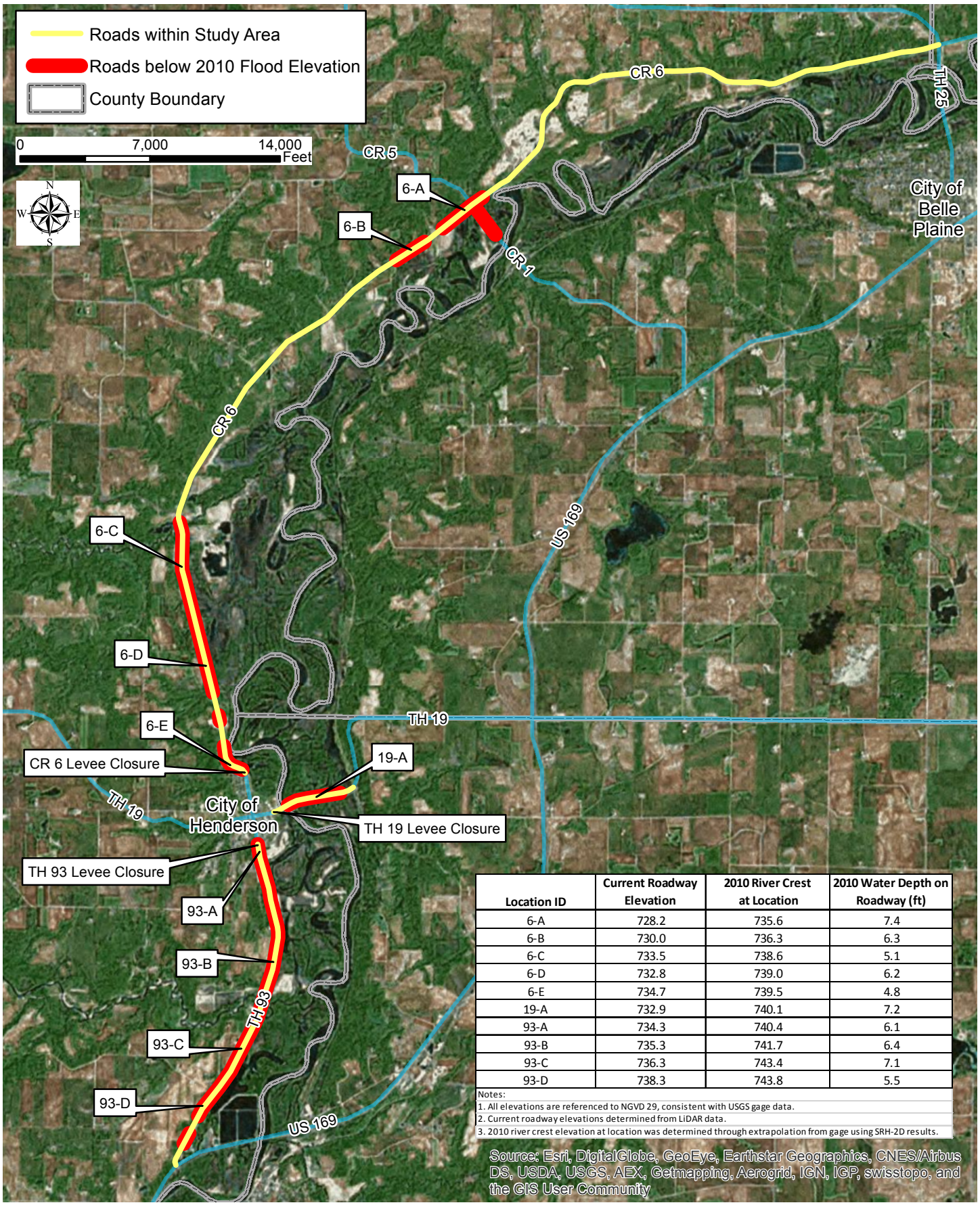
At the second PMT meeting, a suggestion was made to consider increasing the closure frequency values used for the economic analysis to account for the increasing frequency of flood events shown on Figure 3. After the discussion, it was determined that this type of extrapolation would be difficult to defend without conducting a thorough statistical analysis which was beyond the scope of this feasibility study.

3.3 Proposed Roadway Elevations

The primary goal of this study was to determine the feasibility of projects which would significantly reduce the roadway closure frequency and duration due to flooding along the Minnesota River in the Henderson Area. During early project discussions, the proposed conditions were described as roadway elevations which would not require closure during the 100-year event. The effective Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Sibley County (report dated 1999) shows a 100-year elevation of 740.5 (ft, NGVD29) at Henderson. In contrast, the effective hydraulic model of the Minnesota River, provided by the MnDNR for this study, shows a 100-year elevation of 739.9 (ft, NGVD 29) at Henderson. This difference is due to the decreased flow rates which the MnDNR has adopted based on a 2001 USACE/DNR hydrologic study of the Minnesota River. Although the 100-year elevation based on the MnDNR model is lower than that published by FEMA, it is considered the best available data for this study.

During the 2010 flood event, the Minnesota River crested at elevation 740.08 (ft, NGVD29) at Henderson, which was the highest recorded elevation, and was approximately 0.2' higher than the 100-year elevation established by the MnDNR model. This was discussed with the MnDOT hydraulic engineer on the project, and it was decided that to be consistent with previous work completed by MnDOT along other portions of the Minnesota River, the 2010 flood event would be used to set the proposed design criteria. The 2010 flood elevations were extrapolated upstream and downstream of Henderson based on the slope of the MnDOT hydraulic modeling results (using the SRH-2D model). Figure 4 shows the portions of the roadways that fall below the 2010 flood elevation and the approximate depth of water on the roadway during the 2010 flood event.

After discussion with the PMT, it was determined that roadway closures generally occur when the water elevation reaches the shoulder of the roadway. Based on this assumption, the proposed roadway profile was set with the roadway shoulder a minimum of one foot above the 2010 flood elevation.



Location ID	Current Roadway Elevation	2010 River Crest at Location	2010 Water Depth on Roadway (ft)
6-A	728.2	735.6	7.4
6-B	730.0	736.3	6.3
6-C	733.5	738.6	5.1
6-D	732.8	739.0	6.2
6-E	734.7	739.5	4.8
19-A	732.9	740.1	7.2
93-A	734.3	740.4	6.1
93-B	735.3	741.7	6.4
93-C	736.3	743.4	7.1
93-D	738.3	743.8	5.5

Notes:
1. All elevations are referenced to NGVD 29, consistent with USGS gage data.
2. Current roadway elevations determined from LiDAR data.
3. 2010 river crest elevation at location was determined through extrapolation from gage using SRH-2D results.

Path: S:\KO\M\Mnt07\137985\54-prelim-dsgn-rpts\H and H\GIS\TM Fig 3_ClosureInfo_2010EventTable.mxd

Project Number: MNT07 137843
Print Date: 3/7/2017

Map by: rpichelmann
Projection: UTM 15N
Source: MnTOPO, ESRI, SEH

MnDOT Flood Feasibility Study
Henderson, MN

FIGURE 4
Estimated 2010 Flood Depths

3.4 Cursory Hydraulic Modeling

The proposed road raises were evaluated using two methods: (1) with a 1-Dimensional Hydrologic Engineering Center's River Analysis System (HEC-RAS) model provided by the MnDNR which is considered the effective regulatory model, and (2) with a Sediment and River Hydraulics, two-dimensional (SRH-2D) model which was developed by MnDOT for this study. A detailed summary of the SRH-2D modeling completed by MnDOT is provided in the MnDOT Hydraulic Memorandum, dated June 19, 2017 (see Appendix B).

The 1-D HEC-RAS analysis was completed by SEH as a cursory evaluation prior to evaluation by MnDOT with the SRH-2D model. According to 44 CFR 60.3(d), encroachments in the regulatory floodway shall be prohibited unless it can be demonstrated through hydrologic and hydraulic analyses that the proposed encroachment would not result in any increase in flood levels during the 100-year flood event. The intent of the hydraulic modeling was to evaluate whether the proposed improvements for each alternative meet the "no rise" design criteria of having no impact (0.00') on the 100-year water surface elevations of the Minnesota River. If an alternative was not shown to meet the "no rise" criteria, required mitigation methods that would be acceptable to all regulatory agencies were identified.

Highway 19

Highway 19 crosses the Minnesota River and floodplain roughly perpendicular to the flow of the river. The existing Highway 19 crossing includes a six-span bridge with total length of approximately 485 feet over the main channel of the Minnesota River. The remaining roadway crosses the floodplain with road elevation approximately seven feet below the 100-year water surface elevation. Prior to evaluating scenarios which would reduce the flooding frequency of the roadway, the causeway profile and bridge data of the crossing was updated in the HEC-RAS model to better reflect existing conditions. Three scenarios for raising the roadway above the 2010 flood elevation were evaluated with the 1-D HEC-RAS model with the primary goal of achieving a "no rise" design described in 44 CFR 60.3(d).

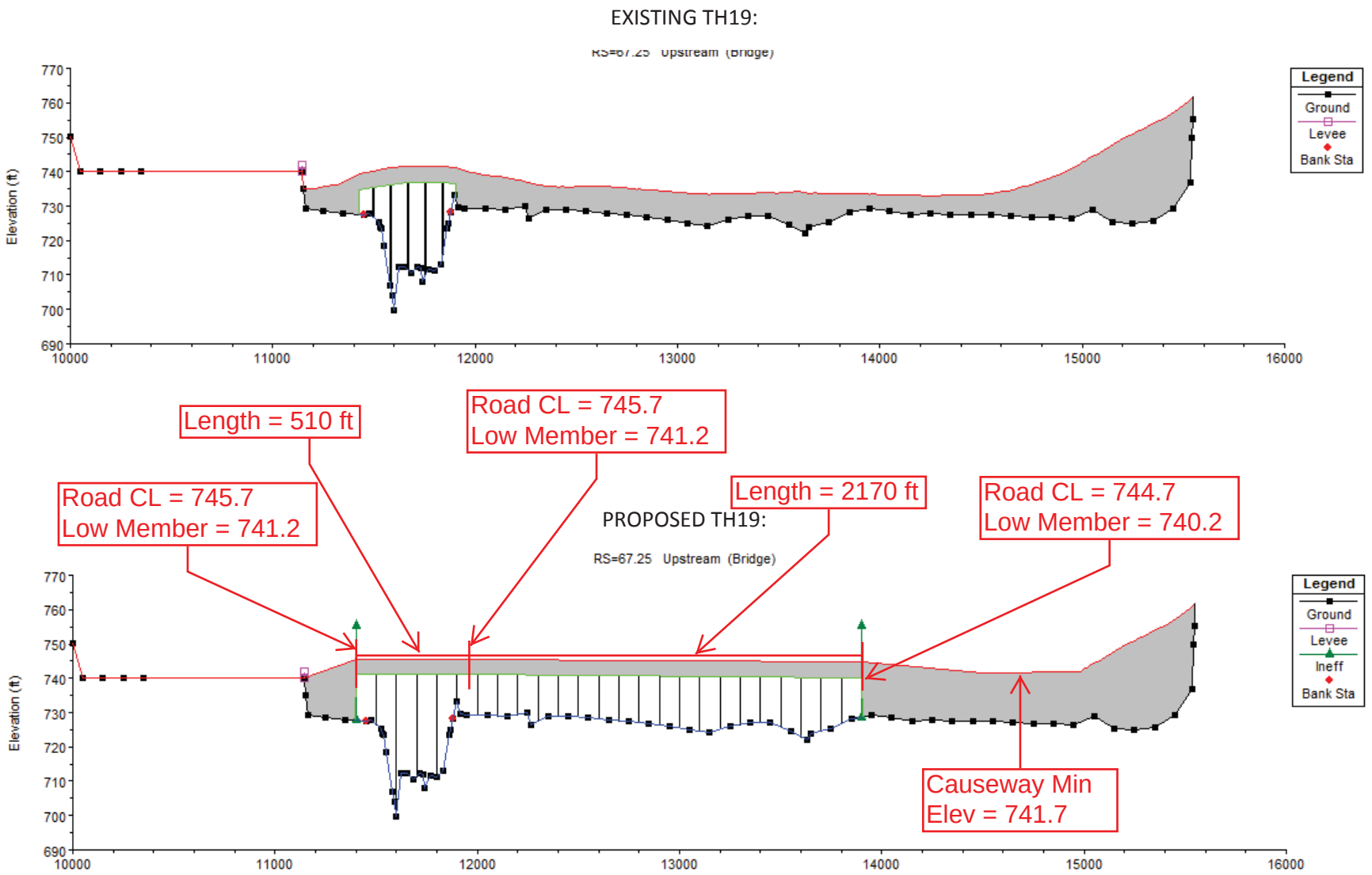
The first scenario involved raising the roadway to meet the project design criteria without providing any additional conveyance. This scenario was created to show the impact the road raise could have if no mitigation is provided. The 1-D HEC-RAS results show that this scenario results in a peak water surface elevation increase of approximately 1.7' during the 100-year flood event.

The second scenario included raising the roadway to meet the project design criteria, and adding large box culverts in an attempt to achieve a "no rise" design without modifying the existing bridge. This scenario was developed as a potentially lower cost alternative to the bridge option described below. After adding fifteen 16' by 12' box culverts, there was still an increase of approximately 0.7' during the 100-year flood event.

The third scenario included the construction of a bridge structure which spans the main channel and most of the designated floodplain. This option was developed as the only alternative which satisfies the "no rise" criteria. In order to have no impact (0.00') on the peak water surface elevations of the Minnesota River during the 100-year flood event, the 1-D HEC-RAS modeling showed that a new bridge with total length of 2500' must be constructed to span the main channel and much of the floodplain. However, SRH-2D modeling completed by MnDOT indicated that a longer bridge (total length 2680 ft.) was needed to satisfy the "no rise" criteria.

The flow area provided by such a bridge provides the additional conveyance needed to offset the fill associated with the road raise. A sketch of the existing and proposed roadway profiles for Highway 19 are depicted in Figure 5. As shown in Figure 5, the low member of the bridge is approximately 1' above the 2010 flood elevation over the main channel, and is at the 2010 flood elevation at the eastern end of the bridge. The minimum roadway elevation on the eastern end of the bridge meets the project design criteria. A total bridge deck/superstructure height of 54" was assumed for this analysis, along with 100-ft bridge spans.

Figure **5**. TH 19 Road Profiles Looking Downstream (North)



Highway 93

Highway 93 roughly parallels the Minnesota River, and the existing roadway is included in the geometry file of the effective HEC-RAS model provided by the MnDNR. For Highway 93, the proposed road raise was modeled in the 1-Dimensional HEC-RAS model and the cursory hydraulic model results show that this change results in an increase of up to 0.03' during the 100-year flood event. Preliminary results from MnDOT's SRH-2D analysis indicated an increase of up to 0.13' during the 100-year flood event without any mitigation for this alternative.

Possible mitigation options to achieve a "no rise" design were discussed with the PMT including construction of new large culverts crossing Highway 19 at Henderson, construction of a swale/ditch along the raised portions of Highway 93, and lowering of the Highway 19 roadway within the Minnesota River floodplain. However, inclusion of the large culverts at Highway 19 showed minimal benefits immediately upstream of Highway 19, and those benefits did not extend far enough upstream to offset the impacts of the road raise. The swale/ditch option was not pursued further due to the additional property acquisition, wetland impacts, and maintenance requirements associated with this option.

Only the Highway 19 roadway lowering option was shown to result in a "no rise" design based on both the 1-dimensional HEC-RAS analysis and the SRH-2D analysis, and be a potentially acceptable alternative. Figure 6 has been prepared to show how the revised Highway 19 profile compares to the existing profile. As shown in Figure 6, the revised profile does not result in a lower overtopping elevation for the roadway, and therefore does not increase the flood risk for the roadway. It does, however, increase the amount of roadway which is overtopped.

County Road 6

The 1-dimensional HEC-RAS model provided by the MnDNR for this study included County Road 6 in the original roadway alignment, which differs from the existing conditions. It was determined that the cursory evaluation using HEC-RAS would not be conducted for this roadway, and that the proposed improvements would be evaluated using SRH-2D instead. Preliminary results from MnDOT's SRH-2D analysis indicated an increase of up to 0.02' during the 100-year flood event without any mitigation. As described in the MnDOT hydraulic memo (see Appendix B), the proposed mitigation needed to achieve a "no rise" condition consisted of excavation of fill from the floodplain and lowering a portion of Sibley County Road 5 near Blakely.

Figure 6- Highway 19 Profile

3.5 Agency Coordination

On March 8, 2017, a preliminary agency coordination meeting was held with Suzanne Jiwani (MnDNR), Nicole Bartelt & Peter Leete (MnDOT), and SEH to discuss the preliminary hydraulic modeling results. The discussion focused on the increased flood elevations associated with the proposed work on Highway 93 and County Road 6. Since there were no feasible options for achieving a "no rise" design for these roadways, the recommendations given by the MnDNR included obtaining a Conditional Letter of Map Revision (CLOMR) prior to the work, and a Letter of Map Revision (LOMR) after completion of the work. This would also involve flood-proofing (for agricultural buildings) and acquisition and removal for habitable structures within the area impacted. Based on the SRH-2D results for the Highway 93 road raise, the impacted area extends upstream of the Highway 93 crossing at Le Sueur. A more detailed breakdown of the process is included below:

- Apply for a CLOMR once the design has progressed, but prior to bidding or construction. In order to receive a CLOMR, it will be necessary to indicate the mitigation method that will be used (flood-proofing, acquisition/removal, etc.). This application is then reviewed by the MnDNR and FEMA, and the review process can take more than a year.
- Complete the construction, and all of the mitigation that is described in the CLOMR.
- Request a LOMR. This essentially documents the work that was done, and the associated increases in the Base Flood Elevations.

The process described above may also be applicable for the road raise on County Road 6, but that work may be ruled out because it could impact river stages along the levee system in Henderson.

A subsequent agency coordination meeting was held on May 23, 2017 with representatives from the MnDNR and MnDOT attending. Additional agency representatives from the US Army Corps of Engineers and US Fish & Wildlife Service were also invited but did not attend. At this meeting, the MnDNR generally concurred with the hydraulic modeling approach used by SEH and MnDOT to evaluate the project alternatives. The MnDNR noted that the US Army Corps of Engineers is developing a revised model of the Minnesota River, and that it will likely be adopted by the MnDNR as the regulatory model upon completion. Future modeling efforts should incorporate the new US Army Corps of Engineers hydraulic model to evaluate project impacts.

4 Study Alternatives and Traffic Forecast Methodology

A number of alternatives were analyzed for this study. The traffic analysis year is 2040 and the traffic analysis alternatives are described as following:

- No-Build: no roadway closure, base alternative for comparison purpose.
- All-Closure: Highway 19 MN River Bridge, County Road 6, Highway 93, Highway 93 East and County Road 5 MN River Bridge are closed
- Highway 19 Only Closure: Highway 19 MN River Bridge Closed with all others open
- County Road 6 Open (Build): Highway 19 MN River Bridge, Highway 93, Highway 93 East and Sibley County Road 5 MN River Bridge are closed
- Highway 19 Open (Build): County Road 6, Highway 93, Highway 93 East and County Road 5 MN River Bridge are closed
- Highway 93 Open (Build): Highway 19 MN River Bridge, County Road 6, Highway 93 East and County Road 5 MN River Bridge are closed

It is noted that the first three alternatives (No-Build, All-Closure and Highway 19 Only Closure) were included for traffic analysis as they were required for subsequent benefit cost analysis as compared scenarios due to different flooding closure events.

Credible traffic forecasts and corresponding Vehicle-Hours-Travelled (VHT) and Vehicle-Miles-Travelled (VMT) are critically important in determining road user benefits and costs for each alternative compared with the no-build and flooding alternatives. The latest MnDOT Collar County Travel Demand Model has incorporated the most recent Thrive 2040 MSP and it was recently refined in the Scott County area and thus named as the Scott County Model (SCM). The Henderson Flood Feasibility Study used the SCM to conduct traffic forecast and analysis to achieve consistent results among the various alternatives considered. The traffic forecast and analysis followed the following steps:

1. The base and 2040 roadway networks in the SCM were refined to include major roadways and traffic analysis zones (TAZs) in the study area. The 2010 and 2040 socio-economic data in the SCM TAZs were reviewed and remained unchanged for this study. However, the 2010 and 2040 socio-economic data were re-allocated proportionally to the subdivided TAZs based on corresponding 2010 census data to develop the subarea model for this study.
2. The base 2010 and 2040 no-build subarea models were run to obtain the daily traffic outputs on major roadway segments as well as VMTs and VHTs within the influencing area bounded by Highway 22 (West), US Highway 212 (North), Highway 21/Highway 13 (East) and County boundaries (South, model limits).
3. The 2010 and 2040 subarea model networks were revised accordingly to reflect different flooding and build alternatives as described previously and were rerun to obtain their daily traffic outputs on major roadway segments and VMTs and VHTs within the same influencing area.
4. The 2010 and 2040 VMTs and VHTs were directly provided for subsequent benefit cost analysis, considering the fact that the VHTs and VMTs benefits for any build alternative are calculated based on the relative changes to the no-build alternative.
5. The 2040 model daily traffic outputs on major roadways were adjusted to develop the final traffic forecasts based on differences between the 2010 base model daily outputs and actual counts to account for modeling errors.
6. All the daily traffic forecasts and VMTs and VHTs for different alternatives were reviewed for reasonableness based on engineering judgment.

4.1 Traffic Forecasts Results

Following the methodology and steps described in the previous section, the resulting VHTs and VMTs are summarized in Table 3.

Table 3 – Subarea Daily VMT and VHT by Alternative

Alternative	2010			2040		
	VMT	VHT	Speed	VMT	VHT	Speed
No-Build	2,082,087	46,467	44.81	3,412,480	81,301	41.97
All-Closure	2,158,803	48,569	44.45	3,481,211	84,385	41.25
Highway 19 Only closure	2,086,199	46,690	44.68	3,415,166	81,640	41.83
County Road 6 Open (Build)	2,145,399	48,307	44.41	3,4565,673	84,095	41.21

Alternative	2010			2040		
	VMT	VHT	Speed	VMT	VHT	Speed
Highway 19 Open (Build)	2,115,395	47,466	44.57	3,443,151	82,952	41.51
Highway 93 Open (build)	2,111,526	47,513	44.44	3,437,863	83,170	41.35

Note: the subarea bounded by Hwy 22 (West), US Hwy 212 (North), Hwy 21/Hwy 13 (East) and County boundaries (South, model limits).

The exiting and forecasted average daily traffic (ADT) volumes for major roadways are summarized in Table 4.

Table 4 – Existing and Forecasted 2040 Average Daily Traffic Volumes by Alternative

Segment	2014 ADTs	2040 Alternative					
		No-Build	All – Closure	Hwy 19 Only Closure	Cty. Rd. 6 Open	Hwy 19 Open	Hwy 93 Open
County Road 6	1,200	1,900	0	3,100	900	0	0
Highway 19 West	2,400	2,700	700	2,300	1,000	3,000	3,000
Highway 19 East	2,400	3,300	0	0	0	6,000	0
Higyway 93 South	2,200	2,600	0	4,100	0	0	3,700
County Road 9 North of Highway 19	760	1,100	3,800	1,000	3,900	5,000	4,500
County Road 17 South of Highway 19	630	800	7,800	700	7,400	3,700	1,400
County Road 8 West of US Highway 169	2,650	3,800	5,800	4,500	5,700	4,600	4,600

5 Benefit-Cost Analysis

This section documents the methodology and results of a screening level benefit-cost analysis for the build alternatives developed as part of the Henderson Flood Feasibility Study.

For the study, four separate build alternatives were analyzed and compared to the No Build alternative. The alternatives are listed below:

1. No Build – do nothing alternative
2. County Road 6 Improvement – reconstruct County Road 6 to above flood levels
3. Highway 19 Improvement – reconstruct Highway 19 to above flood levels
    a. Full Bridge reconstruct with Trail
    b. Full Bridge reconstruct without Trail
4. Highway 93 Improvement – reconstruct Highway 93 to above flood levels

Table 5 represents the previous 7 major flood events that have occurred near the City of Henderson during the past 25-years.

Table 5 – Flood Event Closure Days

Roadway	1993	1997	2001	2010 Spring	2010 Fall	2011	2014	Average
Cty. Rd. 6	32	13	32	16	11	26	12	20
Hwy 93	31	14	30	18	13	26	12	21
Hwy 19	40	21	37	20	13	31	15	25

With 7 major flood events during the last 25-years, this analysis will assume there will be 6 major flood events during the 20-year forecast analysis. The average closure days from Table 5 will be used for the assumed flood event years in the VMT and VHT calculations.

It should also be noted that Highway 19 closed for 3 additional days in 2001 and 4 additional days in 2010 as part of separate flood events. This will be included as a minor flood event that will be assumed to occur 2 times during this 20-year analysis.

5.1 Purpose of Benefit-Cost Analysis

The purpose of a benefit-cost analysis is to express the effects of an investment (or closure) into a common measure (dollars). This allows for the fact that the benefit or costs of a project are often accrued over a long period of time, while the initial investment is incurred during the initial years of the project.

In this analysis approach, any quantified benefits that are greater than or equal to the quantified costs (benefit-to-cost ratio greater than one) represents an economically viable project.

5.2 Benefit-Cost Methodology

The monetary benefit for the project is quantified in terms of reduced VMT, VHT, and estimated crashes over the analysis period between the No-Build and the Build option. The costs typically include construction, bridges and structures, right-of-way, and engineering/project delivery costs. Remaining capital values of these roadway features at the end of the analysis period are subtracted from the total cost of the project.

The screening level of this benefit-cost analysis did not take into account crash reductions or general operating and maintenance costs. However, it did take into account the different maintenance costs due to the bridge closures and temporary mitigations and repairs that occur during and after a flood event.

The results of the analysis provide input for evaluating the overall benefit of the proposed improvements to a particular corridor. Due to the planning level of detail in the calculations, the magnitude of the value is not as important as the value in comparing alternatives.

General Assumptions

- All monetary values are discounted to the 2017 analysis year. Inflation is not included.
- The 20-year benefit period is based on a 2020 day-of-opening through 2040
- Yearly Build and No-Build benefits are calculated based on linear interpolation over the 20-year analysis period.
- The number of days per year used in the analysis was 365.
- Longer travel times and rerouting of trips during construction years are not included.

- Preliminary cost estimates were developed using current estimation methodology. The cost estimates are based on documented construction costs. The cost estimates include all roadway sections including local street connections due to access changes.
- Operating and Maintenance (O&M) values were estimated based on MnDOT and Sibley County guidance.

Traffic Assumptions

As part of the Henderson Flood Feasibility Study, the MnDOT Collar County Travel Demand Model (CCTDM) was used to develop traffic forecast data for all roadways in the study area. The CCTDM includes the 12 counties surrounding the 7-County Twin Cities metropolitan area. The latest version of the CCTDM was utilized and a refined subarea model was developed around the study area, including the potential detour routes that traffic would utilize during flood events and roadway closures.

For each alternative and flood closure event, a separate model was created to include both local and regional trip rerouting. Below are the traffic assumptions used in the VMT and VHT calculations for all alternatives:

- Daily VMT and VHT for all scenarios and possible closure combinations were calculated from the CCTDM model results for the entire 12-County model area network. The CCTDM modeled years were 2010 and 2040; this information was extrapolated out to the 2020 year of opening. The different model scenarios include:
  - No Build
  - County Road 6, Highway 19, Highway 93 Closure (Major Flood Event)
  - Highway 19 Closure Only (Minor Flood Event)
  - County Road 6 Build Alternative; Highway 93 and Highway 19 Closures
  - Highway 19 Build Alternative; Highway 93 and County Road 6 Closures
  - Highway 93 Build Alternative; Highway 19 and County Road 6 Closures
- Yearly values for each alternative were calculated based on a non-flood event, a major flood event year, and a minor flood event year.
  - For non-flood event years, the calculations only use the No Build VMT and VHT data. So there is no potential benefit for days the roadway would normally be open.
  - For major and minor flood event years, the average number of days of closure (see Table 5 above) was used in conjunction with the remaining days in the year to compile a yearly VMT and VHT. The daily values for each closure scenario were combined with the No Build scenario daily values to create a yearly VMT and VHT value.
- Yearly values for each alternative, for both non-flood event and flood event years were carried forward and interpolated for the 20-year analysis.
- The VMT and VHT information for a flood event year would replace the information in the non-flood event. This ensures that the only benefit occurs during the flood event year.
- Six major flood events are assumed to occur during the 20-year analysis (based on historical data). The years for the assumed flood events are 2021, 2025, 2029, 2033, and 2037.
- Two minor flood events are assume to occur during the 20-year analysis (based on historical data). The years for the assumed flood events are 2023 and 2031.

5.3 Benefit-Cost Analysis Results

Table 6, below, summarizes the results of the benefit-cost analysis for the screening level build alternatives for the Henderson Flood Feasibility Study.

Table 6 – Summary of Benefit-Cost Analysis

Scenario	CSAH 6 Reconstruct	TH 19 Reconstruct (with Trail)	TH 19 Reconstruct (without Trail)	TH 93 Reconstruct
VMT & VHT Benefit	$1,288,050	$5,008,651	$5,008,651	$4,813,876
Operating/Maintenance	$198,589	$116,819	$116,819	$106,560
Total Benefit	**$1,486,638**	**$5,125,470**	**$5,125,470**	**$4,920,436**
Total Construction Costs (PV)	$15,698,113	$40,013,768	$33,506,709	$13,926,523
Remaining Capital Value (RCV)	$2,858,966	$12,904,852	$10,687,309	$3,041,144
Total Cost minus RCV	**$12,839,147**	**$27,108,916**	**$22,819,400**	**$10,885,379**
BC RATIO	**0.12**	**0.19**	**0.22**	**0.45**

The preliminary analysis indicates that none of the Build Alternative have a benefit-cost ratio greater than one. The VMT and VHT benefits of the projects are estimated to be less than the costs associated with the construction of the project. At this level of screening analysis, the magnitude of the benefit-cost ratio is not as important as the overall relative comparison of the benefit-cost ratio.

Based on the screening level analysis, the following assessment of each alternative can be made:

- County Road 6 Reconstruction – This option provides the least amount of benefit for the roadway network. With one of the least expensive project costs, the low benefit numbers keep the benefit-cost ratio at the lowest value of the three alternatives.
- Highway 19 Reconstruction – This option provides the highest benefit to the roadway network; however it also incurs the most expensive project costs which are almost 4 times as high as the other build alternatives. Due to the high costs, with or without the trail provided, the benefit-cost ratio is only slightly better than County Road 6 and well below Highway 93.
- Highway 93 Reconstruction – This option provides a significant benefit to the roadway network, just below the Highway 19 benefits. With one of the least expensive project costs, this build alternative provides the highest benefit-cost ratio of the three alternatives.

The complete Benefit-Cost Memorandum is attached in Appendix D which provides additional detail on the benefit cost calculations.

During a flood event, the City of Henderson is severely limited in route choice into and out of the City as three of the four roadways in/out of Henderson can be flooded and closed to traffic for upwards of 3-weeks at a time. During these flood events, residents and other community members must use long detour routes to travel to any destination outside of the city limits. During this time, the businesses within the community can be severely impacted as the traffic traveling through Henderson is completely removed.

Each Build Alternative would provide a benefit during a flood event to the roadway users, residents, and business within the City of Henderson.

6 Alternatives Process

This section describes the process to identify the alternatives to mitigate flooding impacts. Only one alternative for each roadway (Highway 19, Highway 93 and County Road 6) was developed that most effectively mitigated flooding impacts.

6.1 Design Criteria

- New roadway designs will place the shoulder PI 1-foot above design flood elevation
- For the Highway 19 bridge alternative the bottom of the bridge beams over the main channel will be set 1 foot above the design flood event
- New roadway improvements will be designed to 10 ton capacity
- Lane and shoulder widths will match existing geometry
- Fill slopes will be 1:4 and break to 1:3 at clear zone
- Guardrail will be used to avoid/minimize impacts to sensitive resources
- Each alternative includes modifying the existing Henderson levee system (the proposed roads entering the City would essentially be at the same elevation as the top of the levee).
- The conceptual alternatives have been designed to have sufficient waterway opening to prevent any increase in water levels

6.2 Highway 19 Alternative

Existing Conditions

The Highway 19 Bridge is the only Minnesota River crossing within the study area; the bridge structure itself and the low lying segment east of the bridge are prone to flood closures. Highway 19 has an approximate flood closure at a river elevation of 732.9'. This is typically the first roadway to close a handful of days prior to the Highway 93 and County Road 6 routes. For the 25-year history evaluated for this project, Highway 19 has also closed and been reopened on two separate occasions when Highway 93 and County Road 6 were not closed from flooding events. Highway 19 provides a direct connection from the City of Henderson to the east to access US Highway 169; there is a full access freeway interchange at this location.

Proposed Conditions

The proposed alternative is to reconstruct the existing Highway 19 bridge structure to span the river channel and majority of the floodplain, an approximately 2,680 foot long bridge structure with roadway approaches for a total project length of approximately 4,500 feet. Portions of the existing Highway 19 roadway grade will be raised approximately 8' higher than the existing roadway elevation. An additional 2 acres of right-of-way would need to be acquired to construct the Highway 19 alternative. There are two options for the proposed bridge width; one with a proposed trail and one without a trail. The conceptual layout and proposed typical section for this concept are shown in Appendix F.

Highway 19 Alternative total estimated cost (with trail) = $40.0 million (2017 dollars)

Highway 19 Alternative total estimated cost (without trail) = $33.5 million (2017 dollars)

Cost Effectiveness

A benefit-cost analysis was completed for the Highway 19 alternatives which resulted in a benefit-cost of 0.19 with a trail on the bridge and 0.22 without a trail on the bridge. For additional

information regarding the benefit-cost analysis that was performed for this study, please see Section 5 of this report and Appendix D.

Sensitive Resources in the Vicinity of Highway 19

The low-lying bottomlands along the Minnesota River channel are a mix of forests, open wetland and forested wetlands.

Parks and Recreation Areas

The river valley within the Highway 19 alternative study area contains portions of the Minnesota Valley National Wildlife Refuge (Refuge). The Refuge, owned and operated by the US Fish & Wildlife Service, was established in 1976 to preserve wildlife habitat for a diversity of waterfowl, migratory birds, fish, and other wildlife. The Refuge also provides wildlife recreational opportunities and environmental education and interpretive programming for visitors. The Refuge is part of a corridor of land and water stretching nearly 70 miles along the Minnesota River, from Bloomington to Henderson. Comprised of more than 14,000 acres, the Refuge has multiple units and ranges from urban to rural landscapes providing a unique opportunity to enjoy wildlife related recreation. Each unit of the refuge offers a variety of attractions and seasonal activities.

Since the preferred concept follows the existing roadway alignment and primarily stays within existing MnDOT right-of-way, minimal impacts to the Refuge and associated resources are anticipated. The concept of a bridge is generally supported by the environmental review and permitting agencies since it would restore wetlands and wildlife movement within the river corridor.

Wetlands

The proposed improvement would be required to comply with federal and state laws regarding wetlands; requiring mitigation if a permit is obtained for wetland fill. Based on conceptual design construction limits, approximately 2 acres of wetland fill would be required for the construction of the proposed Highway 19 Alternative. The excavation of the road embankment that is adjacent to existing wetlands would effectively create new wetland areas.

Wetland impact numbers were estimated based on National Wetland Inventory (NWI) mapping, aerial photography and professional judgment, which provided a general indication of where wetlands may occur. The actual wetland impact amount would be determined by conducting a Routine Level 2 wetland delineation if the proposed improvement moves forward into preliminary/final design.

Roadway Flood Damage Potential

With an increased roadway elevation the frequency and duration of overtopping will be lessened, therefore, the flood damage potential at the proposed crossing should be significantly lower. The most common mode of failure during flooding events is embankment sloughing along the roadway due primarily to scour from overtopping flows. This type of roadway damage will be eliminated in the area of the crossing where existing fill will be removed and replaced with the proposed bridge structure. It is recommended that riprap be placed along the downstream roadway embankments beyond the bridge to help minimize damage from overtopping scour. Reducing the flood damage potential at the crossing will lead to lower time and costs for restoration after flooding events.

Soils

Poor soils are known to exist within the study area. The proposed excavation of the road embankment will require additional subsurface information and geotechnical data. The geotechnical features that will affect the design and construction of the proposed bridge should be investigated and evaluated during future phases of project development.

Environmental Review

It is anticipated that the proposed project would follow a state-funded project development path. State environmental review of the proposed improvement may be required. Further review of environmental rules and regulations would be necessary during the detailed design and environmental review/permitting phase of the project.

Potential Permits

A number of permits will likely be required if the Highway 19 Alternative is planned for construction. The following paragraphs summarize the key permits that will potentially be required for the proposed improvements.

Part 60.3(d)(3) of Chapter 44 of the Code of Federal Regulations "prohibits encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment is not expected to result in any increase in flood levels…during the occurrence of the base flood discharge". The hydraulic model prepared for this analysis shows that the proposed land bridge described herein did not cause an increase in peak water surface elevations during the 100-year flood event. Also, by removing fill at the Highway 19 crossing, the proposed land bridge would return the flow to a more natural state, which should minimize permitting challenges.

Several stormwater management permits will be required for improvements in the project area. The National Pollutant Discharge Elimination System / State Disposal System (NPDES/SDS) General Permit for Construction Activities (NPDES Permit) will be required as the project alternative would disturb greater than one acre of land and would create greater than one acre of new impervious surface. The primary requirements of the permit will be to establish protective measures to reduce the impacts of erosion and sediment control during construction and to install permanent water quality treatment practices for treating a water quality volume based on the extent of new impervious surfaces. The extent of treatment needed will need to be re-evaluated during future phases of the project as the NPDES Permit is due for reissuance in 2018.

The MnDNR Waters Division oversees the administration of the Public Waters Work Permit Program which regulates water development activities below the ordinary high water level (OHWL) in public waters and public waters wetlands. This project will require a MnDNR Work in Public Waters Permit.

The Rivers and Harbors Act (Section 10) program regulates the placement of structures and/or work in, or affecting navigable waters of the Unites States including the Minnesota River. The USACE is the agency responsible for administering this program. Work outside of the main channel, but within wetlands, will require permits from the USACE under Section 404 of the Clean Water Act.

Wetlands that are above the OHWL will be regulated under the Minnesota Wetland Conservation Act (WCA), which will be administered by MnDOT.

The proposed project for Highway 19 requires modifications to the existing levee system at the existing levee/roadway closure structure. Modifications to the existing levee system will likely

require a Section 408 permit. Since the current study is a feasibility level study, a detailed alternatives analysis was not completed at this time. Such an analysis is recommended to select the most cost-effective and minimal impact approach to modifying the existing system. Early coordination with the US Army Corps of Engineers is recommended.

Highway 19 Alternative Pros/Cons Summary

- Serves the highest level of traffic by providing the most direct travel route
- Provides another crossing of the river during flood years
- Restores natural floodplain conditions
- Permitting agency support
- Highest Cost

6.3 Highway 93 Alternative

Existing Conditions

Highway 93 has an approximate flood closure at a river elevation of 733.7'; this roadway typically closes after Highway 19 has already closed. Highway 93 provides a direct connection from the City of Henderson to the south to access US Highway 169; at US Highway 169, Highway 93 is a limited, ¾ access at-grade intersection. Highway 93 traffic destined for northbound US Highway 169 must travel south along US Highway 169 and use the Highway 93/Le Sueur interchange to make a U-turn maneuver to travel northbound.

Proposed Conditions

The proposed alternative is to raise the existing roadway above the flood elevation for approximately 3.25 miles; there is a small bridge structure spanning the Rush River that will also be reconstructed under this alternative. The increased roadway elevation will range approximately between 6' and 8' higher than the existing roadway. An additional 25 acres of right-of-way would need to be acquired to accommodate the proposed improvements. The conceptual layout and proposed typical section for this concept are shown in Appendix F.

Highway 93 Alternative total estimated cost = $14.9 million (2017 dollars)

Cost Effectiveness

A benefit-cost analysis was completed for Highway 93 alternative which resulted in a benefit-cost of 0.45. For additional information regarding the benefit-cost analysis that was performed for this study, please see Section 5 and Appendix D.

Mitigation To Achieve a No-Rise of the Minnesota River

In order to achieve a "no rise" design the required mitigation is to lower approximately 1,500 feet of the Highway 19 roadway to increase the conveyance during flood events. The elevation of Highway 19 would not be lower than it currently exists, but rather the amount or length of roadway at the current lowest elevation would be increased. Therefore, this mitigation option would not change the frequency or duration of flooding along Highway 19.

Sensitive Resources in the Vicinity of Highway 93

Highway 93 typically is located on a shelf along the Minnesota River valley with the bluff along it west side and to the east it drops off into the Minnesota River low-lying bottomlands.

Parks and Recreation Areas

There are no designated parklands within or adjacent to the Highway 93 corridor. However, several areas along the Minnesota River are accessible for shore fishing and other recreational activities.

Wetlands

The proposed improvement would be required to comply with federal and state laws regarding wetlands; requiring mitigation if a permit is obtained for wetland fill. Based on conceptual design construction limits, approximately 5 acres of wetland fill would be required for the construction of the proposed improvements.

Wetland impact numbers were estimated based on National Wetland Inventory (NWI) mapping, aerial photography and professional judgment, which provided a general indication of where wetlands may occur. The actual wetland impact amount would be determined by conducting a Routine Level 2 wetland delineation if the proposed improvement moves forward into preliminary/final design.

Roadway Flood Damage Potential

With an increased roadway elevation the frequency and duration of overtopping will be lessened, therefore, the flood damage potential for Highway 93 should be significantly lower which will lead to lower time and costs for restoration after flooding events.

Soils

Poor soils are known to exist within the study area. The proposed fill associated with raising the road embankment will require additional subsurface information and geotechnical data. The geotechnical features that will affect the design and construction of the proposed bridge should be investigated and evaluated during future phases of the project.

Environmental Review

It is anticipated that the proposed project would follow a state-funded project development path. State environmental review of the proposed improvement may be required. Further review of environmental rules and regulations would be necessary during the detailed design and environmental review/permitting phase of the project.

Potential Permits

A number of permits will likely be required if the Highway 93 Alternative is planned for construction. The following paragraphs summarize the key permits that will potentially be required for the improvement option.

Part 60.3(d)(3) of Chapter 44 of the Code of Federal Regulations “prohibits encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels…during the occurrence of the base flood discharge”. The hydraulic model prepared for this shows that the proposed improvements described herein are not expected to cause an increase in peak water surface elevations during the 100-year flood event.

Several stormwater management permits will be required for improvements in the project area. The NPDES Permit will be required as the project alternative would disturb greater than one acre of land and would create greater than one acre of new impervious surface. The primary requirements of the permit will be to establish protective measures to reduce the impacts of

erosion and sediment control during construction and to install permanent water quality treatment practices for treating a water quality volume based on the extent of new impervious surfaces. The extent of treatment needed will need to be re-evaluated during future phases of the project as the NPDES Permit is due for reissuance in 2018.

The MnDNR Waters Division oversees the administration of the Public Waters Work Permit Program which regulates water development activities below the OHWL in public waters and public waters wetlands. This project will require a MnDNR Work in Public Waters Permit.

The Rivers and Harbors Act (Section 10) program regulates the placement of structures and/or work in, or affecting navigable waters of the Unites States including the Minnesota River. The USACE is the agency responsible for administering this program. Work outside of the main channel, but within wetlands, will require permits from the USACE under Section 404 of the Clean Water Act.

Wetlands that are above the OHWL will be regulated under the Minnesota WAC, which will be administered by MnDOT.

The proposed project for Highway 93 requires modifications to the existing levee system at the existing levee/roadway closure structure. Modifications to the existing levee system will likely require a Section 408 permit. Since the current study is a feasibility level study, a detailed alternatives analysis was not completed at this time. Such an analysis is recommended to select the most cost-effective and minimal impact approach to modifying the existing system. Early coordination with the US Army Corps of Engineers is recommended.

Highway 93 Alternative Pros/Cons Summary

- Serves the second highest level of traffic
- Lowest Cost
- Highest Benefit/Cost Ratio
- Acquires the most property
- Would also have construction impacts on Highway 19

6.4 County Road 6 Alternative

Existing Conditions

County Road 6 has an approximate flood closure at a river elevation of 733.8'; this roadway typically closes after Highway 19 has closed and at generally the same time Highway 93 closes. County Road 6 provides a parallel connection along the Minnesota River from the City of Henderson to the north to access Highway 25 near the City of Belle Plaine. This route provides the biggest benefit for traffic traveling to/from the north; while southerly traffic would not be benefited from this alternative.

Proposed Conditions

The proposed alternative is to raise the existing roadway above the flood elevation for approximately 4.2 miles; there is a small bridge structure spanning High Island Creek that will also be reconstructed. The increased roadway elevation will range approximately between 6' and 8' higher than the existing roadway. An additional 11 acres of right-of-way would need to be acquired in order to construct the proposed improvements. The conceptual layout and proposed typical section for this concept are shown in Appendix F at the end of this report.

County Road 6 total estimated cost = $15.7 million (2017 dollars)

Cost Effectiveness

A benefit-cost analysis was completed for County Road 6 alternative which resulted in a benefit-cost of 0.12. For additional information regarding the benefit-cost analysis that was performed for this study, please see Section 5 and Appendix D.

Mitigation To Achieve a No-Rise of the Minnesota River

In order to achieve a "no rise" design the required mitigation was to excavate an area from within the floodplain and to lower a portion of County Road 5 to offset the fill to raise County Road 6. This is described in more detail in the 2-Dimensional Hydraulic Modeling Memorandum located in Appendix B.

Sensitive Resources in the Vicinity of County Highway 6

The County Road 6 alignment is typically located along the Minnesota River valley with the bluff to the west side and to the east it drops off into the Minnesota River low-lying bottomlands.

Parks and Recreation Areas

The river valley within the County Road 6 alignment area contains portions of the Minnesota Valley National Wildlife Refuge (Refuge). The Refuge, owned and operated by the US Fish & Wildlife Service, was established in 1976 to preserve wildlife habitat for a diversity of waterfowl, migratory birds, fish, and other wildlife. The Refuge also provides wildlife recreational opportunities and environmental education and interpretive programming for visitors. The Refuge is part of a corridor of land and water stretching nearly 70 miles along the Minnesota River, from Bloomington to Henderson. Comprised of more than 14,000 acres, the Refuge has multiple units and ranges from urban to rural landscapes providing a unique opportunity to enjoy wildlife related recreation. Each unit of the refuge offers a variety of attractions and seasonal activities.

Wetlands

The proposed improvement would be required to comply with federal and state laws regarding wetlands; requiring mitigation if a permit is obtained for wetland fill. Based on the conceptual design construction limits, approximately 8 acres of wetland fill would be required for the construction of the proposed improvements.

Wetland impact numbers were estimated based on National Wetland Inventory (NWI) mapping, aerial photography and professional judgment, which provided a general indication of where wetlands may occur. The actual wetland impact amount would be determined by conducting a Routine Level 2 wetland delineation if the proposed improvement moves forward into preliminary/final design.

Roadway Flood Damage Potential

With an increased roadway elevation the frequency and duration of overtopping will be lessened, therefore, the flood damage potential for County Road 6 should be significantly lower which will lead to lower time and costs for restoration after flooding events.

Soils

Poor soils are known to exist within the study area. The proposed fill associated with raising the road embankment will require additional subsurface information and geotechnical data. The geotechnical features that will affect the design and construction of the proposed land bridge should be investigated and evaluated during future phases of the project.

Environmental Review

It is anticipated that the proposed project would follow a state-funded project development path. State environmental review of the proposed improvement may be required. Further review of environmental rules and regulations would be necessary during the detailed design and environmental review/permitting phase of the project.

Potential Permits

A number of permits will likely be required if the County Road 6 Alternative is planned for construction. The following paragraphs summarize the key permits that will potentially be required for the improvement option.

Part 60.3(d)(3) of Chapter 44 of the Code of Federal Regulations "prohibits encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels…during the occurrence of the base flood discharge". The hydraulic model prepared for this shows that the proposed improvements described herein are not expected to cause an increase in peak water surface elevations during the 100-year flood event. This alternative may require a CLOMR prior to the work, and a LOMR after completion of the work.

Several stormwater management permits will be required for improvements in the project area. The NPDES Permit will be required as the project alternative would disturb greater than one acre of land and would create greater than one acre of new impervious surface. The primary requirements of the permit will be to establish protective measures to reduce the impacts of erosion and sediment control during construction and to install permanent water quality treatment practices for treating a water quality volume based on the extent of new impervious surfaces. The extent of treatment needed will need to be re-evaluated during future phases of the project as the NPDES Permit is due for reissuance in 2018.

The MnDNR Waters Division oversees the administration of the Public Waters Work Permit Program which regulates water development activities below the OHWL in public waters and public waters wetlands. This project will require a MnDNR Work in Public Waters Permit.

The Rivers and Harbors Act (Section 10) program regulates the placement of structures and/or work in, or affecting navigable waters of the Unites States including the Minnesota River. The USACE is the agency responsible for administering this program. Work outside of the main channel, but within wetlands, will require permits from the USACE under Section 404 of the Clean Water Act.

Wetlands that are above the OHWL will be regulated under the Minnesota WCA, which will be administered by MnDOT.

The proposed project for County Road 6 requires modifications to the existing levee system. Modifications to the existing levee system will likely require a Section 408 permit. Since the current study is a feasibility level study, a detailed alternatives analysis was not completed at this time. Such an analysis is recommended to select the most cost-effective and minimal impact approach to modifying the existing system. Early coordination with the US Army Corps of Engineers is recommended.

County Road 6 Alternative Pros/Cons Summary

- Serves the fewest vehicles
- Lowest Benefit/Cost
- Project would lower the overtopping elevation of County Road 5
- More challenging to implement given the mitigation requirements involving the floodplain excavation

6.5 Alternative Summary

Alternative	Highway 19 (with Trail)	Highway 93	County Road 6
Cost	$40	$14	$16
Benefit-Cost Ratio	0.19	0.45	0.12
Traffic effectiveness	Serves the most trips	Serves the second most trips	Serves the fewest trips
Feasibility to Implement	Permitting agency support	Lowest cost	Most challenging
Property Acquisition	2 acres	25 acres	11 acres
Wetlands Impacted	2 acres	5 acres	8 acres

7 Better Detour Routes

This section summarizes the process and findings associated with a review of potential improvements needed to existing routes in order to provide a 10-ton network in/out of Henderson when flood events along the Minnesota River close other area roadways (e.g. Highway 19, Highway 93, and Sibley County Road 6) and require detouring traffic in the area.

Both a northern and southern “better detour” route was identified by the Henderson Flood Feasibility Study PMT members. Each route is described below and depicted on the Figure 7:

- Northern Detour Route – beginning at the intersection of Highway 19/Highway 93 in downtown Henderson, this detour route travels west along Highway 19 for approximately 10.1 miles to the intersection of Highway 19 and Sibley County Road 9 (411th Avenue). This route follows County Road 9 north approximately 2.8 miles to Highway 5 near Arlington. Highway 5 is an existing 10-ton roadway providing access to northern destinations (e.g. Highway 25 or US Highway 212). An existing 38’ by 78’ timber slab span bridge is present along County Road 9.
- Southern Detour Route – beginning at the intersection of Highway 19/Highway 93 in downtown Henderson, this detour route travels west along Highway 19 for approximately 8.1 miles to the intersection of Highway 19 and Sibley County Road 17 (391st Avenue). This route follows County Road 17 south approximately 6.3 miles to the intersection of County Road 8 (336th Street). This route then follows County Road 8 approximately 5.9 miles to US Highway 169 near Le Sueur. US Highway 169 is an existing 10-ton roadway providing access to both south and northern destinations.

MnDOT District 7 and Sibley County provided guidance on the reconstruction costs related to upgrading these roadways to a 10-ton structural capacity. These values along with the estimated reconstruction costs of each detour route is presented in Table 7.

Table 7 – Reconstruction of "Better Detour Routes" to 10-ton Structural Capacity

Roadway	Distance (miles)	Reconstruction Cost[a]
North Detour Route		
Hwy 19 Bluff Area (Hwy 93 to top of bluff)	1.0	$4 million
Hwy 19 top of bluff to County Road 9	9.1	$18.2 million
County Road 9 to Hwy 5	2.8	$1.4 million
Replace County Road 9 timber slab span bridge[b]	n/a	$600,000
Total	**12.9 miles**	**$24.2 million**
South Detour Route		
Hwy 19 Bluff Area (Hwy 93 to top of bluff)	1.0	$4 million
Hwy 19 top of bluff to County Road 17	7.1	$14.2 million
County Road 17 to County Road 8[c]	6.3	$3.15 million
Count Road 8 to US Highway169[d]	5.9	$2.95 million
Total	**20.3 miles**	**$24.3 million**

[a] Reconstruction Costs per/mile
- Hwy 19 Bluff Area = $4M/mi.
- Hwy 19 (non-bluff area) = $2M/mi.
- Sibley County roads = $500K/mi.

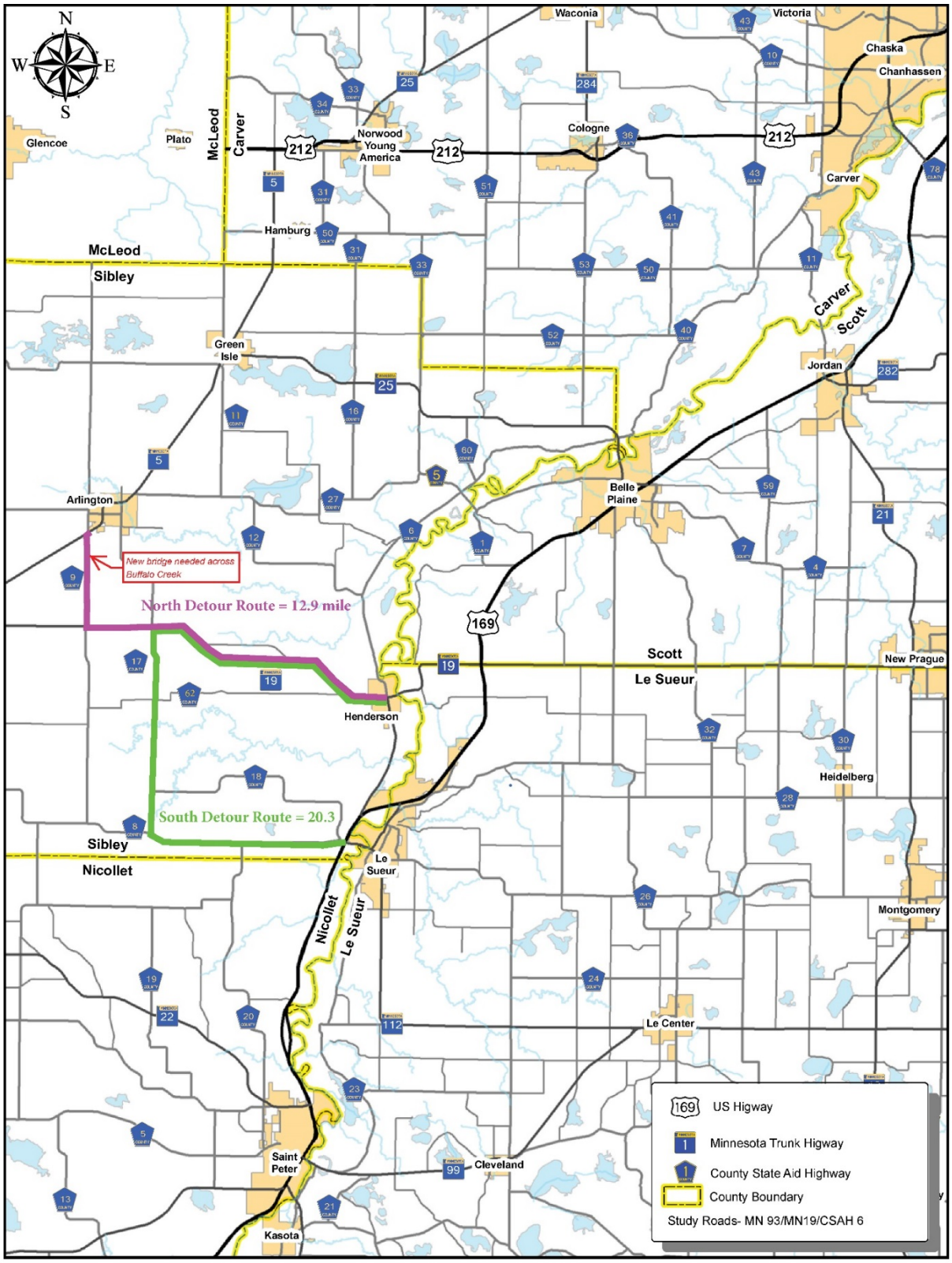
[b] County Road 9 Bridge Reconstruction Cost= 78'x38'x$200=$600k

[c] Assumes County Road 17 bridge over North Branch of Rush River is sufficient

[d] Assumes County Road 8 bridge over South Branch of Rush River is sufficient

A review of the traffic analysis and MnDOT's Collar County Travel Demand Model outputs indicates that the southern detour route (County Road 17 to County Road 8 to US Highway 169) serves substantially higher levels of traffic compared to the north detour route (County Road 9 to Highway 5), when the three flood prone roadways in/out of Henderson (e.g. Highway 19 east, County Road 93, and County Road 6) are closed during flood events.

Figure 7 – Improved Detour Routes



8 Next Steps

Since this was a feasibility level study, further refinement of the concepts and estimated costs to a more developed design level should be undertaken to minimize any potential adverse impacts, while retaining the benefits of reduced frequency and reduced duration of roadway flooding and closure. Findings of this study will be used by MnDOT and the City of Henderson to pursue funding. Once a project is identified and programmed for implementation, the next step in the project development process will be to move an alternative forward into the preliminary design and environmental documentation phase.

Appendix A

Public Involvement Materials

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MINUTES

Henderson Flood Feasibility Study - PMT #1
Monday, December 19, 2016
1:00 p.m.
Henderson City Offices

Meeting Chair: Mark Benson

Minutes by: Bob Rogers

Present: See attached PMT meeting roster

I. Welcome / Introductions

II. Background
- **Matt provided a brief background on why the study is being conducted, which included the previously established "Purpose & Need Statement".**
  - **Purpose:** Provide a safe and accessible, 10-ton route into and out of Henderson to limit the length of detours and impacts to businesses during high water events.
  - **Need:** During 100-year flood events, access to the city of Henderson is severely restricted, necessitating lengthy detours and impacting local businesses and regional traffic.

III. Project Objectives
A. Study alternatives that would raise the three routes that serve Henderson that are susceptible to seasonal flooding of the Minnesota River (TH 19, TH 93, and CR 6).
- **The PMT discussed the three highlighted routes from a map that was distributed at the meeting and the sections of these roadways that fall below the 100-year flood elevation.**
- **The alternatives need to consider both access in/out of the community of Henderson (local perspective) as well as establishing a continuous east-west 10-ton route (regional perspective).**

B. Include an additional alternative that would stabilize the TH 19 roadbed to act as a low-head dam.
- **A separate alternative that will be considered in the study includes stabilization techniques that could be implemented along TH 19 with or without full flood mitigation (raising area roadways).**

C. Study will look at a better detour route as well.
D. Study will look at traffic, environmental impacts, costs, benefit-cost, feasibility, geotechnical and schedule.

IV. Review Project Scope (see attached work plan)
A. Project Timeline – **Currently a 12-month scheduled, which may be accelerated**
B. Project Management – **6 PMT meetings to be held approximately every other month**
C. Purpose and Need – **Previously completed by PMT but may be modified as study progresses**
D. Public Involvement – **Two public open house meetings and four agency coordination meetings planned.**
E. Concept Development – **conceptual design options to be developed and screened. Screening will include construction costs, user costs, environmental effects, etc. The screened alternatives will be included in a flood model to determine potential impacts to the floodplain and river elevations.**

F. Traffic Engineering – **existing traffic volumes will be forecasted to future conditions using the Collar County Traffic Model. The volumes will help calculated user costs and a benefit-cost ratio with and without flood mitigation improvements.**

G. Feasibility Report – **the study findings and recommendations will be presented in a final study report. The findings may include short-term and more long-term improvements.**

H. MnDOT Modeling – **A two-dimensional river modeling effort will be completed by MnDOT with input on the alternatives provided by the study PMT.**

V. Relationship between this study and the Sibley County project at CR 5/CR 6 intersection

- **Tim provided background information on their intersection project that is in the early project development stage with concepts being considered. The County is looking for a solution that addresses the sediment issues with culverts being plugged and the CSAH 6 roadway falling below the 100-year flood elevation.**
- **The grouped discussed several land access and environmental issues associated with improvements in the area.**
- **The Sibley County Road 5/6 options will be included in the river modelling being efforts for the Henderson Flood Feasibility Study.**

VI. Critical Success Factors (brainstorm)

- **Road closures are not just the time when water elevations close the roadways to traffic, but also the repair time needed along the roadway before traffic operations can resume.**
- **Each of the three roads have varying lengths of closure and repair times are highly dependent on the length of closure and severity of the flooding.**
- **The PMT discussed the typical detour routes. TH 19 West is the most likely detour route out of Henderson. Slope failure along TH 19 West has been a recent concern as there have been occasions when saturated soils and failing slopes have resulted in closures of TH 19 West.**

VII. Study Area Issues (brainstorm)

- **Conceptual alternatives will be designed with 1-foot of freeboard above the 100-flood elevation.**
- **Nicki explained the modeling effort and the historic data used in the model and the continuous updates of the model and flow rates that are inputs to the model.**
- **Agricultural field tiling over the past 15 years is not reflected in the model.**
- **The group discussed the different guidelines and criteria for when state highways are closed because MnDOT District 7 typically waits until the water level is nearly overtopping the roadway, while other districts will preemptively close at lower elevations.**
- **Rush River has substantial sedimentation issues.**

VIII. Data Collection

- **MnDOT and the counties (Sibley and Scott) shared road closure information for when closures typically occur under high water conditions. The lengths of closures and repairs are dependent on many factors and can vary considerably from one event to another.**
- **ACTION: Provide any additional historical road closure information/practices to SEH**

IX. Next Steps

- **The first public open house meeting and stakeholder/focus group meetings will be shifted to follow the preliminary development of concepts and analysis.**
- **First electronic newsletter will be prepared in January and shared with all PMT members and the local agencies can distribute it as they deem best.**
- **MnDOT will be setting up a study web site that will include up-to-date project information, maps, meeting announcements, etc.**
- **SEH will conduct traffic forecasting and develop conceptual alternatives for the January PMT. The approach to traffic analysis will also be shared at this meeting.**

X. Next PMT Meeting

A. Monday, January 30th and Monday, February 27th were selected for the next two PMT meetings; 1:00 p.m. at Henderson City Hall

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

If there are errors contained in this document, or if relevant information has been omitted, please contact Mark Benson, SEH Project Manager at 651-490-2194.

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MINUTES

Henderson Flood Feasibility Study - PMT #2
Monday, January 30, 2017
1:00 p.m.
Henderson City Offices

Meeting Chair: Mark Benson

Minutes by: Bob Rogers

Present: See attached PMT meeting roster

Meeting Attendees: See attached meeting roster

I. Welcome / Introductions
- **Matt provided a brief introduction and background for the study. Matt indicated that due to staff changes at MnDOT that he would now be serving as the Project Manager for the study.**

II. Clarification of Study Alternatives
- **The PMT discussed the "10-ton route" alternative in and out of Henderson. It was decided that all improvements associated with the roadways within the study limits would be built to 10 ton structural capacity, but that completing a continuous 10-ton network outside of the study area would not be considered in the analysis. One exception to this was extending the 10-ton route along TH 19 from Henderson up the eastern river bluff to approximately US Highway 169. A second TH 19 alternative will be considered in the assessment that will upgrade the section of TH 19 between US 169 and Henderson to a 10-ton capacity. The cost for this alternative will be based on a previous study completed by MnDOT and SEH will inflate the cost into current dollars for the benefit/cost analysis.**
- **The TH 19 alternative of a low-head dam will be dropped for the analysis since it has been determined that most of the improvements associated with this alternative have already been implemented with past repairs and improvements.**
- **The PMT discussed the "Better Detour" alternative and determined that the study shall consider the cost of improvements along the following routes: TH 19 to Sibley CSAH 9 north to TH 5 (northbound detour route) and TH 19 to Sibley CSAH 9 to Sibley CSAH 8. SEH will calculate a cost for upgrading these routes to 10-ton capacity as well as other potential improvements that would be needed for the roadways to serve as a viable detour route.**

III. Review Study Analysis Assumptions (see attachment)
A. Flooding
- **Rachel presented the historic MN River flood levels through Henderson. This information was generated through the use of gauge data from Jordan, Mankato, and Henderson. The data is being used to define flood frequency and duration of road closures. In addition to the gauge data, roadway elevation data was utilized to estimate the number of historic closures and average number of days the roadways are closed per event. Closure data**

provided by MnDOT was used to further refine the analysis and confirm estimated closure durations.

- **Rachel indicated that the 2010 river crest elevations are being used as the "study design flood" for the base elevations as opposed to the FEMA 100-year flood elevations. This is because the FEMA 100-year flood elevations are based on discharges that have been superseded by DNR and USACE analysis. When the revised discharges are used, the 100-year flood elevations are lower than the 2010 event.**
- **The PMT clarified that the closure events and duration only represent closures directly associated with water elevations of the MN River and are not tied to other activities that could cause closures (e.g. Rush River flooding along TH 93, slope failures, etc.).**
- **In determining future flood events and roadway closures, only the past 25-year flood history is being used in the study analysis because the more recent data indicates flood events are occurring on a more frequent basis. Based on the past 25 years of data, the frequency for flooding and the resultant closure of TH 93 and Sibley CSAH 6 was determined to be once every 3.57 years, while TH 19 was once every 2.78 years. The average number of days the roadways are closed under a major flood event was approximately 20 days for TH 93 and Sibley CSAH 6 and approximately 25 days for TH 19.**

B. Traffic

- **Graham presented traffic analysis information associated with the travel demand model and forecasting activities that have been conducted for the study area and surrounding traffic analysis zones (TAZs). The MnDOT Collar County regional traffic model (which includes twelve counties surrounding the metropolitan area) was used to assess regional traffic impacts associated with roadway closures. Le Sueur, Sibley, and Scott counties are included in the regional model while Nicollet County is outside the limits of the model.**
- **A year 2040 traffic forecast was generated based on historic average daily traffic volumes that were projected out to the year 2040 under a linear growth rate of approximately 1 percent annual growth.**
- **Graham indicated that six scenarios were evaluated as part of the traffic analysis. These traffic scenarios included: Scenario #1: 2040 No-Build where no roadway improvements are made to the study roadways; Scenario #2: Closure of TH 19, TH 93, and CSAH 6; Scenario #3: TH 19 closed, but TH 93 and CSAH 6 remain open; Scenario #4: CSAH 6 improved and remains open while TH 19 and TH 93 are closed; Scenario #5: TH 19 improved and remains open wile TH 93 and CSAH 6 are closed; Scenario #6: TH 93 improved and remains open while TH 19 and CSAH 6 are closed. The regional travel demand model outputs will indicate where trips are routed under each scenario and the model outputs the changes in daily vehicle miles traveled on the system and the vehicle hours traveled by drivers. This data will be utilized in the benefit-cost analysis.**

C. Benefit-Cost

- **Graham explained the process used for assessing the benefits and costs of each scenario/alternative.**
- **The daily cost of full closure was calculated to be approximately $68,000/day when all three routes (TH 19, TH 93, and CSAH 6) are closed due to a flood event.**
- **Graham indicated that each build scenario/alternative will have different benefits and user costs based on the rerouting of trips and the miles traveled and time traveled.**
- **The PMT discussed the extent of the traffic model and determined that a modification to the TH 93 connection into Le Sueur needs to be modified as this roadway closes at generally the same elevation as TH 93 north of US Hwy 169. Graham indicated that this change will have some effect on the redistribution of trips across the regional network.**
- **The PMT also suggested that the report will need to clarify the limits of the model and that it does not include river crossing closures south of the study area (e.g. TH 99 in St. Peter).**
- **Graham summarized the benefit/cost assumptions and input values that will be used in conjunction with the build conditions for the design concepts being developed.**
- **Tim will provide an average cost for CSAH 6 when the roadway is closed due to flooding. The costs will include set-up and takedown for detour routes, removal of silt from the roadway and other standard maintenance costs associated with MN River flood events.**

D. Design
- **Mark present the roadway design assumptions that will be used in developing the conceptual design of each of the build alternative. He indicated that the conceptual designs will have the shoulder PI a minimum of 1' above the 2010 peak water levels. The PMT noted that the TH19 bridge low member will be a minimum of 1' above the 2010 peak water levels.**
- **Tim indicated that the Sibley CSAH 6 right of way is generally a 100' wide corridor.**
- **Outside of the Henderson city limits, the Sibley County land value will for potential right of way costs will be assumed at a consistent $9,000/acres for residential and agricultural lands.**

IV. Update on the Sibley County project at CR 5/CR 6 intersection
- **Early coordination with the MNDNR has occurred and further review of the flood data is underway.**

V. Public Involvement
- **The group discussed the public involvement efforts including the distribution of an electronic newsletter. The first public open house meeting and the agency stakeholder meeting will be held following the development of the preliminary roadway concepts.**

VI. Next Steps
- **At the next meeting in February, SEH will present preliminary design concepts, preliminary costs, and benefit/costs scenarios.**

VII. Next PMT Meeting
A. Monday, February 27th; 1:00 p.m. at Henderson City Hall

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

If there are errors contained in this document, or if relevant information has been omitted, please contact Mark Benson, SEH Project Manager at 651-490-2194.

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ATTENDANCE ROSTER – PROJECT MANAGEMENT TEAM

Re: Henderson
Flood Mitigation Study

Project Manager: Mark Benson

Date of Meeting: January 30, 2017
Time of Meeting: 1:00 p.m.

Location: Henderson City Hall
SEH No.: MNT07 135877

Present	Name	Representing	E-mail	Phone
X	Matthew Young	MnDOT	matthew.young@state.mn.us	507-317-7855
X	Nicole Bartelt	MnDOT	nicole.bartelt@state.mn.us	651-366-4474
X	Fran Bigaoutette	MnDOT	fran.bigaouette@state.mn.us	507-380-9215
X	Charles Kremer	MnDOT	charles.kremer@state.mn.us	507-304-6185
	Rich Lamb	MnDOT	rich.lamb@state.mn.us	
	Gordan Regenscheid	MnDOT		
X	Lon Berberich	City of Henderson	lonber3@mchsi.com	507-327-0646
X	Mathew Thibert	ISG	Mathew.thibert@is-grp.com	507-995-2588
X	Tom Phillips	City of Henderson		952-290-0359
X	Jeff Steinborn	City of Henderson	jsteinborn@mac.com	
X	Robyn Geldner	City of Henderson		
X	Bobbie Harder	Sibley County	BobbieH@co.sibley.mn.us	507-665-3642
X	Tim Becker	Sibley County	TimB@co.sibley.mn.us	507-237-4092
	Lisa Freese	Scott County	lfreese@co.scott.mn.us	
	Lisa Schickedanz	Scott County	lschickedanz@co.scott.mn.us	952-496-8892
X	Jason Swenson	Scott County	jswenson@co.scott.mn.us	952-496-8881
X	Jarrett Hubbard	Scott County	Jhubbard@co.scott.mn.us	
X	Darrell Pettis	Le Sueur County	dpettis@co.le-sueur.mn.us	
X	Mark Benson	SEH PM	mbenson@sehinc.com	651-490-2194
X	Bob Rogers	SEH Planner	brogers@sehinc.com	
X	Rachel Pichelmann	SEH Water R.	rpichelmann@sehinc.com	
	Brad Woznak	SEH Water R.	bwoznak@sehinc.com	
	Nathan Blanchard	SEH Design	nblanchard@sehinc.com	
X	Graham Johnson	SEH Traffic	gjohnson@sehinc.com	
	Ron Farmer	SEH Geotech	rfarmer@sehinc.com	

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MINUTES

Henderson Flood Feasibility Study - PMT #3
Wednesday, February 30, 2017
1:00 p.m.
Henderson City Offices

Meeting Chair: Mark Benson

Minutes by: Bob Rogers

Present: See attached PMT meeting roster

Meeting Attendees: See attached meeting roster

I. Welcome / Introductions

II. Follow up from PMT Meeting #2
   A. New proposed 10-ton "Better Detour Routes"
      - **Bob presented a revised figure depicting the "Improved Detour Routes". Sibley County provided costs of approximately $450K/mi. At the meeting MnDOT indicated that TH 19 could be approximately $4.5M/mi for a full reconstruction in some areas. SEH to review information provided by MnDOT and determine average cost per mile for 10 ton upgrade.**
   B. Roadway shutdown/clean-up costs
      - **Updated closure costs were received from MnDOT.**
   C. Traffic projections update
      - **Based on feedback from the previous PMT meeting, traffic projections were adjusted to account for closures of TH 93 in Le Sueur.**
   D. Flood closures/modelling update
      - **Graham provided an update of the cost of closure calculations when taking into consideration of vehicle miles traveled and vehicle hours traveled for the study area under the various closure scenarios. The PMT discussed how the user costs are calculated on a per/day of closure. The final daily cost of closures when all three routes are closed is $87,000.**

III. Technical Analysis Update
   A. Flood Elevations Map
      - **Rachel discussed how the flood elevations have been updated based on additional data and a refined methodology that follows the 2010 river crest elevations and SRH-2D modeling. The future build condition has been set with the roadway shoulder construction being 1-foot above the 2010 flood elevations.**
   B. Roadway Design Alternatives
      - **A set of roadway typical sections was presented for each of the three roadway build alternatives (e.g. TH 19, TH 93, and CSAH 6).**
      - **The potential impacts associated with raising the Highway 93 roadway were presented along with a preliminary cost estimate, which is subject to change with additional design refinements that are expected in the coming weeks.**
      - **Rachel explained that the TH 93 option did show a potential stage increase in the base flood elevations based on the HECRAS 1-D model, which focuses more on river**

conveyance. Nikki indicated that the 2-D model (looking at conveyance and storage) is currently being run for TH 93. The TH 19 & CSAH 6 options will also be modeled.

- **Additional coordination with resource agencies will occur to discuss potential mitigation techniques if a rise is identified.**
- **Nikki indicated that the 2D river model has been updated in terms of existing conditions (e.g. areas previously farmed, which are now forested). The model was calibrated to match the 2010 flood event.**
- **A regulatory review and cost estimate for potential mitigations of each of the build alternatives will be discussed with the MNDNR (and other resources agencies) and the estimated costs will be included in the benefit/cost analysis.**
- **The PMT discussed how the stop-wall closures could be eliminated under each of the build alternatives and the potential impacts to surrounding residential properties. Rachel indicated that modification to the USACE levy system may require extensive analysis to show that the proposed roadway improvements would not adversely any portion of the levy system.**
- **Potential improvements to either TH 19 or TH 93 would be led by MnDOT, whereas Sibley County would likely lead any improvements along CSAH 6.**
- **Nikki indicated that replace bridges (e.g. Rush River bridge on TH 93 and High Island Creek bridge on CSAH 6) should be modified to assume a 2:1 slope from the ground/river bottom elevation with 2' vertical abutments, which would lengthen the existing bridge open whereby providing a widened waterway opening.**
- **The PMT discussed the TH 19 bridge option that included an approximately 2,500' bridge length with 100' pier spacing. Across the main river channel, the bottom of the bridge beam set 1' above the 2010 river crest elevation. Further review of the east tie-in location will be reviewed to assess potential impacts on the RSS slope from the recent railroad bridge replacement project.**

C. Benefit-Cost (B/C) Analysis

- **Graham provided a summary of the benefit-cost methodology used in the analysis. The CSAH 6 option has the lowest costs, but also the lowest benefits to system users. The TH 19 option has the highest costs and highest benefits. TH 93 has a cost similar to CSAH 6, but much higher benefits for users. Therefore, the preliminary B/C ratios indicate that TH 93 has the most favorable B/C followed by TH 19 with CSAH 6 having the lowest B/C ratio.**

IV. Next Steps

- **Agency coordination with MNDNR, USFWS, USACE, High Island Watershed Management Organization.**
- **Additional agency coordination will be occurring on potential impacts**
- **SEH will update all materials, including the modeling results, and send out a .pdf packet to PMT members to review**
- **Next PMT Meeting is proposed to be Tuesday, April 11th at 2:00 p.m.**
- **An open house meeting is being targeted for Wednesday, May 17th. The details of the meeting time/location will be defined in the coming weeks with input from Henderson staff.**
- **Rachel provided an update on the Sibley County CR 5/CR6 intersection project including ongoing agency coordination and design options.**

V. Next PMT Meeting

- **Tuesday, April 11th at 2:00 in Henderson**

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

If there are errors contained in this document, or if relevant information has been omitted, please contact Mark Benson, SEH Project Manager at 651-490-2194.

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MINUTES

Henderson Flood Feasibility Study - PMT #4
Tuesday, April 11, 2017
2:00 p.m.
Henderson City Offices

Meeting Chair: Mark Benson

Minutes by: Bob Rogers

Present: See attached PMT meeting roster

Meeting Attendees: See attached meeting roster

I. Welcome / Introductions

II. Agency Coordination
   A. Meeting with Minnesota Department of Natural Resources (MNDNR)
      - **Rachel provided an overview of the meeting that was held with the MNDNR. She indicated that the MNDNR confirmed that any alternative that is unable to obtain a "zero rise" in the base flood elevation would require a floodplain map amendment.**
      - **Rachel explained that the more complex map amendment process can be costly, time consuming, and has no guarantee that it would be allowed by the permitting agencies. Therefore, the study will only consider options (including mitigation strategies) that show a "no rise" condition under preliminary hydraulic modelling.**

III. Review Status of Technical Analysis
   A. Better Detour Memo
      - **Bob presented the findings of the technical memo that included cost estimates for improving a northern detour route and a southern detour route.**
      - **The PMT discussed how the southern route may be more beneficial to users because according to traffic data there are more trip that are destined/originate from places to the south (Le Sueur, St. Peter, Mankato) as opposed to trips traveling to the north.**
   B. Roadway Design Alternatives (CR 6, TH 93, and TH 19)
      - **Mark used the draft public open house presentation to recap the study purpose, background, assumptions, and analysis methodologies.**
      - **Mark presented the conceptual design details for each of the roadway alternative (Highway 19, Highway 93, and County Road 6). Other information presented included flood modeling results, preliminary cost estimates, mitigation options, and benefit/cost ratios for each alternative.**
      - **The PMT made several suggestions for revising the presentation slides to include more/less detail for discussions at the open house meeting.**

Action Item: SEH will revise the open house presentation with many of the suggestions received at the PMT meeting.

IV. Public Involvement

A. Open House Meeting – Wednesday, May 17th, 5:00-7:00 p.m. (5:30 presentation) at the Roadhouse Event Center.

- **The PMT discussed the meeting format, presentation content, meeting announcement/newsletter, etc. Mayor Paul Menne will begin the presentation by welcoming attendees and saying a few words about the importance of the study for the city to continue to seek a long term solution for the transportation network in/out of the community during flood events. Matt Young will then provide an overview of the study purpose and Mark Benson will present the technical details of the study scope and findings. The presentation will end by encouraging attendees to proceed back to the "open house" portion of the meeting to view study materials and ask questions.**
- **SEH will ensure all meeting materials are set-up by 4:00 p.m., so that early arrivals can review the materials and ask questions.**
- **Copies of all open house meeting materials will be posted on the project web site in advance of the open house meeting. http://www.mndot.gov/d7/projects/hwy19study**

Action Item: SEH will revise the study newsletter/open house announcement and distribute an electronic copy to the PMT for final review/comment.

Action Item: The PMT members will distribute the meeting announcement to their respective stakeholders.

V. Next PMT Meeting

- **Tuesday, June 13th 1:00 – 3:00 p.m.**

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

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ATTENDANCE ROSTER – PROJECT MANAGEMENT TEAM

Re: Henderson Flood Mitigation Study
PMT Meeting #4

Project Manager: Mark Benson

Date of Meeting: April 11, 2017
Time of Meeting: 2:00 p.m.

Location: Henderson City Hall
SEH No.: MNT07 135877

Present	Name	Representing	E-mail	Phone
X	Matthew Young	MnDOT	matthew.young@state.mn.us	507-317-7855
X	Nicole Bartelt	MnDOT	nicole.bartelt@state.mn.us	651-366-4474
X	Fran Bigaoutette	MnDOT	fran.bigaouette@state.mn.us	507-380-9215
	Charles Kremer	MnDOT	charles.kremer@state.mn.us	507-304-6185
	Rich Lamb	MnDOT	rich.lamb@state.mn.us	
	Gordon Regenscheid	MnDOT	gordon.regenscheid@state.mn.us	507-304-6105
	Cody Thompson	MnDOT	cody.thompson@state.mn.us	507-665-3782
	David Albrecht	MnDOT	David.albrecht@state.mn.us	507-665-3782
X	Lon Berberich	City of Henderson	lonber3@mchsi.com	507-327-0646
	Mathew Thibert	ISG	Mathew.thibert@is-grp.com	507-995-2588
X	Cory James	ISG		
X	Tom Phillips	City of Henderson		952-290-0359
X	Jeff Steinborn	City of Henderson	jsteinborn@mac.com	
X	Paul Menne	City of Henderson		
X	Bobbie Harder	Sibley County	BobbieH@co.sibley.mn.us	507-665-3642
X	Tim Becker	Sibley County	TimB@co.sibley.mn.us	507-237-4092
	Kim Flanaghan	Sibley County	kimf@co.sibley.mn.us	507-237-4109
	Lisa Freese	Scott County	lfreese@co.scott.mn.us	952-496-8363
X	Lisa Schickedanz	Scott County	lschickedanz@co.scott.mn.us	952-496-8892
	Jason Swenson	Scott County	jswenson@co.scott.mn.us	952-496-8881
	Jarrett Hubbard	Scott County	Jhubbard@co.scott.mn.us	952-496-8012
	Darrell Pettis	Le Sueur County	dpettis@co.le-sueur.mn.us	507-357-2251
X	Dave Tiegs	Le Sueur County	dtiegs@co.le-sueur.mn.us	507-357-8536
X	Mark Benson	SEH PM	mbenson@sehinc.com	651-490-2194
X	Bob Rogers	SEH Planner	brogers@sehinc.com	
X	Rachel Pichelmann	SEH Water R.	rpichelmann@sehinc.com	
	Graham Johnson	SEH Traffic	gjohnson@sehinc.com	

Short Elliott Hendrickson Inc., 3535 Vadnais Center Drive, St. Paul, MN 55110-5196
SEH is an equal opportunity employer | **www.sehinc.com** | 651.490.2000 | 800.325.2055 | 651.490.2150 fax

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MINUTES

Henderson Flood Feasibility Study - PMT #5
Tuesday, June 13, 2017
1:00 p.m.
Henderson City Offices

Meeting Chair: Mark Benson

Minutes by: Bob Rogers

Present: See attached PMT meeting roster

Meeting Attendees: See attached meeting roster

I. Open House Summary – May 17, 2017
   A. The PMT discussed the details and success of the open house. Many comments and questions were received during the Q&A portion of the meeting. A list of the questions/topics raised are included in the open house summary packet that was distributed to all PMT members.
   B. The comment period is scheduled to expire on Friday, June 16th. A final summary of the open house, including all written comments received, will be provided on the project web site.
   C. The final Study Report will include the open house summary packet.
   D. The PMT discussed that the study conclusions will not identify a particular "preferred" option, but rather highlight the process followed, methodology used, and findings of the various technical assessments.

II. Agency Meeting Summary – May 23, 2017
   A. The purpose of the agency meeting was to update the various resource agencies on the purpose of the flood mitigation study as well as share the preliminary findings. The resource agency staff identified several areas where additional information may be required if and when any particular alternative moves forward in the more detailed project development process.
   B. The PMT discuss the input received from the agencies including the need to use the "new" (not yet released) US Army Corps of Engineers model of the Minnesota River.
   C. The staff from the various resource agencies did not have a preferred option from a hydraulic standpoint, but did discuss some of the environmental benefits of the Highway 19 alternative (fewer wetland impacts and restored floodplain habitat) when being compared to the Sibley County Road 6 and Highway 93 alternatives.

III. Proposed Final Report Outline
   A. A report outline was distributed that depicted the various subject areas that will be documented in the final study report.
   B. The PMT emphasized how the alternatives section need to clearly document the design assumptions used for the comparative analysis in the feasibility study and that the level of design was at a higher level for the development of conceptual alternatives and that more detailed information would need to be gathered to better scope the project improvements and associated costs of any particular alternative.

IV. Next Steps

The report will be drafted by July 15th. The PMT will have 30 days (by approximately August 15th) to provide comments on the draft report. The final report will be disseminated by early September 2017.

V. Update on the Sibley County project at CR 5/CR 6 intersection

A. A draft report for the intersection project is being reviewed by the County. The report includes three options for improvements and outlines pro/cons of each option. The intersection improvements are independent from the flood mitigation options (TH 19, TH 93, and CSAH 6) studied in the Henderson Flood Mitigation Study.

VI. Next PMT Meeting

A. The group decided that once the draft report is distributed for review that a possible future meeting may be called but no future meeting date(s) have been set.

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

If there are errors contained in this document, or if relevant information has been omitted, please contact Mark Benson, SEH Project Manager at 651-490-2194.

c:\users\brogers\desktop\pmt#5\pmt #5 minutes 061317 .docx

Henderson Flood Mitigation Study

DEPARTMENT OF TRANSPORTATION

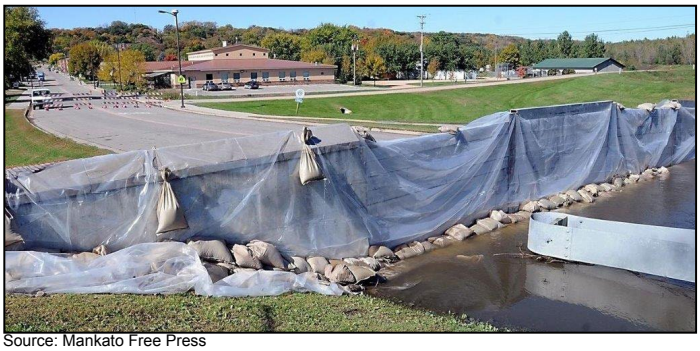
Study Initiation

The Minnesota Department of Transportation (MnDOT), in cooperation with the City of Henderson, Sibley County, Scott County, and LeSueur County, has initiated a feasibility study to investigate transportation improvements in the Minnesota River Valley to determine possible improvements that would minimize roadway closures due to flood events. The study will focus on the bridges and approach roadways for state Highway 19, Highway 93, and Sibley County Road 6. The Highway 93 and County Road 6 alternatives will primarily be related to elevating the roadway profiles above the 100-year flood elevation and the Highway 19 alternatives will study raising the bridge and roadway approaches above the flood elevation and an option aimed at improving the roadway stability and strategies to mitigate slope failures.

The goal of the study is to identify a safe and accessible, 10-ton route into and out of Henderson to limit the length of detours and impacts to businesses and regional traffic during high water events.

The feasibility study will take place through 2017 and will include the following key elements:

- Public and agency involvement
- Hydraulic model development and analysis (including bridge analysis)
- Traffic modeling and analysis
- Development and screening of conceptual design alternatives
- Feasibility report with findings and recommendations



Source: Mankato Free Press

Background

Flooding in the Minnesota River Valley has created traffic and mobility challenges for MnDOT and local communities for decades. The roadways leading into and out of the City of Henderson (Highways 19 and 93 and County Road 6) have been hit especially hard in recent years, with closures due to flooding reaching an all-time high. During seasonal flooding events, residents and commuters traveling through the area have to resort to detours that take them miles out of their way, costing both time and money. The lengthy detours and restricted access to the Henderson Area can substantially impact local businesses and regional traffic.

As noted in the 2016 Henderson Comprehensive Plan, “every spring when the annual flooding of the Minnesota River begins, and every time a large rain storm is predicted in the summer, the level of concern rises with the water levels as townspeople ask themselves if this will be the next time that the roads into town are flooded or washed-out again and the community becomes stranded with only one way out.”

Public Involvement

We encourage your participation and questions throughout the study process. MnDOT and the City of Henderson will be hosting two public open house meetings as part of the study process. The first public open house meeting will be held in Spring 2017. Detailed exhibits will be available for review, and staff will be present to answer questions and hear your comments. Each open house will be preceded by a newsletter. A final newsletter will be distributed at the completion of the study.

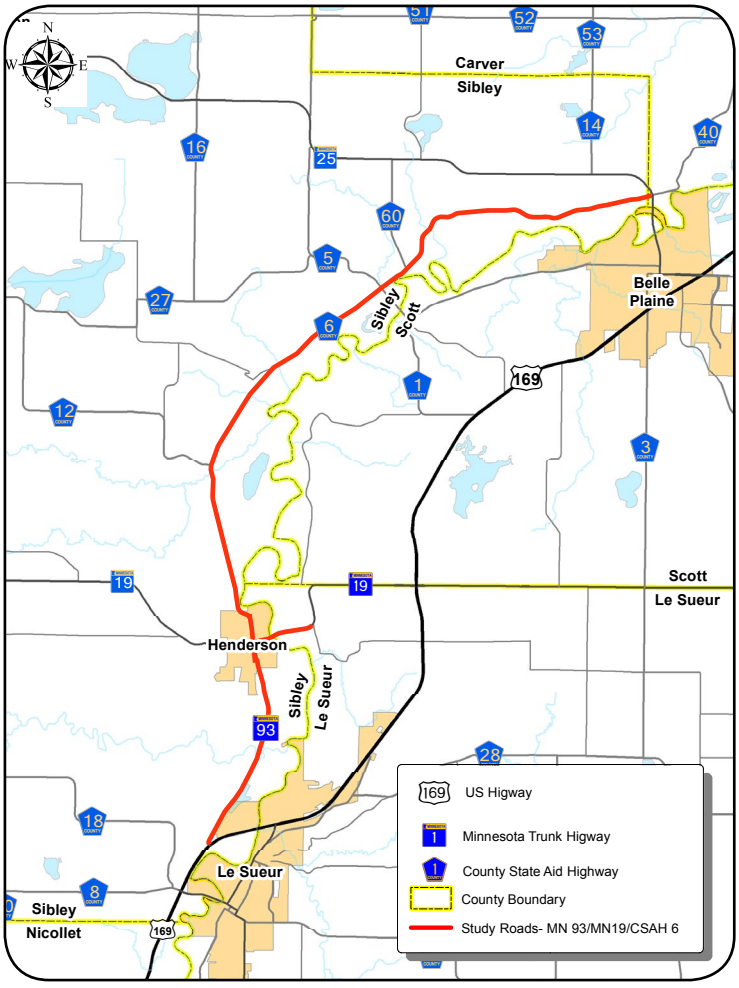
Project Management Team

The Project Management Team (PMT), comprised of staff from MnDOT, local governmental units (city of Henderson and the counties of Sibley, Scott, and LeSueur) will meet regularly throughout the study process and serve as a communication link to constituents and elected officials. Meetings may also be held with environmental review and permitting agencies during the study period.

Where can I get more information?

For the most up-to-date project information, visit:

http://www.dot.state.mn.us/d7/projects/hwy19study/index.html



Contact Us

Matt Young
MnDOT Project Manager
MnDOT District 7
2151 Bassett Drive
Mankato, MN 56001-6888
Phone: 507.317.7855

Email: matthew.young@state.mn.us

Henderson Flood Mitigation Study

Background

Flooding in the Minnesota River Valley has created traffic and mobility challenges for MnDOT and local communities for decades. The roadways leading into and out of the City of Henderson (Highways 19 and 93 and County Road 6) have been hit especially hard in recent years, with closures due to flooding occurring more often. During seasonal flooding events, residents and commuters traveling through the area have been forced to use detours that take them miles out of their way, costing them both time and money. The lengthy detours and restricted access to the Henderson Area can substantially impact local businesses and regional traffic.

Study Overview

The Minnesota Department of Transportation (MnDOT), in partnership with the City of Henderson, Sibley County, Scott County, and Le Sueur County, has been working on a feasibility study to investigate transportation improvements in the Minnesota River Valley to determine possible improvements that would minimize roadway closures due to flood events. The study is focusing on the bridges and approach roadways for state Highway 19, Highway 93, and Sibley County Road 6.

Public Open House
May 17, 2017

Roadhouse Event Center
510 Main Street
Henderson, MN 56044

5:00-5:30 Welcome & View Study Materials
5:30-6:00 Presentation
6:00-7:00 View Study Materials, Question & Answer

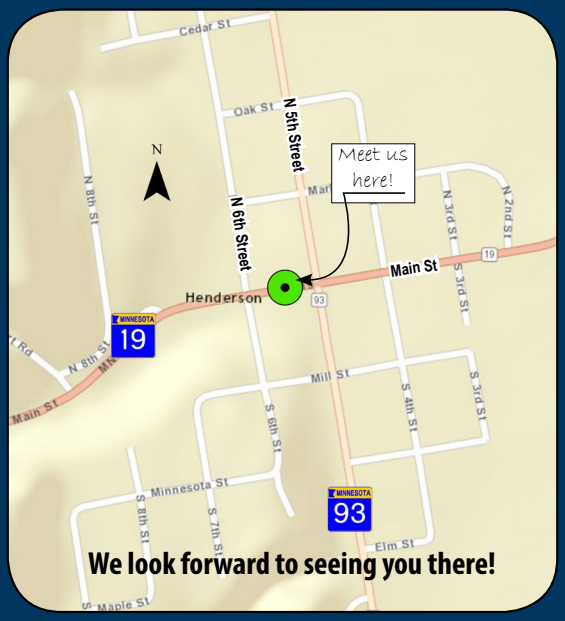
You are invited to an open house to:

- View draft flood mitigation materials including:
  - Minnesota River hydraulic modeling
  - Roadway conceptual layouts
- Cost estimates
- Ask questions
- Give feedback

The project information to be presented at the Public Open House is also available for review at:

www.mndot.gov/d7/projects/hwy19study

"The outcome of this study will impact Henderson for generations. Please consider coming to any portion of this event, you and your involvement is what makes Henderson GREAT!"
-- Mayor Paul Menne



The goal of the study is to identify a feasible, safe and accessible, 10-ton route into and out of Henderson, which would limit the length of detours and impacts to businesses during high water events. Currently, there is no funding programmed for implementing flood mitigation improvements. The results of this study will compare the alternatives considered and evaluate their relative benefits, costs, and impacts. This information can then be used by the project partners to seek funding for further design and construction.

To date, conceptual roadway improvements for the three routes that serve Henderson (Hwy 19, Hwy 93, and County Road 6) have been developed. Each alternative is independent of the others and would allow the roadway to remain open to traffic under a flood level equal to the Minnesota River crest during the 2010 flood event. The Highway 93 and County Road 6 alternatives involve raising the roadway profiles to an elevation above the 2010 flood elevation and the Highway 19 alternative would raise and substantially lengthen the bridge across the Minnesota River floodplain.

As part of the study, each alternative has been preliminarily reviewed for benefits to users/motorists, environmental concerns (wetland, floodplain and floodway impacts), right of way and access impacts, and construction costs. A benefit/cost analysis for each alternative has been developed. A final study report is expected to be complete in fall 2017.

Project Management Team

A Project Management Team (PMT), comprised of staff from MnDOT, local governmental units (city of Henderson and the counties of Sibley, Scott, and Le Sueur) has been meeting regularly throughout the study process. The members of the PMT serve as a communication link to constituents and elected officials. Meetings have also been held with environmental review and permitting agencies.

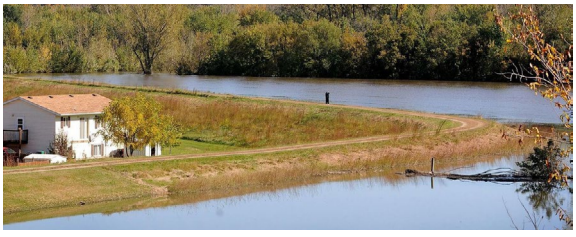
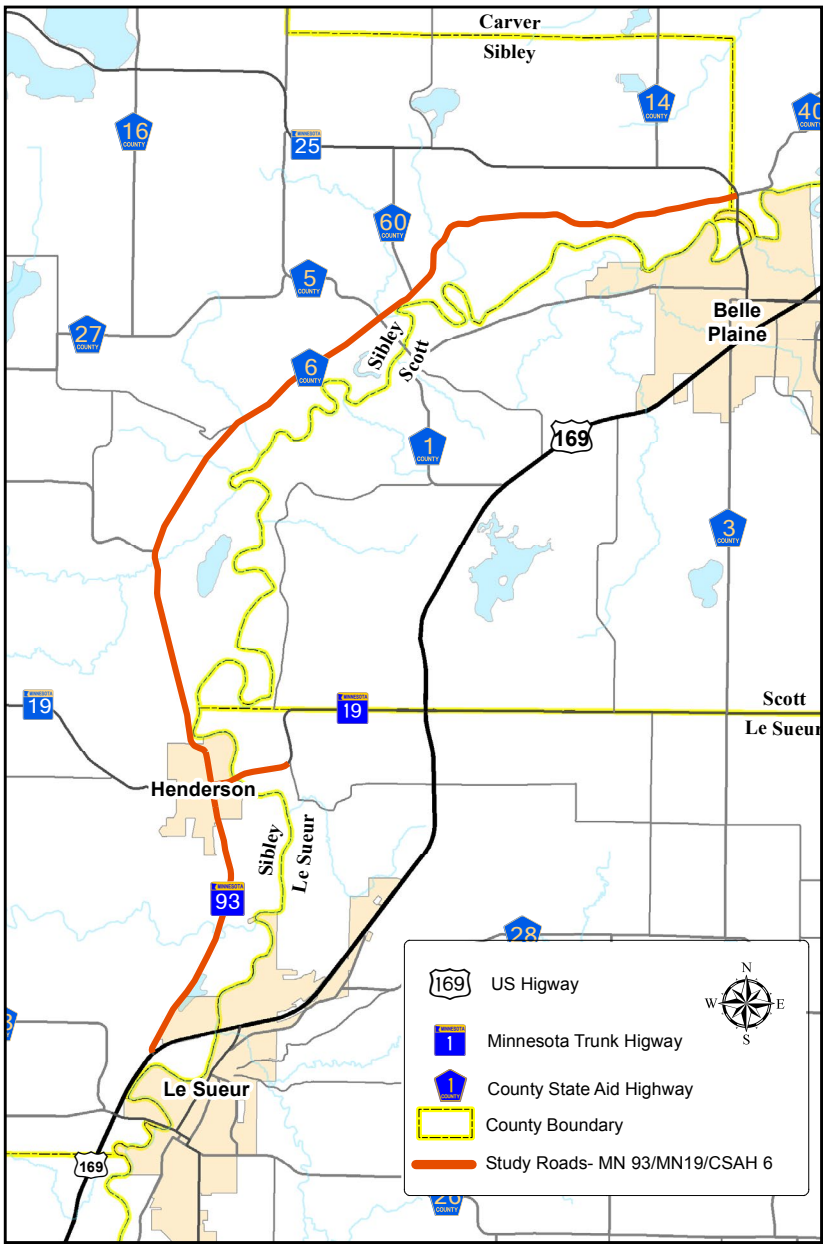


Photo Source: Mankato Free Press

Study Area- Hwy 93/ Hwy 19/Hwy 6



Contact

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2151 Bassett Drive
Mankato, MN 56001-6888

www.mndot.gov/d7/projects/hwy19study

DEPARTMENT OF TRANSPORTATION

Building a Better World for All of Us®

MEMORANDUM

TO: Matthew Young
Project Manager

FROM: Mark Benson
Sarah Shock

DATE: May 24, 2017

RE: Summary of Open House for the Henderson Flood Mitigation Study

This memo documents summary information regarding the Open House event held in Henderson, MN on May 17, 2017.

Basic Meeting Information

- When: May 17, 2017 from 5-7pm
- Where: Henderson Roadhaus Event Center 514 Main St, Henderson, MN 56044

Meeting Notifications

- MnDOT news release distributed to local media outlets
- Electronic meeting newsletter was distributed to all members of the PMT for dissemination to their respective stakeholders
- Meeting information was posted to the project website
- Facebook blast that included information from the newsletter and link to the website

Attendance

- Attendance: Approximately **52** individuals signed in
    - See Attachments for digital scans of the sign-in sheets
- **12** staff present
    - City of Henderson: **2**; MnDOT: **4**; Sibley County: **1**; SEH: **5**

Meeting Description

The public meeting was held in an open house style. There was a 30 minute presentation followed by approximately 40 minutes of question & answer interaction. Project layouts were available at tables for review and a flood modeling video was also on display for viewing, with staff members present at each station to answer questions and help describe the project. A comment table was available for attendees to write and submit comments, and comment cards were distributed during meeting closure.

Project boards were also available depicting summary project information, flood frequency, flood modelling, traffic forecasting, benefit-cost analysis, detour routes, alternative design standards and pros/cons assessment. Staff members were available next to the displays to answer questions.

Comments:
Formal comments written on comment cards by attendees and mailed or emailed to MnDOT District 7 Project Manager Matthew Young are included in the attachments. Verbal comments captured by staff during Q & A session following the presentation included, but is not limited to, the following:

- What will happened to the levy gate(s) under the various options?
- Under the Hwy 19 option would the road be designed to a 10-ton capacity to US Hwy 169?
- How could the completion of an environmental review/assessment affect the cost-benefit data?
- Are any of the options detrimental to the current levy system (gates and/or embankment)?
- Did the cost-benefit data look at future impacts to Hwy 19 if the Hwy 93 option is chosen?
- Was there any consideration for new innovative options, like land bridges that allow water to pass through and under the roadbed?
- Concern was expressed over the method by which the slopes and tie-in locations were derived. Individuals concerned about impacts to private property.
- Are the roadway flood feasibility improvements and the City levy update tied and/or connected?
- Why was the 2010 flood data used as a design year flood event as opposed to a 100 year event?
- Will the City of Henderson and the residents be responsible for paying for the project if State and/or federal funds are not provided?
- How accurate is the cost-benefit price per acre for land acquisition?
- Comment made about the flooding impacts near the Rush River Bridge and what the TH 93 option mean for that location.
- Asked why MnDOT would consider the Hwy 93 option when Hwy 19 is the regional truck route, and the main transportation corridor for the community.
- Is there an estimated date for when the USACE and USGS flood model/projections/report will be completed?
- Who has the final say on which route/option is chosen?
- An individual expressed concern that not enough public involvement had occurred to date and that a referendum might be in order to see if the City wants to continue to pursue options.
- Multiple questions were asked about the status of funding and the cost to the City thus far.

Attachments:
Newsletter #2 - Electronic Meeting Announcement
MnDOT News Release
Public Comments
Sign in Sheets
Project Presentation Slides
Project Boards

Newsletter #2 - Open House Meeting Announcement

Henderson Flood Mitigation Study

Background

Flooding in the Minnesota River Valley has created traffic and mobility challenges for MnDOT and local communities for decades. The roadways leading into and out of the City of Henderson (Highways 19 and 93 and County Road 6) have been hit especially hard in recent years, with closures due to flooding occurring more often. During seasonal flooding events, residents and commuters traveling through the area have been forced to use detours that take them miles out of their way, costing them both time and money. The lengthy detours and restricted access to the Henderson Area can substantially impact local businesses and regional traffic.

Study Overview

The Minnesota Department of Transportation (MnDOT), in partnership with the City of Henderson, Sibley County, Scott County, and Le Sueur County, has been working on a feasibility study to investigate transportation improvements in the Minnesota River Valley to determine possible improvements that would minimize roadway closures due to flood events. The study is focusing on the bridges and approach roadways for state Highway 19, Highway 93, and Sibley County Road 6.

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May 17, 2017

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- Cost estimates
- Ask questions
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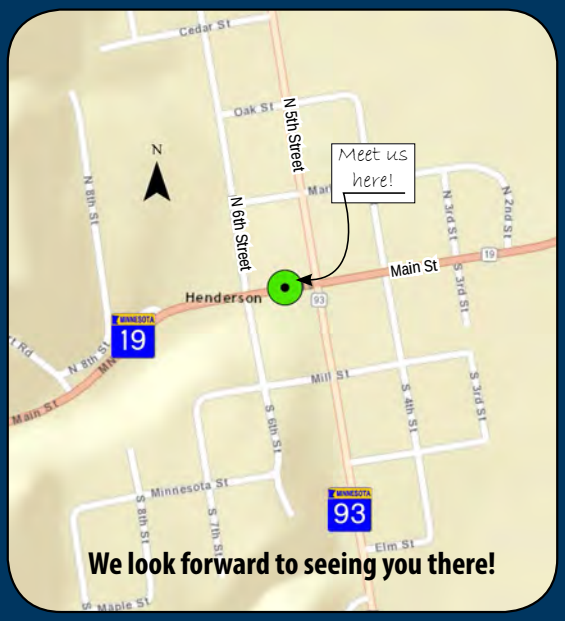


The goal of the study is to identify a feasible, safe and accessible, 10-ton route into and out of Henderson, which would limit the length of detours and impacts to businesses during high water events. Currently, there is no funding programmed for implementing flood mitigation improvements. The results of this study will compare the alternatives considered and evaluate their relative benefits, costs, and impacts. This information can then be used by the project partners to seek funding for further design and construction.

To date, conceptual roadway improvements for the three routes that serve Henderson (Hwy 19, Hwy 93, and County Road 6) have been developed. Each alternative is independent of the others and would allow the roadway to remain open to traffic under a flood level equal to the Minnesota River crest during the 2010 flood event. The Highway 93 and County Road 6 alternatives involve raising the roadway profiles to an elevation above the 2010 flood elevation and the Highway 19 alternative would raise and substantially lengthen the bridge across the Minnesota River floodplain.

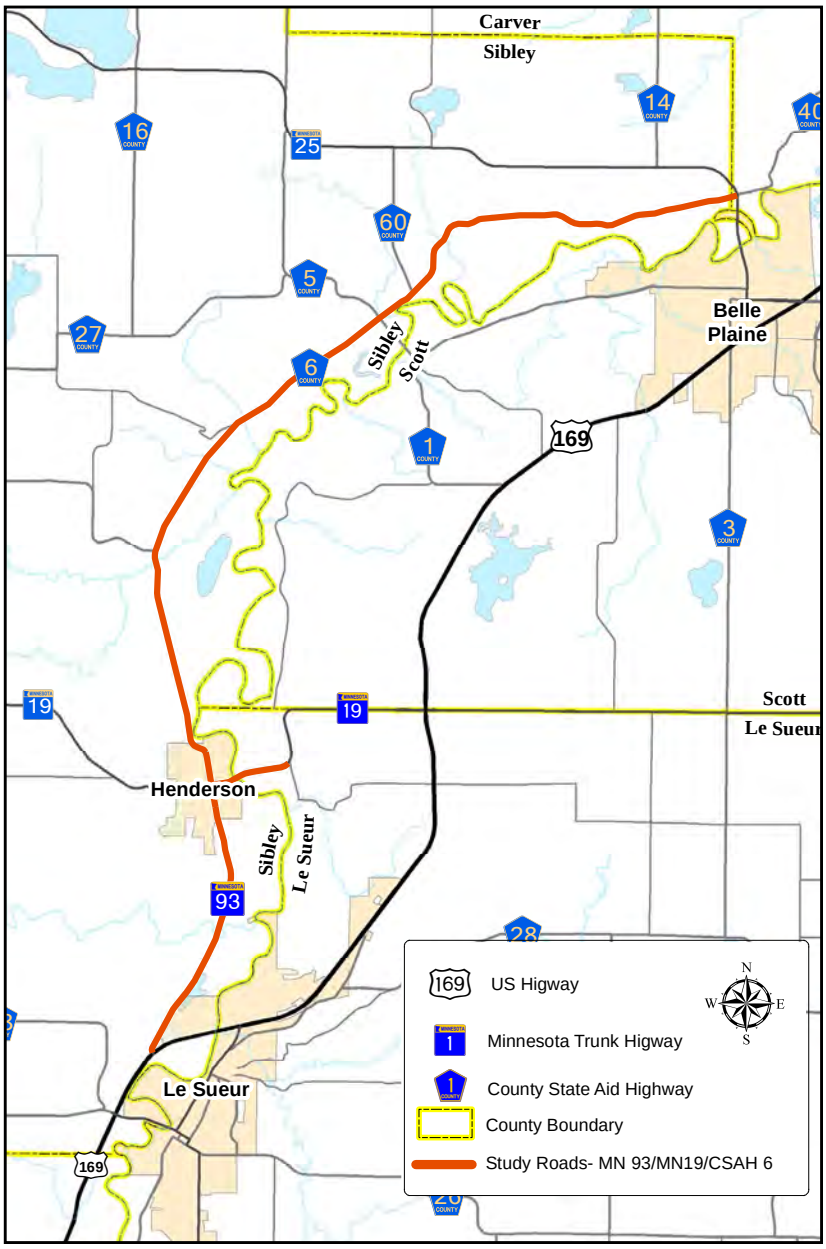
As part of the study, each alternative has been preliminarily reviewed for benefits to users/motorists, environmental concerns (wetland, floodplain and floodway impacts), right of way and access impacts, and construction costs. A benefit/cost analysis for each alternative has been developed. A final study report is expected to be complete in fall 2017.

Project Management Team

A Project Management Team (PMT), comprised of staff from MnDOT, local governmental units (city of Henderson and the counties of Sibley, Scott, and Le Sueur) has been meeting regularly throughout the study process. The members of the PMT serve as a communication link to constituents and elected officials. Meetings have also been held with environmental review and permitting agencies.

Photo Source: Mankato Free Press

Study Area- Hwy 93/ Hwy 19/Hwy 6



Contact

Matt Young
MnDOT Project Manager
507.317.7855
matthew.young@state.mn.us

MnDOT
District 7
2151 Bassett Drive
Mankato, MN 56001-6888

www.mndot.gov/d7/projects/hwy19study

DEPARTMENT OF TRANSPORTATION

MnDOT News Release - Open House Meeting

MnDOT Press Release: May 17 open house set for Henderson flood study

Mark Benson to: Bob Rogers 05/02/2017 01:45 PM

From: Arndt, Rebecca (DOT)
Sent: Tuesday, May 2, 2017 9:30 AM
To: #DOT_D7USERS
Subject: FW: May 17 open house set for Henderson flood study

News Release

May 2, 2017

Contact: Rebecca L. Arndt

Office: 507-304-6106

rebecca.arndt@state.mn.us<mailto:rebecca.arndt@state.mn.us>

May 17 open house set for Henderson flood study
Options for Highways 19, 93 and County Road 6 presented

MANKATO, Minn. – The public is encouraged to attend an open house that will show the results to-date of a feasibility study designed to investigate transportation improvements in the Henderson area of the Minnesota River Valley during flood events.

The open house, which includes a presentation from 5:30 to 6:30 p.m., will be held from 5 to 7 p.m. on Wednesday, May 17 at the Roadhouse Event Center, 510 Main Street, Henderson. Presentation materials can be found today at www.dot.state.mn.us/d7/projects/hwy19study/< http://www.dot.state.mn.us/d7/projects/hwy19study/> .

“Ideally, we would like interested persons to view the materials on the website and e-mail me with any questions so that we can address any common themes in the presentation,” explains MnDOT project manager, Matthew Young. “And, of course, we will have team members available to address additional comments at the open house.”

The goal of the study is to identify safe and accessible routes to and from Henderson and to limit the length of detours and impacts to businesses and regional traffic during high water events. Options for Highways 19 and 93 and Sibley County Road 6 are presented, but no funding is identified at this time.

The study also tackled the benefit/cost analysis of elevating roadway profiles (Highway 93 and County Road 6), expanding the bridge and roadway approaches (Highway 19) and improving roadway stability to mitigate slope failures. Other work included developing hydraulic models, modeling traffic and designing alternatives.

The feasibility study was initiated by the Minnesota Department of Transportation, along with the city of Henderson, Sibley County, Scott County and Le Sueur County in January. More information can be found at the website at www.dot.state.mn.us/d7/projects/hwy19study/< http://www.dot.state.mn.us/d7/projects/hwy19study/> .
To request an ASL or foreign language interpreter or other reasonable accommodation, call Janet Miller at 651-366-4720 or 1-800-657-3774 (Greater Minnesota); 711 or 1-800-627-3529 (Minnesota Relay). Individuals may also send an e-mail to janet.rae.miller@state.mn.us< mailto:janet.rae.miller@state.mn.us>.

###

Rebecca L. Arndt
Public Information Officer
MnDOT District 7
507-304-6106
rebecca.arndt@state.mn.us<mailto:rebecca.arndt@state.mn.us>
@mndotscentral
[http://ihub/communications/images/mndot-email-signature.png]
Your brand isn’t your logo or colors. It’s what you do every day and must be built.

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Public Comments

Fwd: Flood Mitigation Study - Henderson
Mark Benson to: Bob Rogers 05/31/2017 07:28 AM

From: Young, Matthew (DOT)
Sent: Wednesday, May 17, 2017 9:50 AM
To: 'Bill.M.Bigaouette@wellsfargo.com' <Bill.M.Bigaouette@wellsfargo.com>
Subject: RE: Flood Mitigation Study - Henderson

I do get your point of view and truly appreciate your interest. An example of what we can do is not just raise the road of highway 19, which we know would create the dam effect you mention. Instead this study proposes a longer bridge and eliminating the existing dam effect the current highway 19 creates. This is just an example.

Next week I will be meeting with members of the Corps of Engineers and DNR to present this study. I will make it a point to bring up your concern as they are likely the organization who would need to review the watershed for the "big picture" effects.

Matt

From: Bill.M.Bigaouette@wellsfargo.com [mailto:Bill.M.Bigaouette@wellsfargo.com]
Sent: Wednesday, May 17, 2017 9:22 AM
To: Young, Matthew (DOT) <matthew.young@state.mn.us>
Subject: RE: Flood Mitigation Study - Henderson

From past experiences the "DAMS" that I am referring to are when MNDOT repairs/rebuilds roads that cross the River.. They simply build them up which in essence great a Dam effect…. This slows the flow and backs up on to private properties. And now at a more increased rate. If we want the water not to flood roads and please don't forget about the private land owners, then get rid or find a better solution for road structures that cross rivers/tributaries. What history tells me is that those downstream (Minneapolis area) want a slower onslaught of water so they don't get flooded…. Appears that they really don't care about us in the outstate area.. !!! I can say much more on this topic but I think you got the picture from my point of view…

From: Young, Matthew (DOT) [mailto:matthew.young@state.mn.us]
Sent: Wednesday, May 17, 2017 8:44 AM
To: Bigaouette, Bill M.
Subject: RE: Flood Mitigation Study - Henderson

Bill,
Thank you for the email and your concerns. While I recognize that water use in our region needs much review, the purpose of this particular study is the travel around Henderson during these flooding events. This is the portion of the problem that MnDOT can and has a responsibility to review.

Being a resident of St. Clair, just east of Mankato and bordering the Le Sueur River, my community is also experiencing increased flooding requiring sandbagging. I understand the personal impacts the flooding causes.

What you state is correct, the alternatives identified are to raise road elevations above the flood elevation. However, the alternatives studied have been determined by hydrologist to not increase the river elevations and will not create "dams". We specifically took this into account when designing the alternatives.

If you wish to discuss this further, please feel free to reply or give me a call. I do appreciate your

email.

Matt Young
MN Dept. of Transportation
District 7 - Mankato
Phone: 507-317-7855

From: Bill.M.Bigaouette@wellsfargo.com [mailto:Bill.M.Bigaouette@wellsfargo.com]
Sent: Wednesday, May 17, 2017 8:10 AM
To: Young, Matthew (DOT) <matthew.young@state.mn.us>
Subject: Flood Mitigation Study - Henderson

Read your documents, seen your plan,, but completely disagree with what you perceive as the problem, your approach and possible resolution.

You defined the issues as flooding in these areas but do not address WHY these areas are getting flooded !! Easy, the rest of the county/state continue to dump water into tributaries that then dump into the Minnesota River, which then cause the issue of flooding. Not only flooding but higher flooding and more consistent flooding. Never used to have flooding to occur every year and sometimes 3-4 a year… Your resolution is to take tax payers monies and make higher roads, bigger dams (roads) to remedy this issue. I suggest you go to the source and curb/stop those who are creating this issue! That would consist of the Ag community who continue tile and dump water on us !!!! Very disappointed with your plan and will not attend your meeting.

Bill Bigaouette
Henderson Mn.

Fwd: HWY 19 Study Feedback
Mark Benson to: Bob Rogers 05/31/2017 07:28 AM

From: Young, Matthew (DOT)
Sent: Wednesday, May 31, 2017 6:56 AM
To: 'John Levar' <jlevar@asteng.com>
Subject: RE: HWY 19 Study Feedback

Thank you John for clarifying our phone discussion with this email, it is well written and quite clear. As we discussed, your concerns are warranted and have been expressed and discussed by the Flood Study Project Team. Your neighbor to the north has also expressed similar concerns. The current study does call for an expansion of the Rush River Bridge, however it is understand that may not alleviate the potential for the Rush River flooding. Further and extensive review of the Rush River will be needed during the design should the Highway 93 option be pursued. Should property acquisition be needed from you, you would be contacted in person during the design of the project.

This correspondence will be included in the report so should this option be pursued your concerns will not be forgotten. If you have any additional concerns or questions, please don't hesitate to contact me. Thank you for your time preparing this email.

Matt Young
MN Dept. of Transportation
District 7 - Mankato
2151 Bassett Drive
Mankato, MN 56001
Phone: 507-317-7855

From: John Levar [mailto:jlevar@asteng.com]
Sent: Tuesday, May 30, 2017 8:25 PM
To: Young, Matthew (DOT) <matthew.young@state.mn.us>
Cc: John Levar <jlevar@asteng.com>
Subject: HWY 19 Study Feedback

Matt,

Thank you for speaking with me last week. As we discussed, we own property (22.5 acres) at the intersection of HWY 93 and 308th lane next to the Rush River where it passes under HWY 93. With the misguided and rampant addition of drain tile in the farm fields upstream within the Rush River watershed, we have experienced significant increases in the flow and flooding associated with Rush River since we purchased the property nearly 10 years ago. In fact, we are now finding 18"-24" diameter sections of drain tile washed up in the banks of the river within our property. This is a well documented issue within the county and within the last few years resulted in a neighboring property (Beinfang) being purchased by the county through funds provided through a federal flood relief act.

As it stands currently, neighboring properties upstream from ours have built large berms adjacent to the river edge keeping the river volume within the taller banks. With our property being heavily wooded, we don't have the opportunity to do that and when the volumes spill over the natural banks, we have very high flows of water push through our property and onto 308th Lane, then cross over Highway

93, often closing the road when this occurs. At times we have seen as much as 3 feet of soil removed from large areas of the properly and we routinely loose 5-10 feet of riverbank during a single event. Needless to say the damage is significant and its effects linger for months.

With this background in mind, my concern within the study is that the proposal of increasing the elevation of HWY 93 will essentially render our property useless to us and essentially turn it into a containment pond. In addition to the right-of-way taking out our orchard and some of the only regularly serviceable portions of our property, it would leave us with little opportunity to salvage the property given a common flood event associated with the Rush River. We all tend to focus on the Minnesota River, but the Rush typically floods prior to the Minnesota overflowing at least 50% of the time and the damage is very signficant. In order to maintain any access to 308th lane, it would also have to be elevated, and our property would cease to be serviceable to us at that point. I would ask that if this is ultimately the option chosen, that funds be included to purchase our entire parcel as the solution would prevent its from being able to use the property any longer.

If you have any further questions or concerns, please feel free to contact me.

Regards,

John Levar, P.E.
XXX 308th Lane
Henderson, MN

Home Address
901 Huntington Way
Jordan, MN 55352
612-308-3076

Fw: Flood Mitigation Study
Mark Benson to: Bob Rogers 06/13/2017 04:36 PM

From: Young, Matthew (DOT)
Sent: Monday, June 12, 2017 1:25 PM
To: 'Darrell Amberson' <d.amberson@frontier.com>
Cc: 'm amberson' <m.amberson@frontier.com>
Subject: RE: Flood Mitigation Study

Marge,

Thanks again for the email and enjoyable conversation. As we discussed on the phone I am replying to your email to document some of our discussion. I have responded to specific questions below in RED. Here are a few of the other aspects we discussed:

1. This study was initiated by the city of Henderson with MnDOT providing the coordination and funding. The results of the study won't be to choose an option but to deliver the options with estimated cost and value. Once the study is completed all parties involved will have a better understanding and can pursue funding options.
2. Should the Highway 93 option be chosen a more detailed study of the Rush River would be needed to determine what impacts an 8' road raise of 93 would have.
3. If you would like me to stop at your residence I would be happy to.
4. Thanks again for your input into this project. This correspondence will be documented with the study so the information won't be lost.

If you would like to add any additional information or my responses are different than we discussed please feel free to email or call me. Thanks again!

Matt Young
MN Dept. of Transportation
District 7 - Mankato
Phone: 507-317-7855

From: Darrell Amberson [mailto:d.amberson@frontier.com]
Sent: Monday, June 12, 2017 12:22 PM
To: Young, Matthew (DOT) <matthew.young@state.mn.us>
Cc: 'm amberson' <m.amberson@frontier.com>
Subject: Flood Mitigation Study

Matt,

Darrell and I were unable to attend the May 17th public meeting regarding the Flood Mitigation Study as it impacts Henderson and the surrounding area. As residents of Henderson Township, we appreciate the opportunity to share our thoughts with you.

First of all, thanks for the very detailed proposals and background information available on line. A tremendous amount of work has gone into this study.

We are located just off of Hwy 93 at 308th Lane, which is just north of Rush Creek. We are neighbors with John Levar, to give you a closer idea of where we are. Since purchasing the farm in 2002, we have experienced six closures of 93 (and 19) that have necessitated us taking a farm vehicle up our field roads, through a neighbor's farm to get into Henderson, where the fire department has instructed us to leave a vehicle at the fire station so we can get to our jobs in the Cities. Doable, but added 3-4 hours of travel time each work day. We burned vacation days when

possible, due to the cost and time involved to get past flood conditions.

We produce certified grass alfalfa hay and have lost entire crops in several of those flood events. When we've had to reseed the field, it is at the cost of a few thousand dollars in organic seed, after hours of heavy equipment work to remove the layer of silt deposited in the field. We are not the only land owners who have had to dig out and replant.

In order of preference (first to last) for the various proposals, including comment:

- Hwy 19 – most expensive, but makes the direct connection to Hwy 169 for travel north and south.
    - Main thorough fare for east-west travel.
    - The natural flood plain conditions are restored.
    - The bridge span would appear to have a widened waterway opening to facilitate better flow of water coming from St. Peter/Mankato, as well as better handle the high volume of water from Rush Creek.
- Hwy 93 – an 8' rise in the elevation makes me think we'll have something akin to a ski jump coming off of Hwy 93 onto our township road, 308th Lane. The current study and cost associated would show it as a rise up to Highway 93. The full raising of 308th is not part of this study. Unfortunately we had to focus the study only on the main thoroughfares in order to get a straight comparison between the different options. 308th would be reviewed in greater detail should it be the chosen option.
    - Is the cost of raising the township road (plus all the driveways along the west side of 93) part of this proposal? The cost to tie existing roads and driveways into the proposed highway 93 are included in the study cost.
    - Are culverts or other water handling solutions part of raising 93? If adequate flow of water from the west is not addressed the new road will become a new dam creating a lake on our land as well as our neighbors. When the Rush Creek overflows it comes into our valley area then drains to the east and into the Minnesota River. A bridge expansion over the Rush River is part of this study. Additional study and design would need to take place should the Highway 93 option be constructed.
    - Will the new bridge over Rush Creek have a span and widened waterway opening that will adequately handle the water from Rush Creek so that the 8' higher road will not serve as a dam and back the water up to the west where our farm is, as well as a number of other properties (Adams, Levar, Seifert/Lemart, Geldner/Moore)? Yes, the bridge would be widened. Exactly what that would look like would come with a detailed design should this option be constructed.
- Sibley County Road 6 – lot of wetland considerations, which makes it appear to be a difficult proposal to get support on.

Matt, if you have any interest is visiting our farm to see the impact flooding has had in the area, we would welcome a chance to talk with you and answer any questions you might have.

Again, thank you for all the information that your PMT has made available to the residents. We are very pleased to know that a long term solution to the flooding is being considered.

When the decision is made as to which proposal to proceed with, we understand the next step will be to investigate some funding opportunities.

Sincerely,

Marge and Darrell Amberson
32388 – 308th Lane
Henderson, MN 56044

Henderson Flood Mitigation Study

COMMENTS & FEEDBACK

* NAME _____ * PHONE _____

* EMAIL _____

* ADDRESS _____

(* Indicates optional)

Check the box if you would like to be contacted: ☐

COMMENTS: Hwy 19 - if this is the best route, then the hill beyond the bridge may need to be addressed as there could be some sliding which would block the road. (mudslide doesn't happen often) Hwy 93 - might be a better a choice in terms of money to redo the road. Scope of the project may want to include the Rush River bridge area. Appears the bridge today may not be adequate as the water flows out of the bank to the N - bypassing the bridge altogether. Good presentation - thank you for the study.

Please leave your feedback in the comment box tonight or mail in with this pre-addressed card. Comments may also be directed to Matthew Young, MnDOT Project Manager, by email at matthew.young@state.mn.us or by phone at (507) 304-6183. Your feedback will be shared with project staff and included in the project record. Find more information and sign up for email updates at the project website: www.dot.state.mn.us/d7/projects/hwy19study

Open House Meeting Sign-in Sheets

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

Staff	Name: Mark Benson	Address: SEH
	Phone:	
	Email:	

Staff	Name: Bob Rogers	Address: SEH
	Phone:	
	Email:	

Staff	Name: Graham Johnson	Address: SEH
	Phone:	
	Email:	

Staff	Name: Lon Beberly	Address: Box 411
	Phone: 507-327-0646	Henderson, MN 56044
	Email:	

	Name: Bob Wolf	Address: 320 Maple Ridge Dr
	Phone: 507-381-1983	Henderson
	Email:	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

2

Name: Joel King	Address: 105 N. 4th ST.
Phone: 507-380-4888	Henderson, MN
Email:	

3

Name: Becky Pollack, Ney Nature Center	Address: 28038 Nature Center lane, PO Box 93
Phone: 507-357-8580	Henderson MN 56044
Email: rebecca@neycenter.org	

4
5

Name: Vic + Sheeby Lueders	Address:
Phone: 612-968-4095	
Email: VSLueders@hotmail.com	

6
7

Name: Doug & Dee Thomas	Address: 25899 335th Ave.
Phone: 612-290-1708	Henderson
Email:	

8

Name: Warren Felix	Address: 408 N. 6th
Phone: 507-248-3301	Henderson
Email:	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

9

Name: Baylyx Anderson	Address: 407 Main St. Henderson, MN 56044
Phone: 507-248-3223	
Email: hendersonmnnews@gmail.com	

10

Name: JEFF STEINBORN	Address: 307 MAIN ST.
Phone: 507-291-0762	HENDERSON, MN 56044
Email: JSTEINBORN@MAC.COM	

11

Name: CORY JAMES, I&S GROUP	Address: 115 E. HICKORY ST.
Phone: 507-387-6651	MANKATO, MN 56001
Email: cory.james@is-grp.com	

12

Name: TERRY DEMPSEY	Address: NEW ULM
Phone:	
Email:	

13

Name: Tom Graham	Address: Henderson
Phone:	
Email:	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

14

Name: Les Taimpo	Address: 314 N. 5th St Henderson
Phone: 507-248-3385	
Email:	

15 16

Name: Meghan & Greg Graham	Address: 400 S. 5th St. Henderson
Phone: 952-200-4812	
Email: Meghan.Graham14@gmail.com	

17

Name: Pat Steckman	Address: 507 Main St #2
Phone: 507-248-3458	Henderson
Email: pdsteck@gmail.com	

18

Name: Daniel R Reiman	Address: 707 Cedar st Po Box 304
Phone: 612-501-2721	Henderson
Email: Mserman@frontiernet.net	

19

Name: Lisa Reiman	Address: 707 Cedar St Po Box 304
Phone: 612-586-5870	Henderson
Email:	

20+1

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

21

Name: ROGER JUST	Address: 38270 290 ST HENDERSON
Phone: 507 248 9632	
Email: justroger@frontiernet.net	

Name:	Address:
Phone:	
Email:	

Name:	Address:
Phone:	
Email:	

Name:	Address:
Phone:	
Email:	

Name:	Address:
Phone:	
Email:	

1

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

22

Name: Bill Pinska	Address: Box 527 Arlington MN 55307
Phone: 507-964-2250	
Email: BillP@co.sibley.mn.us	

23

Name: Joe White	Address: 592 Industrial Drive Winsted MN
Phone: 320-552-1483	
Email: JoeW@Rambuildings.com	

24

Name: Orville Resch	Address: 35444 290th St. Henderson
Phone: 248-3331	
Email:	

25

Name: Chase Boehm	Address: 36004 276th St Henderson
Phone: 507 382 0191	
Email:	

26

Name: Jerry Bovee	Address: Henderson
Phone:	
Email: jbovee@frontiernet.net	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

27

Name: Joe Connolly	Address: RR1 & Queen
Phone: 507-665-6150	
Email:	

28

Name: Eileen Brandt	Address:
Phone: 507-380-0754	32805 300th St. Henderson
Email:	

29

Name: Bill Freitag	Address: 34503 250 St Henderson
Phone: 507 340 2647	
Email:	

30

Name: Dennis Graham	Address: PO 41 Henderson
Phone:	
Email: dgraham@frontiernet.net	

31

Name: Ron Walters	Address: P.O. Box 225 Henderson, MN 56044
Phone: 507-248-3516	
Email:	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

32

Name: Mathew Thibert	Address: 115 East Hickory St. Mankato, MN 56001
Phone: 507-995-2588	
Email: mathew.thibert@is-grp.com	

33

Name: John King	Address: LeSueur, MN
Phone:	
Email:	

34
1

Name: Ned & Mary Ann Picking	Address: Henderson
Phone:	
Email:	

35

36

Name: Amy Hordel	Address: 507 N 7th Henderson
Phone:	
Email: amyhordel@yahoo.com	

37

Name: Lisa Schickedanz	Address: Scott County
Phone:	
Email: LSchickedanz@co.scott.mn.us	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

38

Name: Ron Steinborn	Address: 34130 250 St.
Phone: 612 - 245 - 3803	Henderson
Email: Steinbornronald@GMAIL.com	

39

Name: Marcia Parrott	Address: 30090 State Hwy 93
Phone: 507 248 9697	Henderson
Email: dparrott@frontiernet.net	

40
41

Name: Kevin + Judy Savage	Address: 32324-300th St
Phone: 507-248-3569	Henderson, MN 56044
Email: None	

42

Name: Sam Parker	Address: 10 Civic Center Plaza, Suite 3
Phone: (507) 389-8886	Mankato, MN 56002
Email: Sam@rvrdc.org	

43

Name: Judy Loewe	Address: 339 Maple Ridge Dr
Phone: 507-248-3345	Henderson, MN 56044
Email: GJLoewe@frontiernet.net	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

44

Name: Robyn Geldner	Address: PO Box 296
Phone: (507) 327-3957	Henderson SL6044
Email: rgeldner@gmail.com	

Staff

Name: Sarah Shork	Address:
Phone:	
Email:	

~~45~~ Staff

Name: Bobbie Harder	Address:
Phone:	
Email:	

46

Name: SVEN MATTSON	Address:
Phone:	
Email: CMATTSON@FRONTIERNET.NET	

47

Name: Teresa Konechne	Address: PO Box 462
Phone:	Henderson
Email: fontheroad@yahoo.com	

Henderson Flood Mitigation Study Open House
Please Sign-In

Meeting Description: *Public Open House #1*	Date: *May 17th, 2076*
Location: *Roadhouse Event Center, Henderson, MN*	Time: *5:00 - 7:00 pm*

48

Name: Rich Worm	Address: 227 Maple Ridge Dr
Phone: 507-248-3231	
Email: richandjanw@gmail	

49

Name: Lori Eggers	Address:
Phone: 612 655 2306	
Email:	

50

Name: Don Boehnke	Address: 36004 272nd St Henderson
Phone: 507-381-2425	
Email:	

51

Name: J. Schuette	Address:
Phone:	
Email: vergaen23@gmail.com	

52

Name: Michael + Leanne Reinhardt	Address: Henderson
Phone: 507-248-3799	
Email:	

~~53~~

↳ See prev. Sheet - Bobbie Harder = Staff

Open House Presentation Slides

Henderson Flood Mitigation Study

May 17, 2017

DEPARTMENT OF TRANSPORTATION

Background

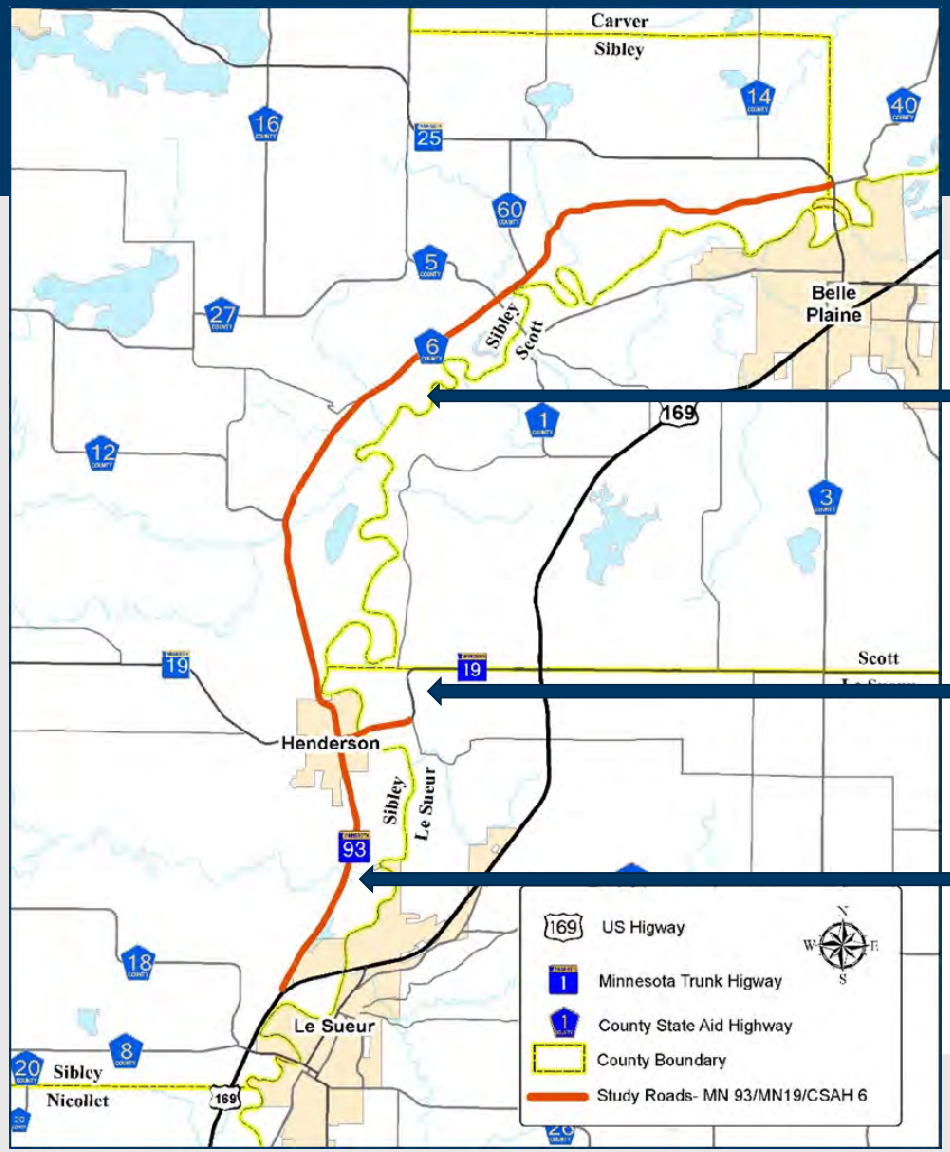
Comments from Mayor Paul Menne

Project Partners	Resource Agencies
MnDOT	US Army Corps of Engineers
City of Henderson	MN Department of Natural Resources
Le Sueur County	US Fish and Wildlife Service
Sibley County	
Scott County	

Purpose

- Study to identify the feasibility of improvements to Highway 19, Highway 93 and County Highway 6 to minimize transportation disruption caused by seasonal flooding of the Minnesota River
- No funding has been identified for any improvements
- Results will aid the City and MnDOT in pursuing flood mitigation funding

Henderson Flood Study Alternatives



County Road 6

Highway 19

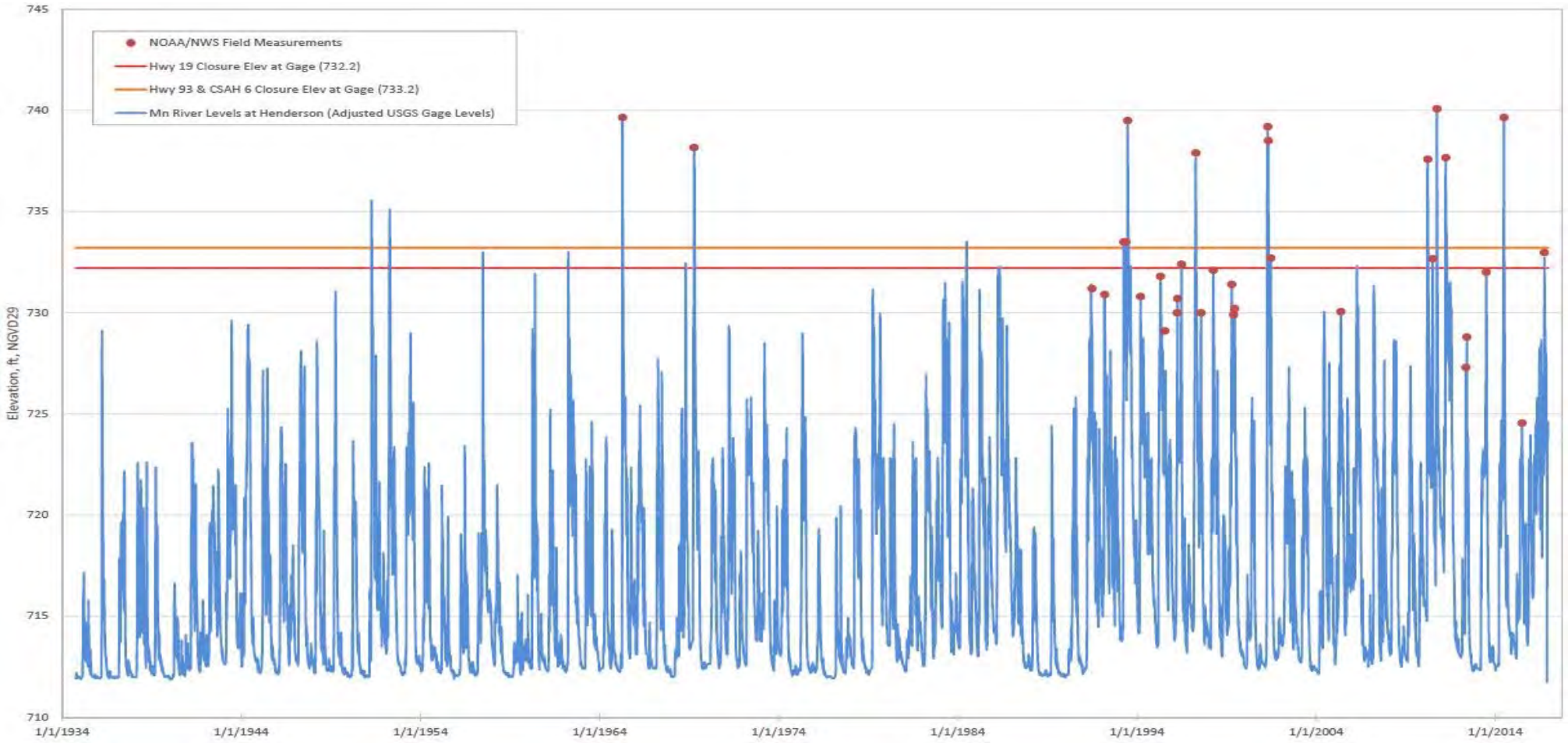
Highway 93

A better detour route was also studied

Elements

- Analysis of historical flooding
- Traffic forecasting and analysis
- Development of alternatives
- River modeling
- Evaluation of alternatives
  - Includes benefit-cost analysis
- Public and Agency involvement
- Final report

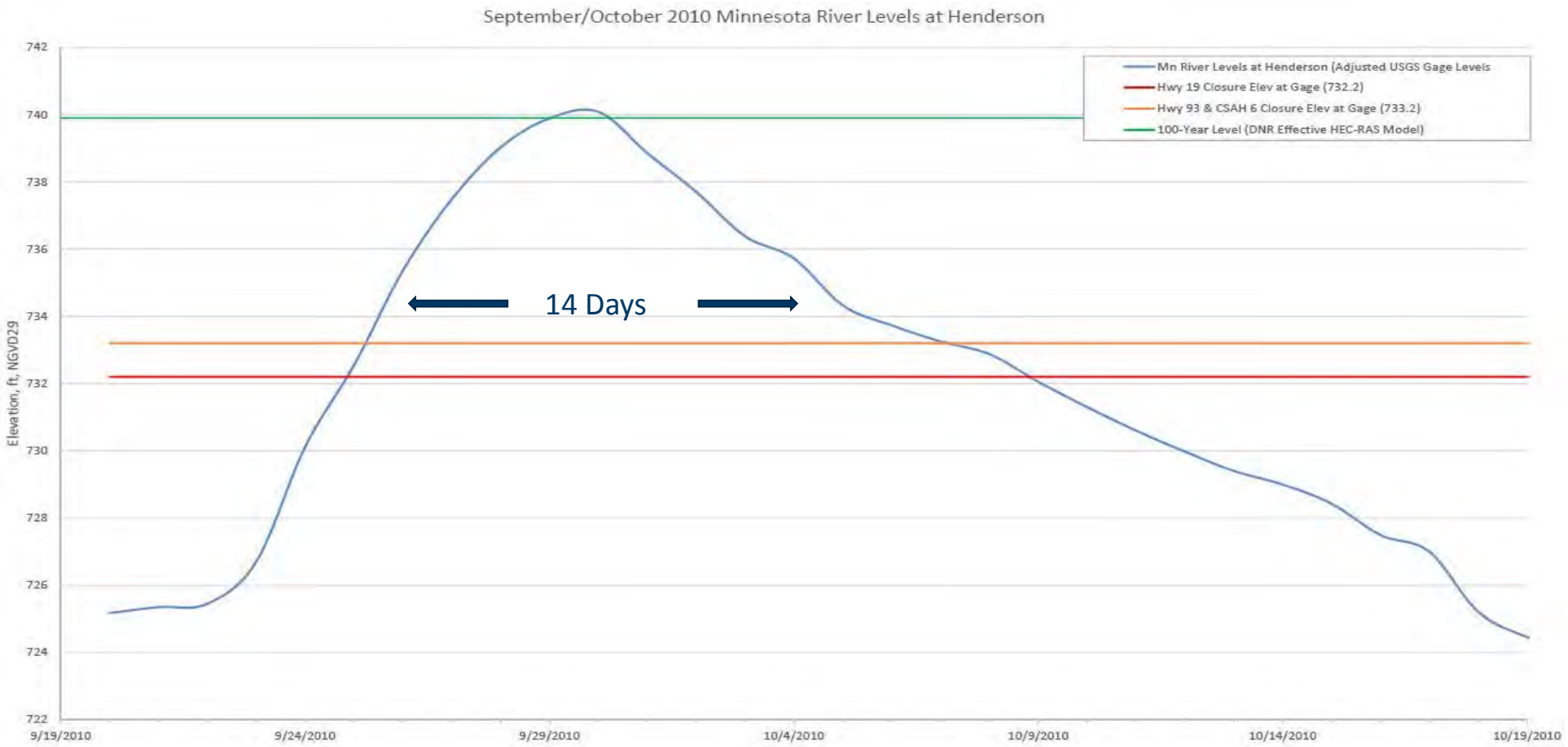
Henderson Flooding - 16 Closures Over 80 Years



Design Flood Event – September 2010 Flood

- Highest Recorded River Level at Henderson
  - Elevation 740.1 ft at Highway 19
  - Exceeded 1965, 2014 Floods by 0.4’
- More Conservative Design than MnDNR 100-Year Level
- Consistent with Recent MnDOT Projects Along MN River

Henderson Flooding –September 2010 Event



Road Elevations Below the 2010 Flood Elevation

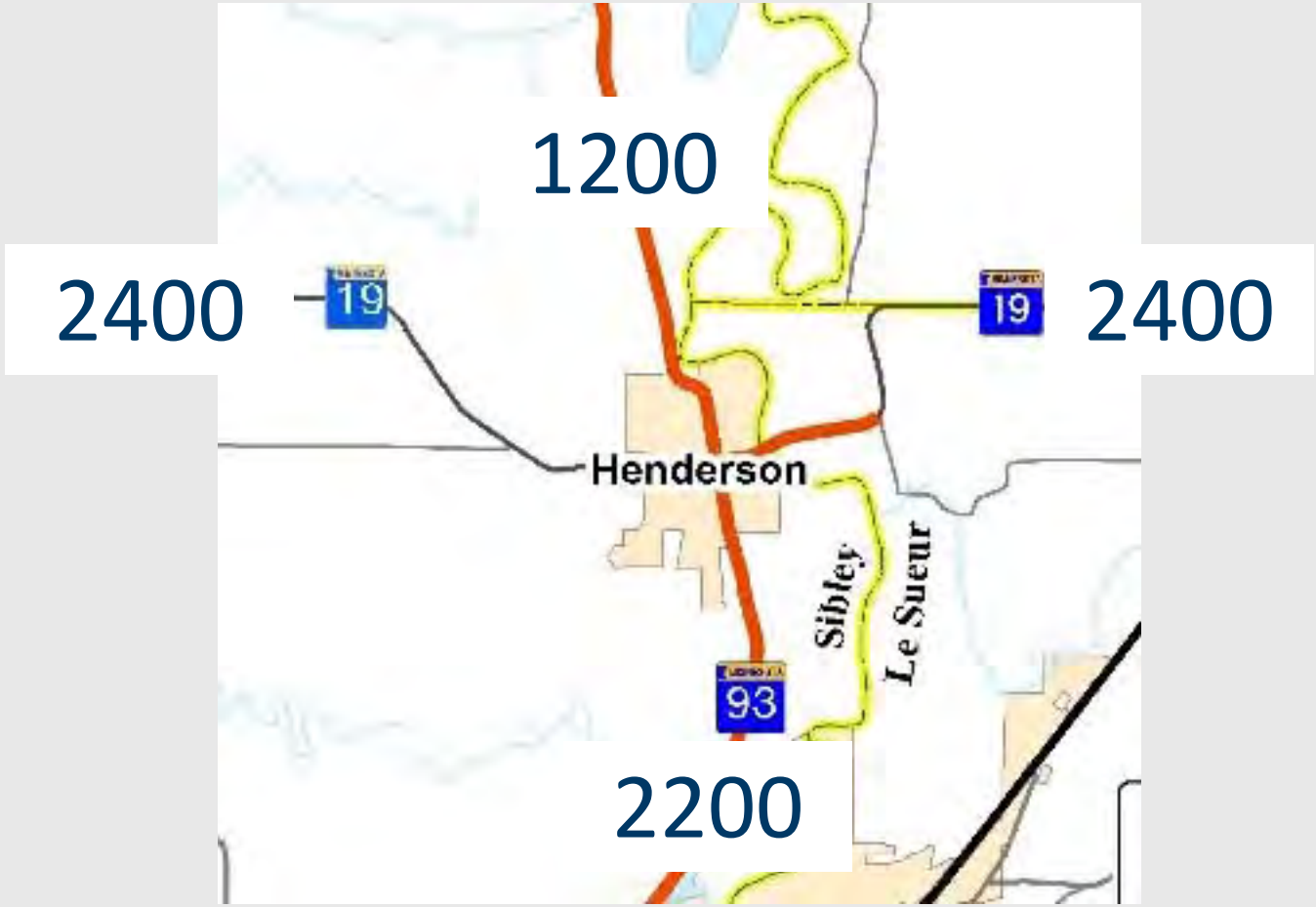
- County Road 6 – Up to 7.4 feet of water over roadway
- Highway 19 – Up to 7.2 feet of water over roadway
- Highway 93 – Up to 7.1 feet of water over roadway

Traffic Modeling

- Utilized most recent version of the MnDOT's Collar County Travel Demand Model to develop forecast and traffic routing preferences during flood closures
- Model provides Vehicle Miles Traveled and Vehicle Hours Traveled for different scenarios

MnDOT economic data was used to determine the cost of additional time and miles travelled

Average Daily Traffic Volumes



Daily Cost of Highway Closures

When Highways 19, 93 and County Hwy 6 are closed, the value of the additional time and miles traveled is:

$87,000 per day in todays dollars

Benefit - Cost

- A benefit-cost analysis is being used to help compare the economic advantages and disadvantages of the three alternatives.
- The total benefit dollars are then compared to the total costs for each alternative.
- **For this planning study, it is the relative comparison of the benefit cost ratios that will be used to compare alternatives**

- Benefits Include:
  - Vehicle miles travelled
  - Vehicle hours travelled
  - Operations and maintenance
- Costs Include:
  - Construction
  - Right-of-Way
  - Engineering
  - Flood Mitigation
  - ***Costs are approximate and should only be used for relative comparison between alternatives***

Design Process

Design Assumptions

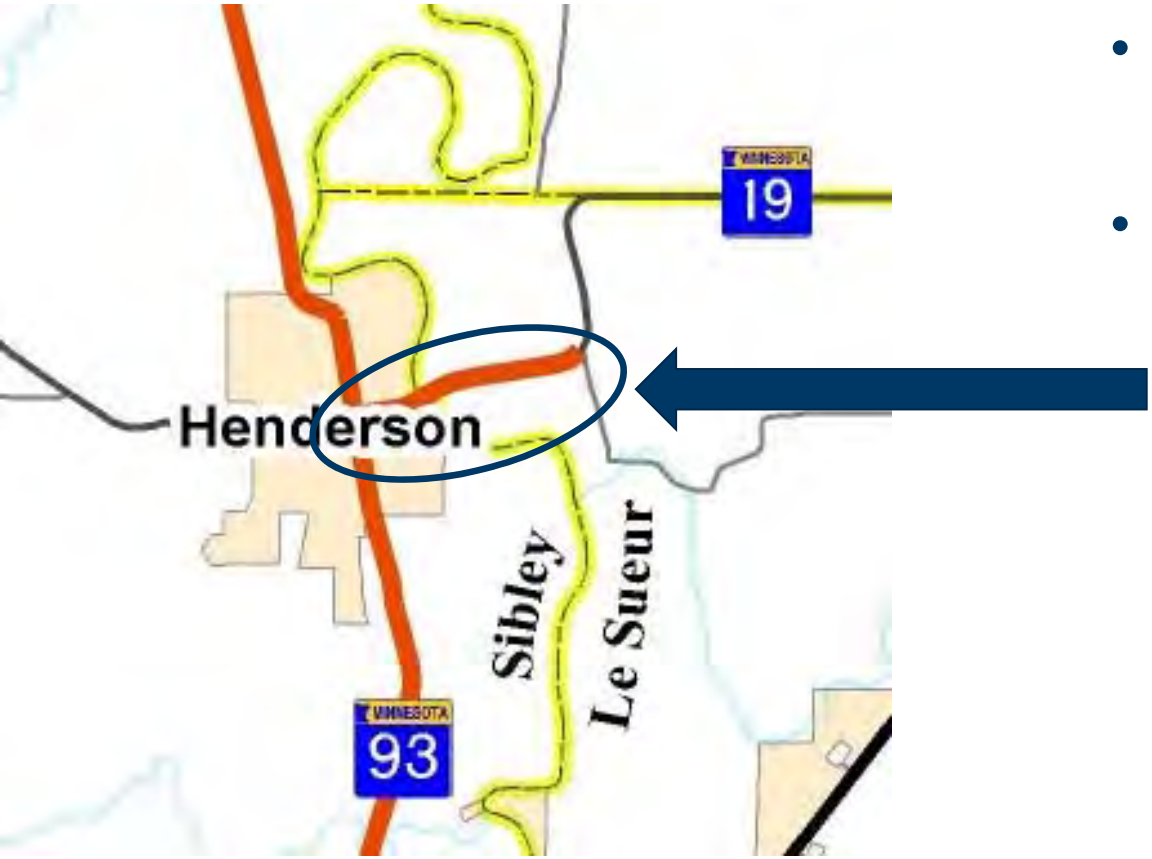
- Design road segments to be a minimum 1-foot above 2010 flood event
- Design roadways and bridges to match existing widths
- Design roadways to 10 ton design
- Each alternative includes modifying the existing Henderson Levee system (the proposed roads would essentially be at the same elevation as the top of the levee).
- The alternatives have been designed to have sufficient waterway opening to prevent any increase in water levels

Why Not Just Raise The Road?

- Raising the road would act as a dike or dam and restrict the river causing impacts up stream to adjacent properties
- The regulations do not allow fill in the floodway that will cause the river to rise

You may have noticed the recent projects that raised Highway 169. Those projects were permitted because they did not cause the river to raise.

Highway 19 Design Summary



- Build 2680 foot long bridge over the Minnesota River Valley
- Raise Highway 19 up to 8.2 feet for 1800 feet

Highway 19 Design Summary

Bridge Length = 2680 feet

Right-of-Way = 2 acres

Wetland Impacts = 2 acres

Approximate Project Cost with Trail on Bridge = $40 million (2017 $)

Benefit /Cost = 0.19

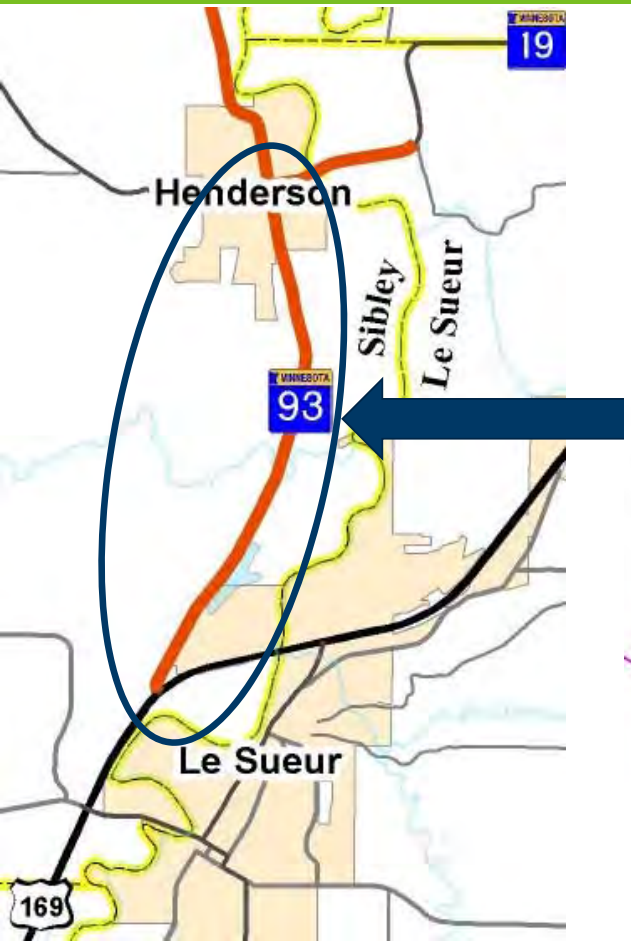
Approximate Project Cost with no Trail on Bridge = $36 million (2017 $)

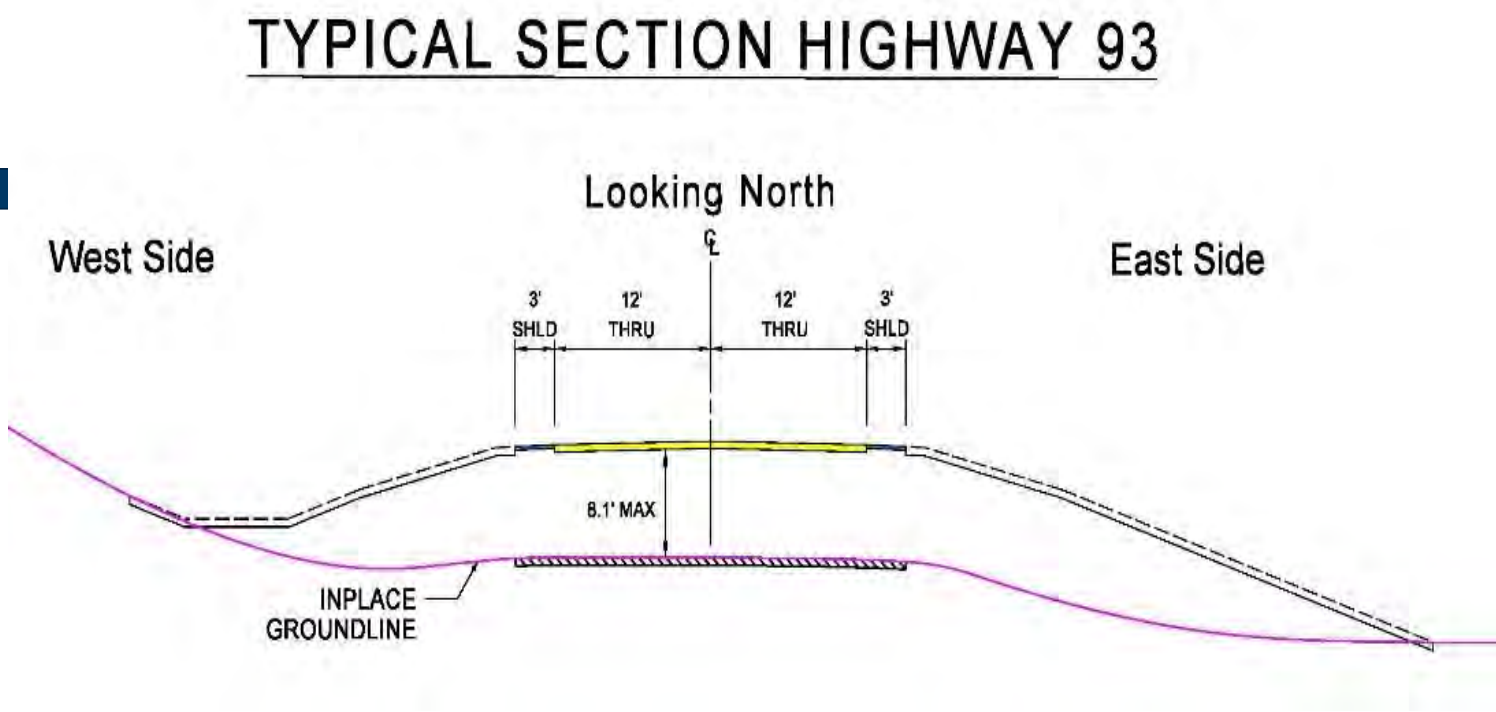
Benefit /Cost = 0.22

Pros/Cons

- Serves the highest level of traffic by providing the most direct travel route
- Provides another crossing of the river during flood years
- Restores natural floodplain conditions
  - Permitting agency support
- Highest Cost

Highway 93 Design Summary





Highway 93 Design Summary

Reconstructed Roadway Length = 3.4 miles

Includes replacement of Rush Creek Bridge

Mitigation for fill in floodplain is to lower 1500 feet of Highway 19 (without increasing flood frequency)

Approximate Project Cost
Estimate = $14 million (2017 $)

Right-of-Way = 25 acres

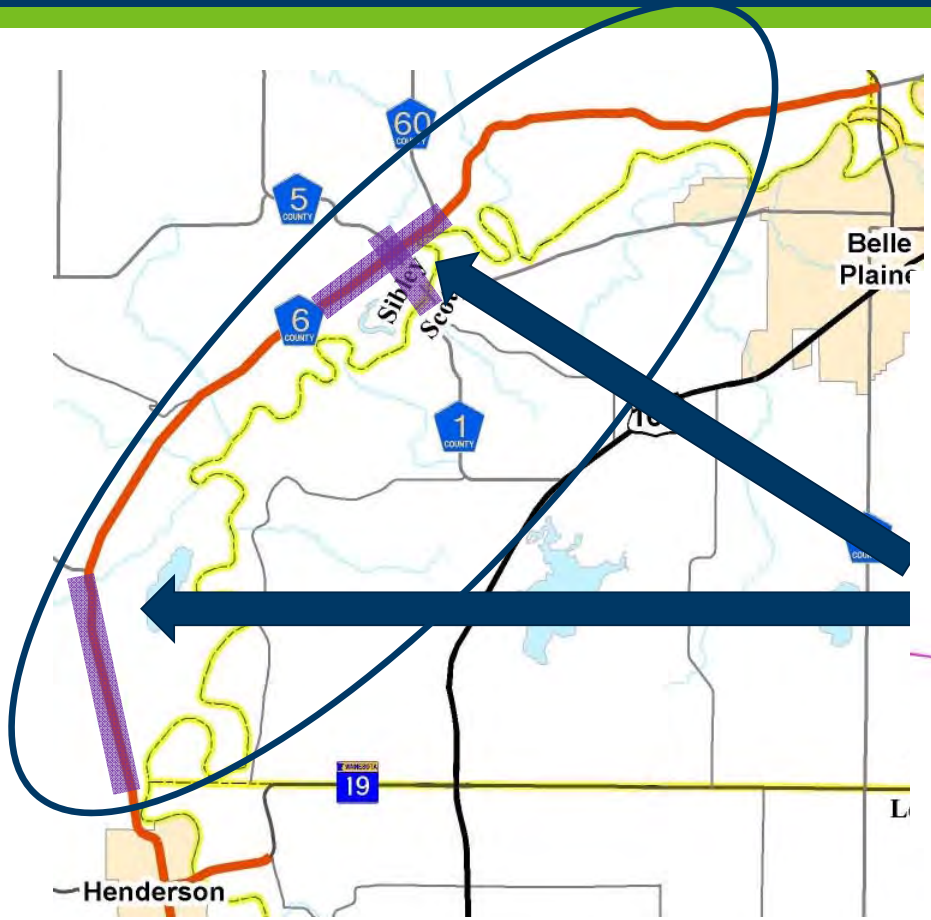
Wetland Impacts = 5 acres

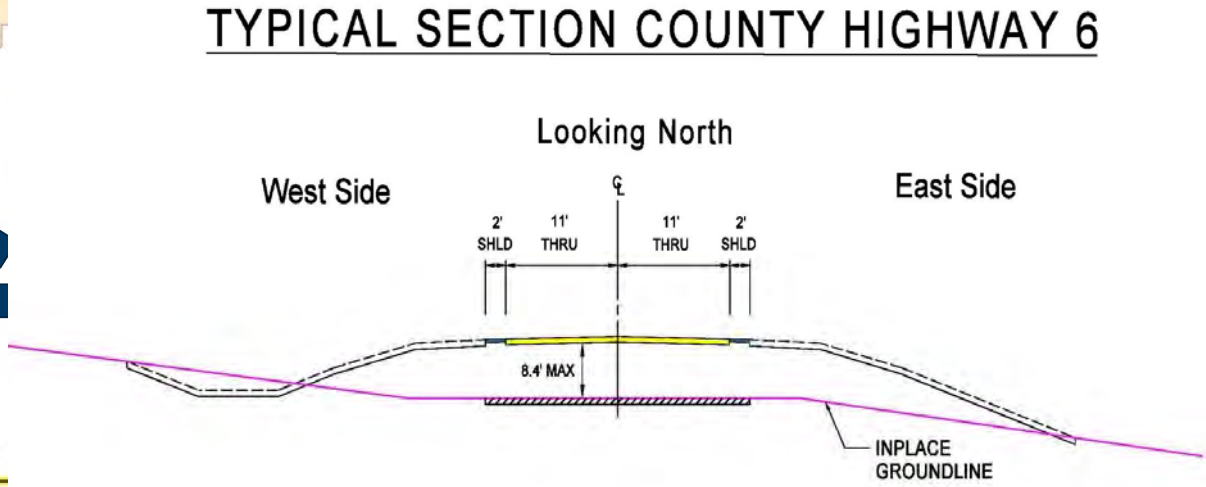
Benefit /Cost = 0.45

Pros/Cons

- Serves the second highest level of traffic
- Lowest Cost
- Highest Benefit/Cost Ratio
- Acquires the most property
- Would also have construction impacts on Highway 19

County Highway 6 Design Summary





County Highway 6 Design Summary

Reconstructed Roadway Length = 4.3 miles

Mitigation for fill in floodplain is to excavate an area from within the floodplain and to lower a portion of County Road 5 to offset the fill to raise County Road 6

Approximate Project Cost Estimate = $16 million (2017 $)

Right-of-Way = 11 acres

Wetland Impacts = 8 acres

Benefit /Cost = 0.12

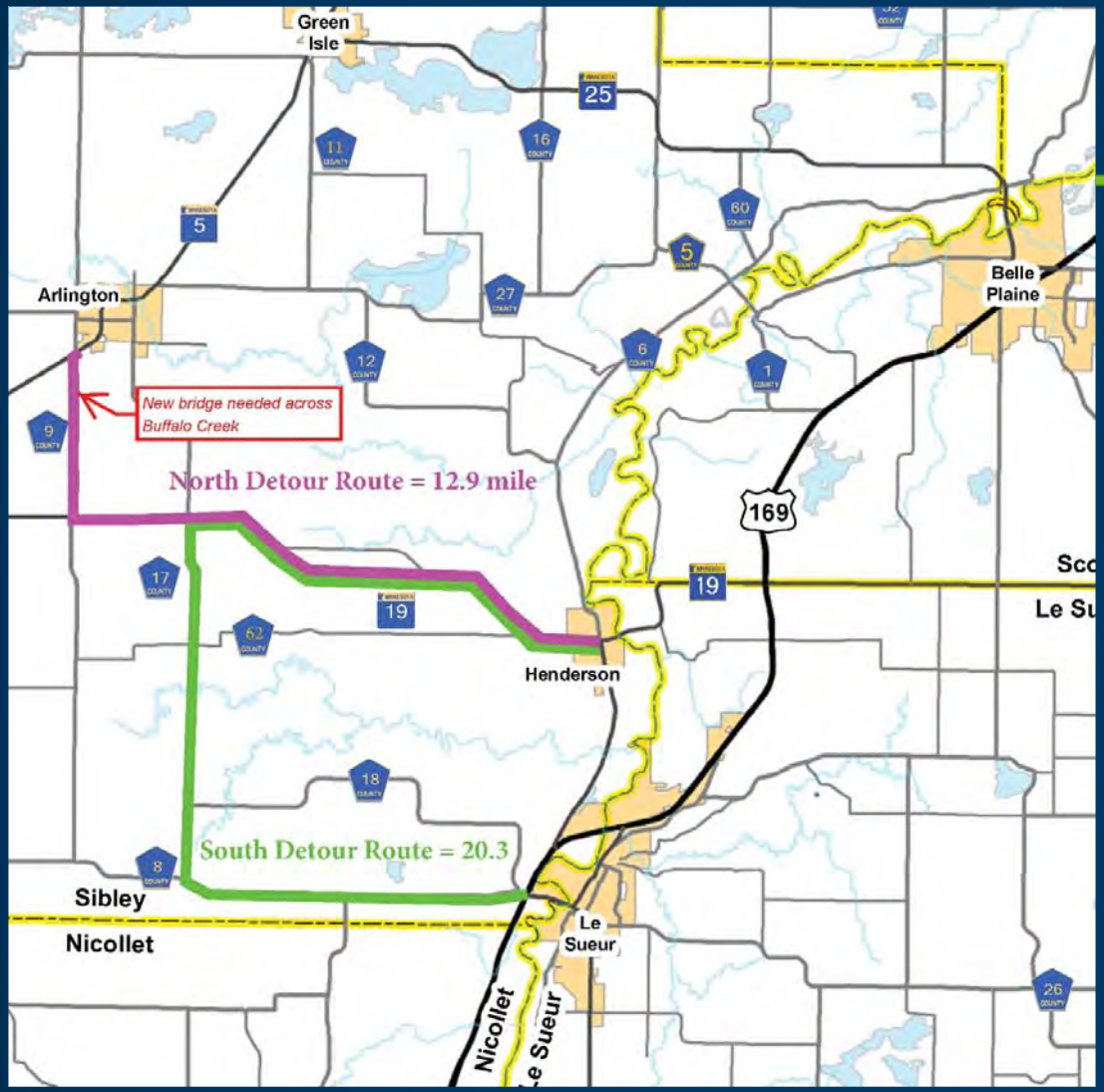
Pros/Cons

- Serves the fewest vehicles
- Lowest Benefit/Cost
- Project would lower the overtopping elevation of County Road 5
- More challenging to implement given the mitigation requirements involving the floodplain excavation

Alternative Summary

Alternative	Cost	Benefit-Cost
Highway 19	$40	0.19
Highway 93	$14	0.45
County Highway 6	$16	0.12

Better Detour Route Alternative



- North route is 12.9 miles and uses County Highway 9
  Approximate Cost = $23.6 million
- South route is 20.3 miles and uses County Road 17 and County Road 8
  Approximate Cost = $24.3 million
- Traffic modelling shows South route would be more highly utilized than the North (twice the traffic)
- ***Costs are approximate and should only be used for relative comparison between alternatives***

Open House Stations

- Flooding History
- Traffic Forecasting and Analysis
- Alternatives
- River Modeling
- Comment Cards
  - Comments due June 16

Next Steps

- Review Public Feedback
- Prepare Report
- Investigate Funding Opportunities

DEPARTMENT OF TRANSPORTATION

For More Information Please Visit the Project Website

mndot.gov/d7/projects/hwy19study

Matt Young

MnDOT Project Manager

507.317.7855

Matthew.young@state.mn.us

MnDOT –District 7

2151 Bassett Drive

Mankato, MN 56001-6888

Thank you!

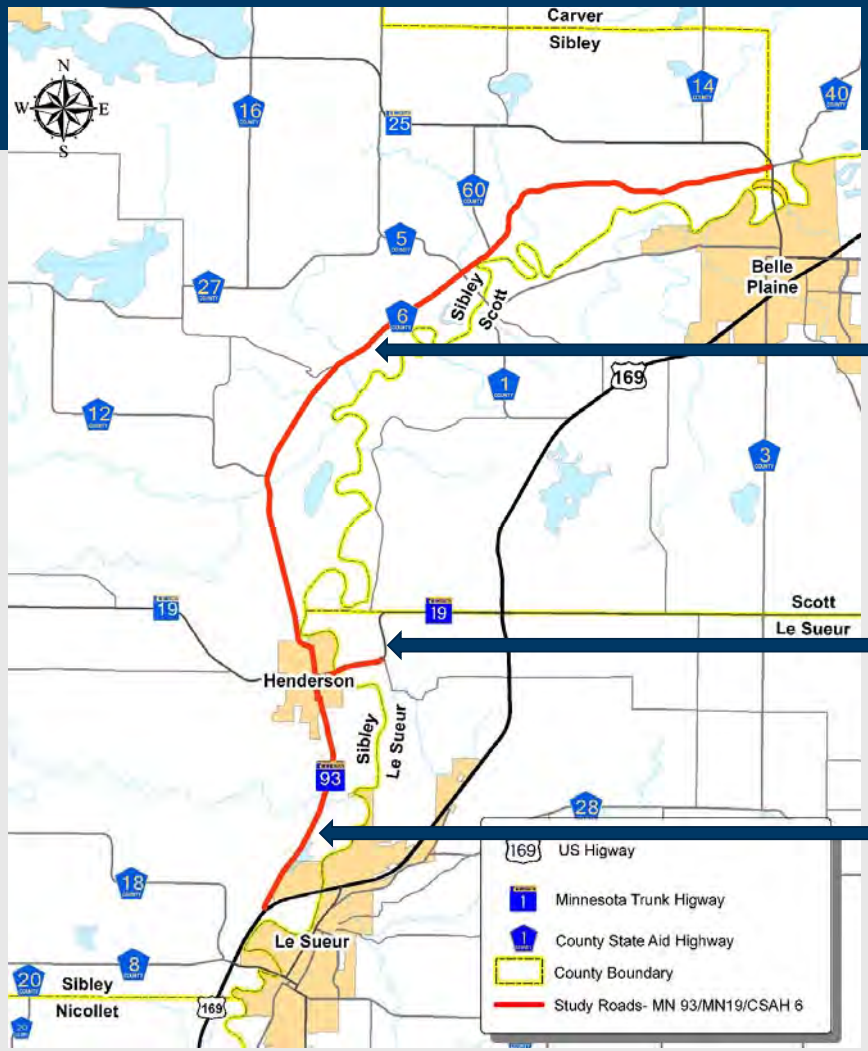
Matt Young

matthew.young@state.mn.us

507-317-7855

Open House Meeting Dispaly Boards

Henderson Flood Study Alternatives



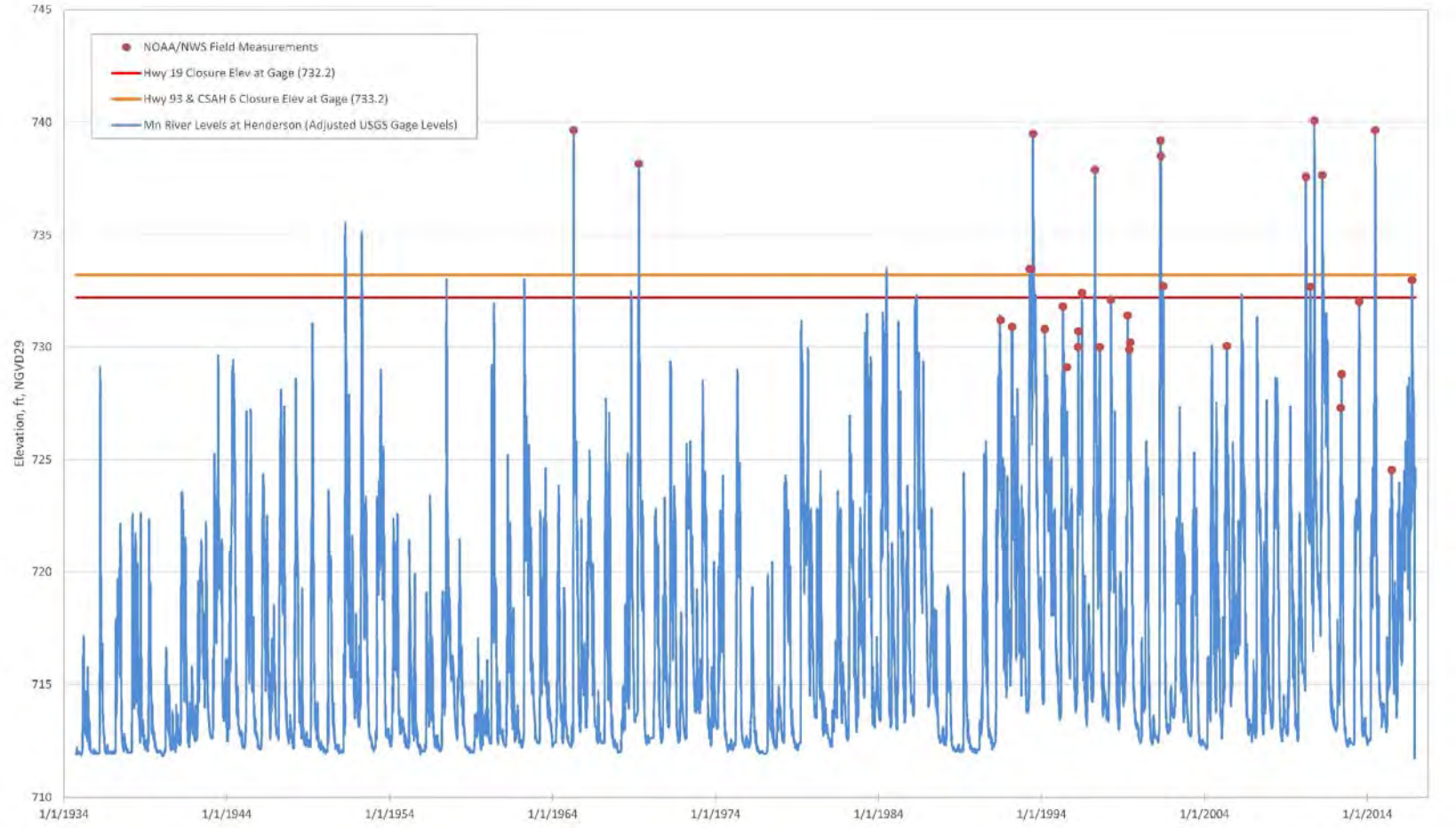
County Road 6

Highway 19

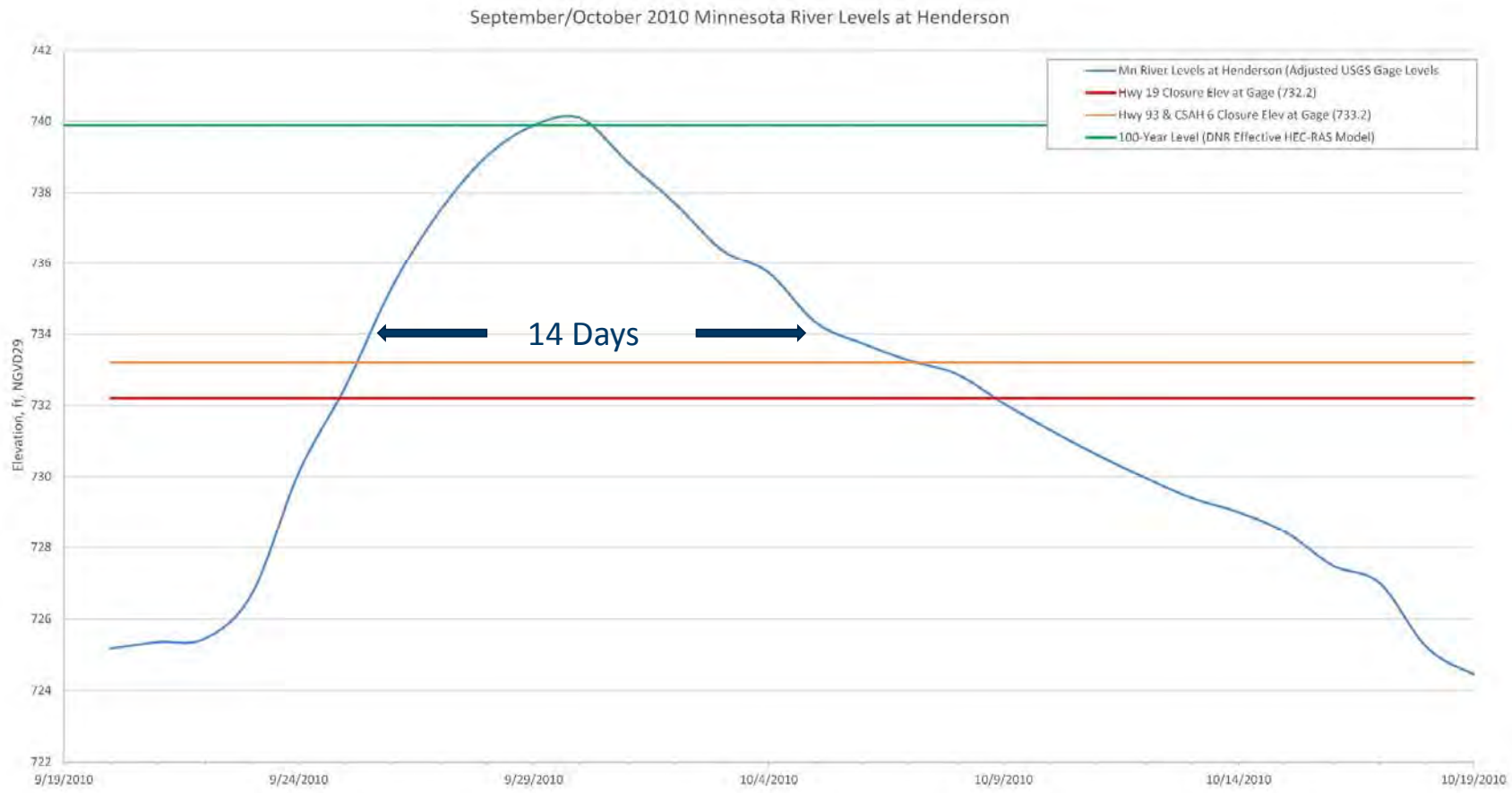
Highway 93

A better detour route was also studied

Henderson Flooding - 16 Closures Over 80 Years



Henderson Flooding –September 2010 Event

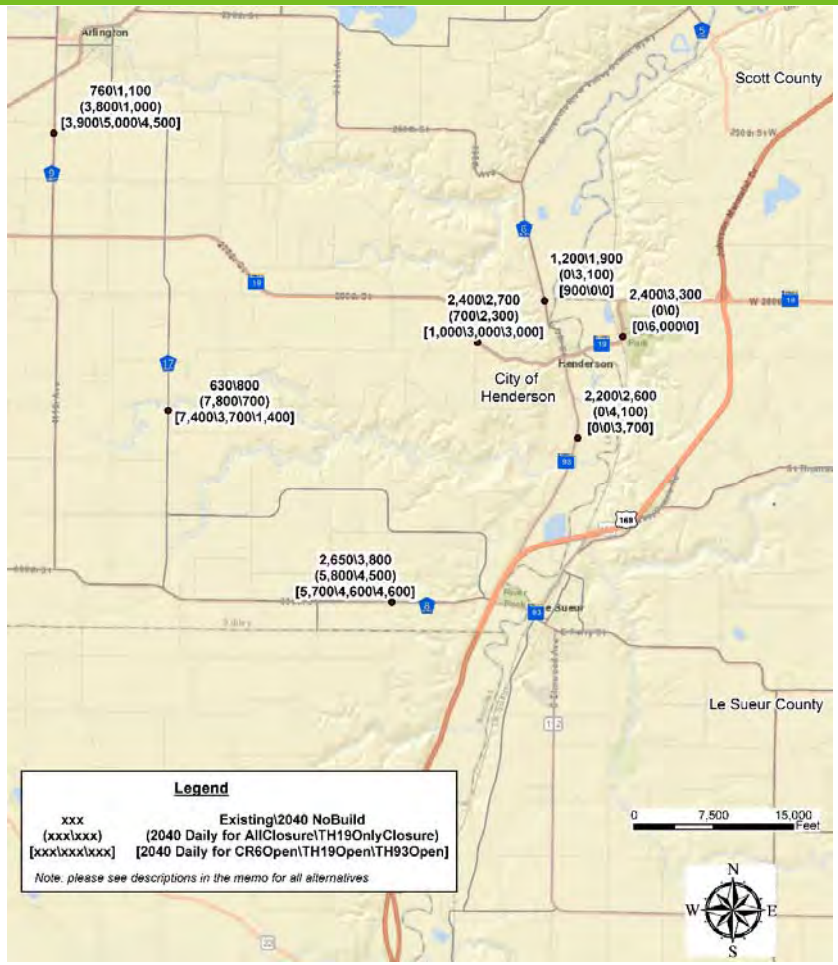


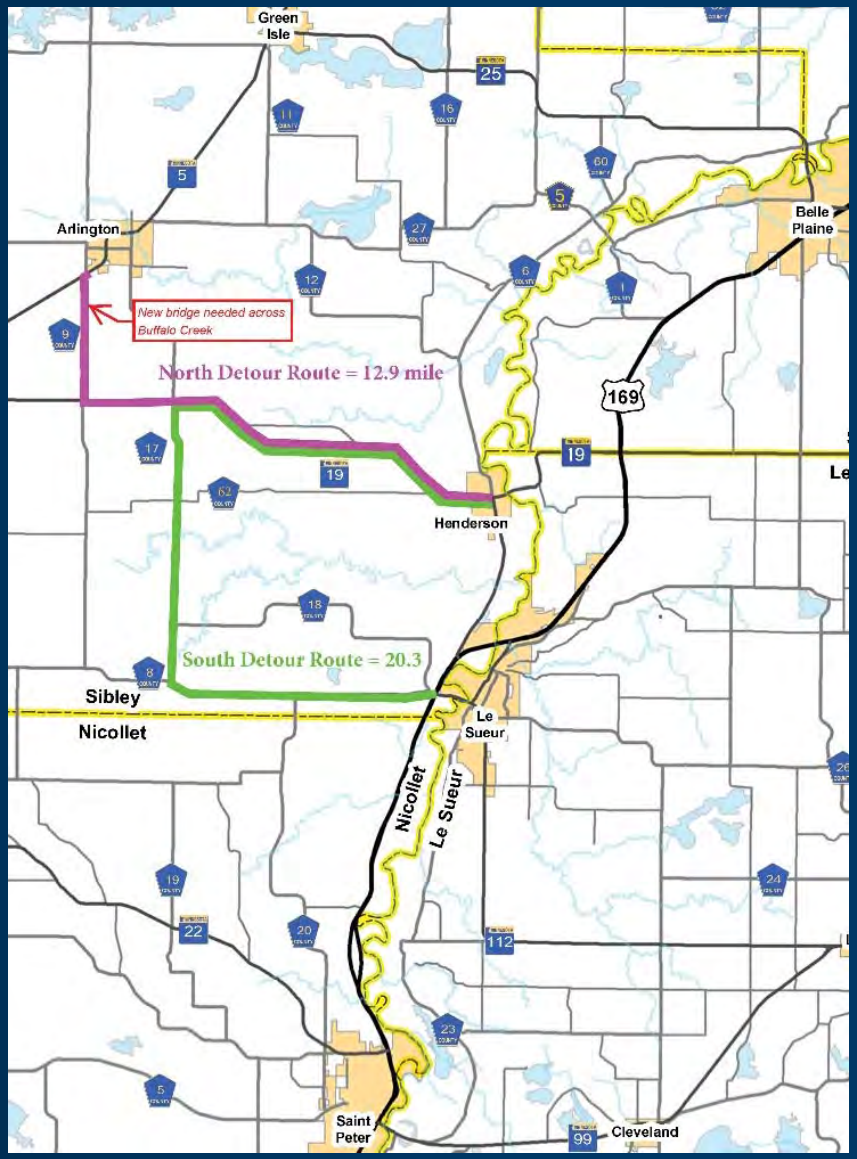
Road Elevations Below the 2010 Flood Elevation

- County Road 6 – Up to 7.4 feet of water over roadway
- Highway 19 – Up to 7.2 feet of water over roadway
- Highway 93 – Up to 7.1 feet of water over roadway

Traffic Modeling

- Utilized most recent version of the MnDOT's Collar County Travel Demand Model to develop forecast and traffic routing preferences during flood closures
- Model provides Vehicle Miles Traveled and Vehicle Hours Traveled for different scenarios
- When Highways 19, 93 and County Hwy 6 are closed, the value of the additional time and miles traveled is:
  $87,000 per day in todays dollars





Better Detour Route Alternative

- North route is 12.9 miles and uses County Highway 9
  Approximate Cost = $23.6 million
- South route is 20.3 miles and uses County Road 17 and 8
  Approximate Cost = $24.3 million
- Traffic modelling shows South route would be more highly utilized than the North (2 X)
- ***Costs are approximate and should only be used for relative comparison between alternatives***

Building a Better World for All of Us®

MINUTES

Henderson Flood Feasibility Study - Agency Meeting
May 23, 2017
10:00 a.m., SEH Office

Meeting Chair: Mark Benson

Minutes by: Bob Rogers

Present: See attached PMT meeting roster

Meeting Attendees: See attached meeting roster

I. Please Review Project Website for Background Information
   A. http://www.dot.state.mn.us/d7/projects/hwy19study/

II. Introductions

III. Scope: Study the feasibility of improvements to Highway 19, Highway 93 and County Highway 6 to reduce transportation disruption due to seasonal flooding
   A. An overview of the flood feasibility study was provided that summarized the purpose and process for studying roadway improvements in order to provide an alternative route in/out of Henderson during flood events along the Minnesota River. Three corridors were reviewed: TH 19, TH 93, and Sibley County Road 6.
   B. A Project Management Team (PMT) has met several times during the study process. The PMT consists of representatives from MnDOT, City of Henderson, and Sibley, Le Sueur, and Scott counties. The PMT has reviewed technical materials as well as provide guidance to SEH (consultant).
   C. The agency representatives discussed the various elements of the feasibility study and the preliminary findings/results.

IV. Historical Flooding
   A. Design Flood – Through the study process it was determined that the 2010 flood event would be used for the design flood event. This event closed all three roadways and was the highest flood event on record in Henderson. The 100-year flood elevation at Henderson according to FEMA is 740.5, but the DNR's hydraulic model (considered best available data) shows a 100-year flood elevation at Henderson of 739.9 because of the lower discharge rates. The 2010 flood level at Henderson was 740.1. River gage data was gathered from multiple gage stations including Henderson, Jordan, and Mankato. This data was used to estimate the frequency and closure of each of the roadways due to flooding of the Minnesota River.

V. Traffic Analysis & Benefit-Cost
   A. The feasibility study utilized MnDOT's Collar County Travel Demand Model for forecasting future trips throughout the regional transportation system. The model outputs used in the study included vehicle miles traveled (VMT) and vehicle hours travelled (VHT). The daily cost of closure when all three roadways are closed is approximately $87,000/day.
   B. VMT and VHT were then used in developing benefit-cost ratios for each alternative considered.

VI. Alternatives

A. Design Criteria – each alternative was designed at a minimum of 1-foot above the 2010 flood elevation. Existing roadway geometrics (lane and shoulder widths) would be replace in kind under each alternative, but the roadway improvements would be constructed to a 10-ton structural capacity.

B. TH 19 Alternative

1. Requires construction of a 2,680' long bridge over the Minnesota River floodplain. The improvement spans from the Henderson levee system on the west to the railroad bridge on the eastern edge of the floodplain. At its highest point, this alternative would raise of the roadway approximately 8.2 feet above the existing road elevation. The group discussed the costs and impacts associated with the TH 19 alternative. This alternative has the highest cost ($40 million), a 0.22 benefit-cost ratio, has the least amount of right of way acquisition, has the least amount of wetland impacts (2 acres), and restores the natural floodplain conditions with the removal of the existing TH 19 causeway.

2. The existing TH 19 Bridge was built in 1987 and currently has a debris problem during flood events.

3. The agency representatives indicated that this alternative was favorable as it would reestablish the natural floodplain conditions, and has the lowest amount of wetland impacts.

C. TH 93 Alternative

1. Requires up to eight feet of fill to raise the roadway above the 2010 design year flood event. The length of roadway to be reconstructed and raised is approximately 3.4 miles. This alternative requires the replacement of the Rush River Bridge. Cost of this alternative is $14 million, it has a B/C ratio of 0.45 (highest among the three options), requires 25 acres of new right of way, has 5 acres of wetland impacts, and requires mitigation to obtain a no rise condition for the Minnesota River profile. The proposed mitigation includes lowering portions of TH 19 east of Henderson to an elevation equal to the existing low point along the causeway.

2. The group discussed where the wetland impacts are likely to occur along TH 93 and whether there were design options to reduce wetland impacts.

3. The group discussed how the Rush River Bridge would need to be further analyzed to determine the optimal bridge length and any other improvements to minimize wash-outs and bluff/soil failures that have occurred along TH 93.

D. CSAH 6 Alternative

1. Requires raising the roadway by up to eight feet, costs approximately $16 million, requires 11 acres of right of way acquisition, 8 acres of wetland impacts, and the lowest B/C ratio at 0.12. The mitigation required to reach a "no rise" condition includes the removal of approximately 400,000 cubic yards of fill within the floodplain as well as lowering the CSAH 5 causeway across the Minnesota River near Blakeley. CSAH 5 was raised several feet back in 2002 to reduce roadway closures due to flooding.

E. Modeling Results – all alternatives, with proposed mitigation for TH 93 and CSAH 6, resulted in a "no rise" condition in both the HEC-RAS (1-dimensional) and SRH (2-dimensional) models. The group discussed several technical items related to the river modelling efforts.

1. A new USACE river model is being developed and will needed to be used in the future as a check for any alternative that is carried forward in the project development process.

VII. Public Open House

A. Held Tuesday, May 17 from 5 p.m. to 7 p.m. Attended by approximately 50-60 individuals.

B. Feedback – most people in attendance recognized the issue with the river flooding limiting access to/from Henderson and the social and economic impacts the roadway closures have on the

community. Verbal comments were received that stated preferences for a particular alternative with the greatest support for the TH 19 alternative.

VIII. Agency Input

A. The agency representatives also discussed future requires for several items including: possible need for a LOMR, Public Waters Permit, T&E species, LEDPA, and environmental review requirements.

IX. Next Steps – following this agency coordination meeting, the PMT will meet again in June 2017 to discuss the public and agency input received in May. A draft Feasibility Study Report is planned to be complete in July and distribution of the final report in early fall 2017. There is currently no funding for any flood mitigation improvements along any of these three corridors.

SEH believes that this document accurately reflects the business transacted during the meeting. If any attendee believes that there are any inconsistencies, omissions or errors in the minutes, they should notify the writer at once. Unless objections are raised within seven (7) days, we will consider this account accurate and acceptable to all.

If there are errors contained in this document, or if relevant information has been omitted, please contact Mark Benson, SEH Project Manager at 651-490-2194.

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SEH ATTENDANCE ROSTER – PROJECT MANAGEMENT TEAM

Re: Henderson
Flood Mitigation Study

Project Manager: Mark Benson

Date of Meeting: May 23, 2017
Time of Meeting: 10:00 am

Location: SEH Office
SEH No.: MNT07 135877

Present	Name	Representing	E-mail	Phone
✓	Matthew Young	MnDOT	matthew.young@state.mn.us	507-304-6183
✓	Nicole Bartelt	MnDOT	nicole.bartelt@state.mn.us	651-366-4474
✓	Mark Benson	SEH PM	mbenson@sehinc.com	651-490-2194
✓	Bob Rogers	SEH Planner	brogers@sehinc.com	
✓	Rachel Pichelmann	SEH Water R.	rpichelmann@sehinc.com	651-724-8245
–	Nick Tiedeken	MnDOT	NICKOTIEDEKEN@state.mn.us	651-366-3628
✓	Sarma Straumanis	MnDOT	sarma.straumanis@state.mn.us	651-366-3636
✓	Peter Leete	MnDNR	peter.leete@state.mn.us	651-366-3634
✓	Rita Weaver	MnDNR	rita.weaver@state.mn.us	651-259-5802
✓	Garry Bennett	MNDNR	garry.bennett@state.mn.us	320-234-2550 x 230

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Appendix B

2D Hydraulic Modeling Memorandum

DEPARTMENT OF TRANSPORTATION

Memo

Bridge Office
Mail Stop 610
3485 Hadley Avenue North
Oakdale, MN 55128-3307

Office Tel.: 651/366-4500
Fax: 651/366-4509

Date: June 19, 2017

To: Matt Young
Project Manager, Henderson Flood Feasibility Study

From: Nicole Bartelt
Hydraulics Design Engineer

Subject: S.P. 4004-124 Henderson Flood Mitigation Feasibility Study
Sibley County, City of Henderson
2-Dimensional Hydraulic Modeling: Alternative Concept Analysis

Summary

This analysis summarizes the 2-dimensional (2D) hydraulic modeling development and results for the Henderson Flood Mitigation Feasibility Study. Three alternative design concepts were analyzed for the 100-yr flood condition. This analysis supplements the Hydraulic Memo by SEH, Inc. dated June 19, 2017. The SEH Hydraulic Memo summarizes the overall hydraulic modeling effort, including the 1-dimensional HEC-RAS model, hereafter referred to as the "HEC-RAS model". Details of the alternative design concepts can be found in the SEH Hydraulic Memo, and will be further documented in the Henderson Flood Mitigation Feasibility Study Report (to be published in Fall 2017).

Background

The Minnesota River was formed when the Glacial River Warren drained the Glacial Lake Aggasiz around 10,000 years ago. The River Warren carved out a very wide river valley, within which the current (much smaller river by comparison), meanders through. The Minnesota River migrates and moves throughout the floodplain, and roads and bridges have to cross that floodplain to connect both sides. Until recently, most hydraulic modeling of rivers and waterways has been done within 1-dimensional (1D) modeling schemes. Where the model only describes the water surface changes along a river profile, and cannot determine differences across the river or floodplain at any given cross section. In many cases, this is a perfectly good representation of the river. However, when trying model wide floodplains, road and bridge crossings that are skewed (not perpendicular) to the river, or roads with multiple bridge and culvert crossings, 1D models

are ill-equipped to represent those hydraulic conditions, where the conditions do change across the floodplain or cross section. 2-dimensional (2D) models work differently, as they can describe hydraulic conditions both along the floodplain/river, and across the floodplain (in two-dimensions). Due to the wide floodplain and sinuosity of the Minnesota River, and complicated river crossings, a 2D model is a better representation of the hydraulic conditions, especially when used in concert with 1D hydraulic modeling efforts.

Model Development

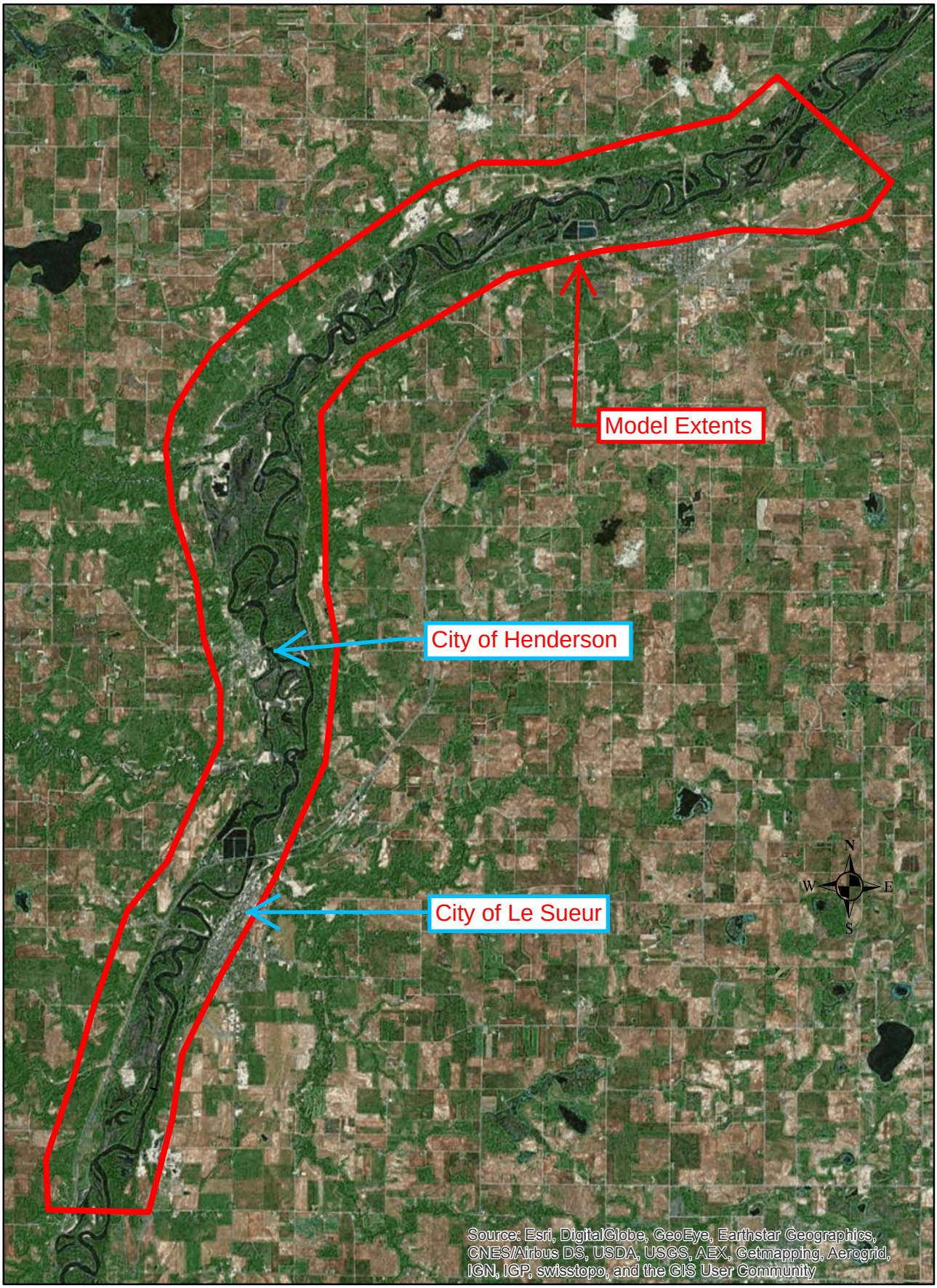
The 2D model chosen for this analysis was the Sediment and River Hydraulics – Two-Dimensional model (SRH-2D). This model was developed by the Bureau of Reclamation, is fully supported by the Federal Highway Department (FHWA), and is a Federal Emergency Management Agency (FEMA) accepted model for regulatory flood modeling. The model is run within the Surface water Modeling Software program (SMS), which provides pre and post processing tools and a graphical user interface.

Model Domain and Mesh Generation

The model extent is from approximately 3-miles downstream of Belle Plaine to 5.8-miles upstream of Le Sueur and covers approximately 31-miles of the Minnesota River. The key areas of interest were around the City of Henderson, City of Blakeley, and between Henderson and the Highway 169/Highway 93 interchange near the City of Le Sueur. The model boundary conditions were set far enough up and downstream to not allow influence of the boundary conditions on the areas of interest and vice versa. Figure 1 shows the model domain/extent.

A hybrid or flexible mesh was developed using a variety quadrilateral and triangular elements. Using a flexible mesh (to have different shapes of elements) is one of the advantages of the SRH-2D model. More mesh detail was included along the river and roadways, with less detail in open floodplain areas. Figure 2 shows a portion of the mesh generated near the City of Henderson, overlaid on top of an aerial image and the digital elevation model (DEM).

Figure 1: 2D Model Extent
Henderson Flood MitigationStudy



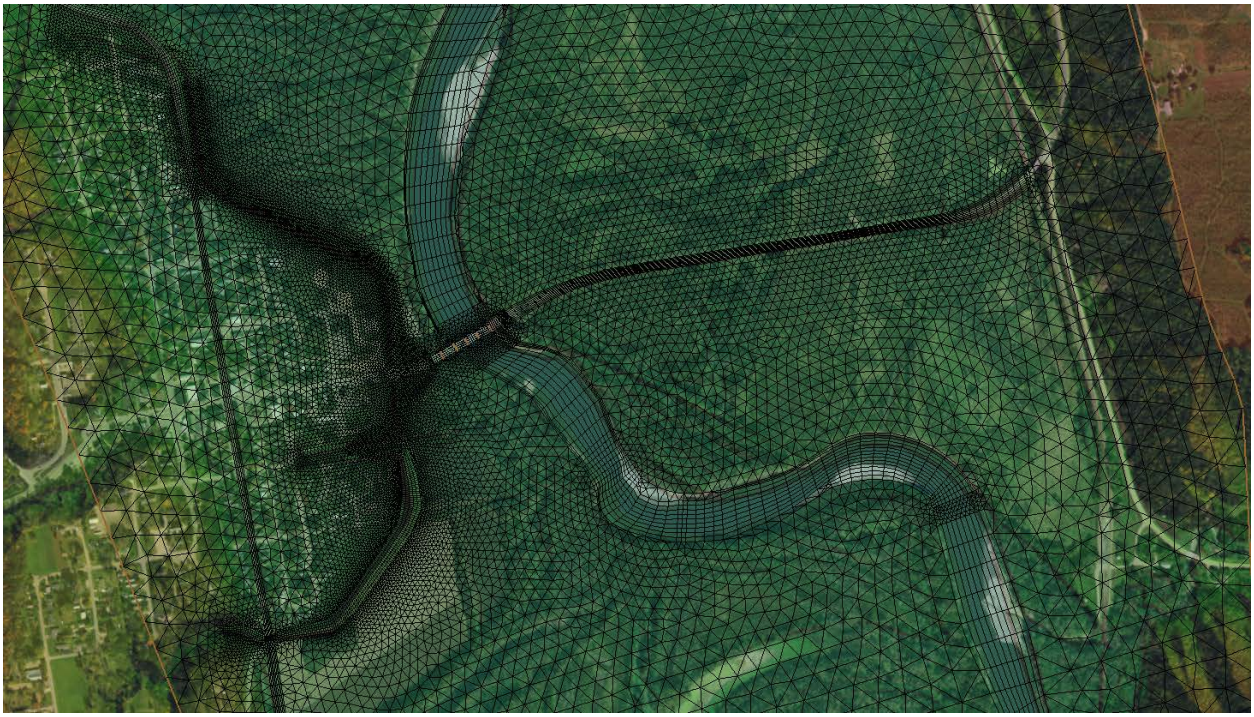


Figure 2: Mesh detail near the City of Henderson

Hydrology
The SRH-2D used the same hydrology (flowrates) as the HEC-RAS model. See the SEH Hydraulic Memo dated June 19, 2017 for further information. The model was run to a steady-state condition, with a constant inflow boundary condition.

Projection / Datum
This model set-up in UTM Zone 15N coordinates. Any data sets brought into the model were projected to UTM Zone 15N. The vertical datum for this model is the North American Vertical Datum of 1988 (NAVD88).

Boundary Conditions
The upstream boundary condition was set using flowrates from the US Army Corps of Engineers (USACE) updated Minnesota River Hydrologic Study, dated October 2001. The HEC-RAS model similarly used those flowrates. Additional inflow boundary locations were set at 4 major tributaries, again to match with the USACE hydrologic study and HEC-RAS model.

The downstream boundary was set using the 100-yr water surface elevation from cross section 25 of the Scott County FIS HEC model (Elevation = 728.5, NAVD88).

Topography / Elevation datasets
The topography of the floodplain was primarily obtained using the 3-meter digital elevation model (DEM) provided from the MnTopo website (http://arcgis.dnr.state.mn.us/maps/mntopo/). This is a subset of the statewide lidar dataset collected and processed for the MnDNR. A 1-meter DEM was used for the area immediately surrounding and including the City of Henderson for further detail.

This lidar dataset does not include bathymetric information, as lidar is generally cannot penetrate below water. Lidar was collected on April 22, 2010, when the river level was up around a 2-year event water surface elevation. Bathymetry was supplied or supplemented as follows. MnDOT collected bathymetry for approximately a 0.7-mile reach of the Minnesota River, equally distributed up and downstream of the Highway 19 crossing. For the rest of the river, a representative channel was "burned-in" into the lidar dataset in ArcMap. The representative channel was determined from reviewing the HECRAS model cross section and the cross sectional area for a 2-year event.

The levee closure points at Henderson were entered directly into the mesh generator, where the mesh elements at the closure points were assigned a constant elevation.

For the proposed alternative concepts, tin models from the designer were converted into scatter datasets and imported into the model.

Figure 3 is a close-up of the elevation datasets near the City of Henderson. Figure 4 shows the elevation datasets overlaid on top of an aerial image of the model domain.

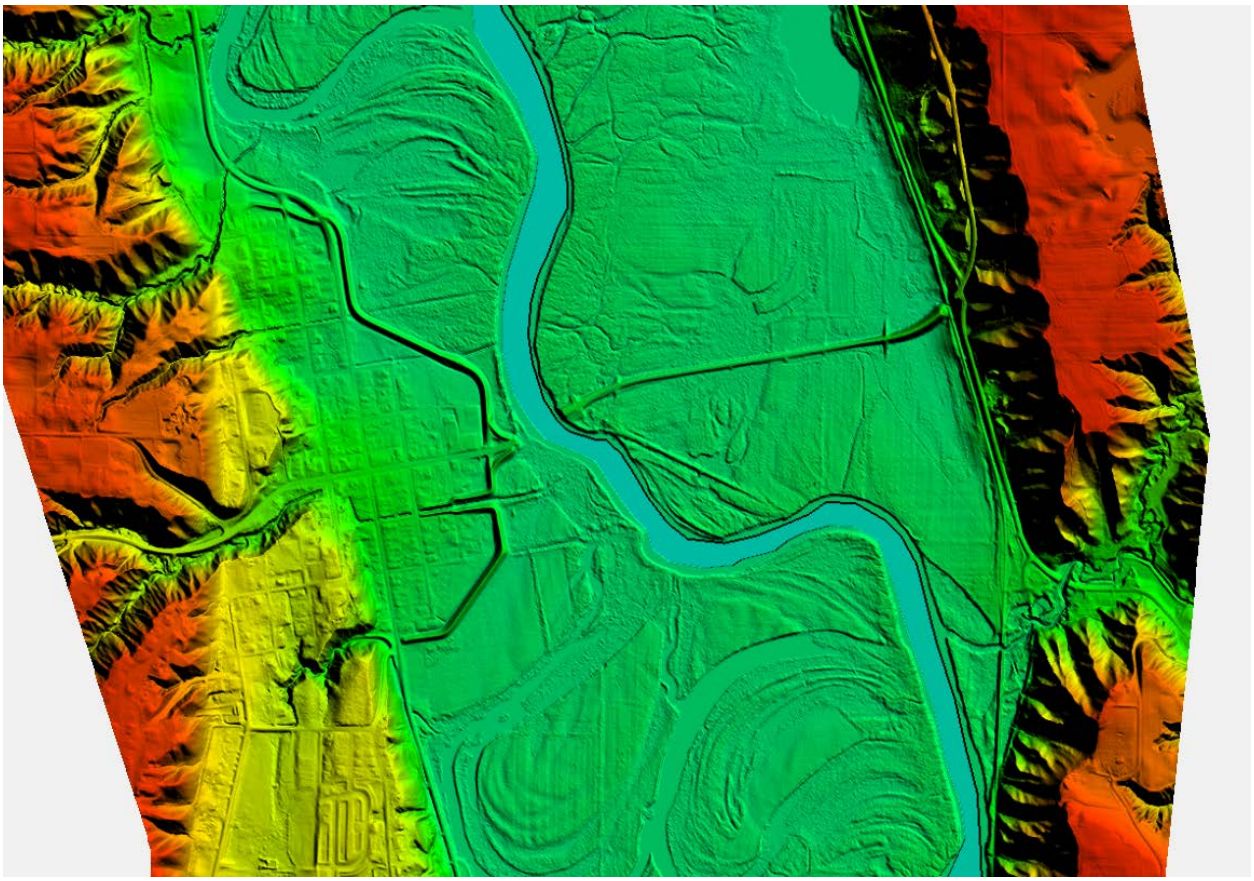


Figure 3: Elevation datasets near the City of Henderson

Figure 4: Elevation datasets over aerial image

Materials coverage

The materials overage was delineated using aerial photography and the National Land Cover Database. Manning's roughness (n) values were estimated for each cover type using the inplace FIS values, typical manning's n values for the delineated land cover types (i.e. channel) and

modeling experience. Values were adjusted during model calibration. Material properties used for the 100-yr event are shown below in Table 1. A portion of the materials coverage near the City of Henderson is shown in Figure 5.

Table 1: Material Properties

Material Name	***Manning's Roughness Value (n-value)***
Open water	0.035
Channel	0.03
Woody wetlands	0.09
Developed	0.02
Road	0.022
Forest	0.11
Pasture/Hay	0.045
Crops	0.04
Veg Floodplain (not forested)	0.06
Upland mixed veg	0.06
Open Pit	0.02

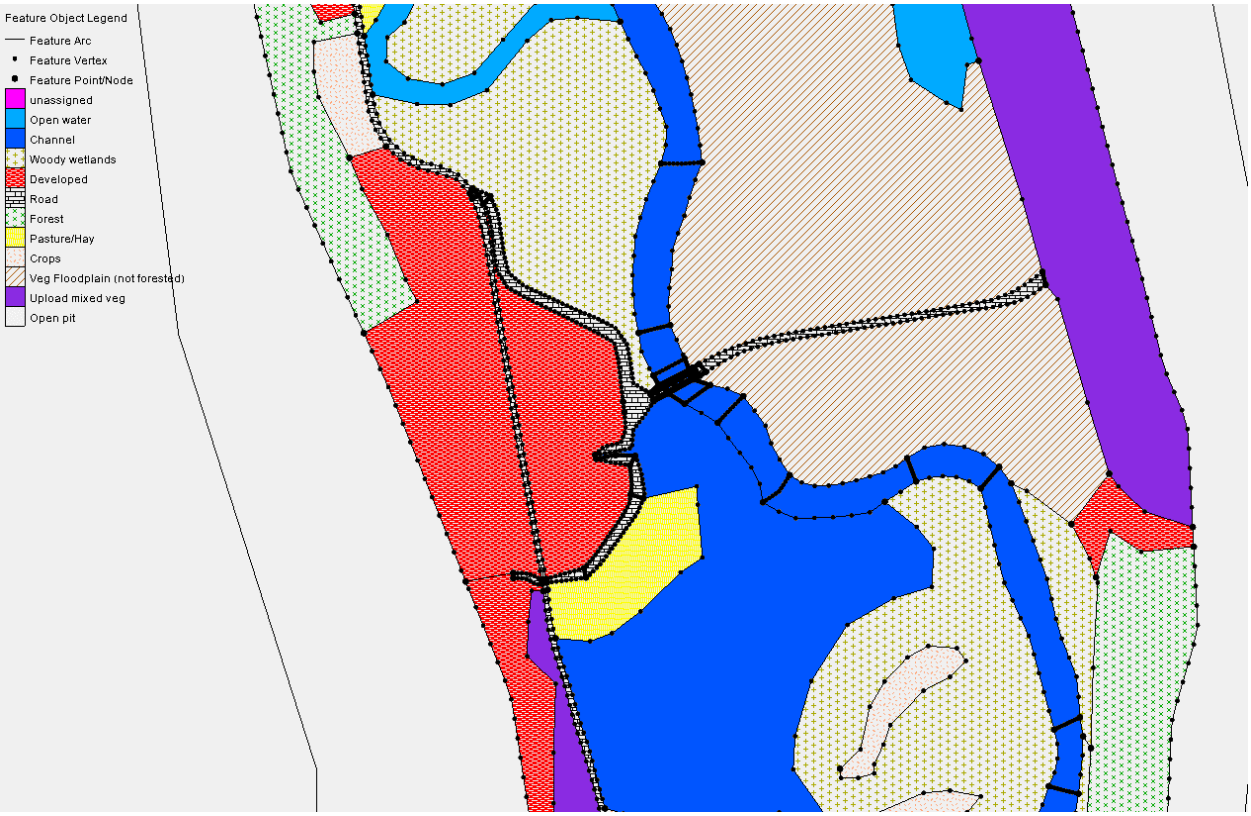


Figure 5: Material coverage near City of Henderson

Model calibration

The model was validated against and correlated well to the HEC-RAS model. Although the regulatory event is the 100-yr event, the design event was the Fall 2010 water surface profile. The model was calibrated to the Fall 2010 water surface elevations, by adjusting the manning's n values

for various cover types. Boundary conditions during that calibration run were adjusted to estimated Fall 2010 event flowrates.

1D vs. 2D modeling results

Table 2 shows the results of the HEC-RAS vs. SRH2D models for the existing 100-yr condition, taken along the main channel of the Minnesota River. There was substantial agreement between the two models, with the exception of immediately upstream of the Co Hwy 5 Bridge at Blakely. The primary area of focus was near Henderson (for calibration and comparison).

Table 2: Comparison HEC-RAS vs. SRH-2D, Existing Conditions, 100-yr event

Location Description	HEC-RAS River Station	HEC-RAS 100-yr WSEL	SRH-2D 100-yr WSEL
Hwy 25 – Belle Plaine	33	731.18	731.4
High Island Creek	58	738.29	738.9
Hwy 19 – Henderson	69	740.27	740.21
Hwy 169 – Le Sueur	83	744.4	744.32

All elevations given in NAVD88 (HEC-RAS model results converted from NGVD29. NAVD88 = NGVD29+0.12ft)

Existing Model Results

The model was run to simulate flooding for the 100-yr flood event under the existing conditions. The existing model results provide the basis for comparison to the concept alternatives modeling results. The 100-yr water surface elevation contour map is shown below in Figure 6. An inset of the 100-yr water surface elevation contours with velocity vectors is shown in Figures 7-9.

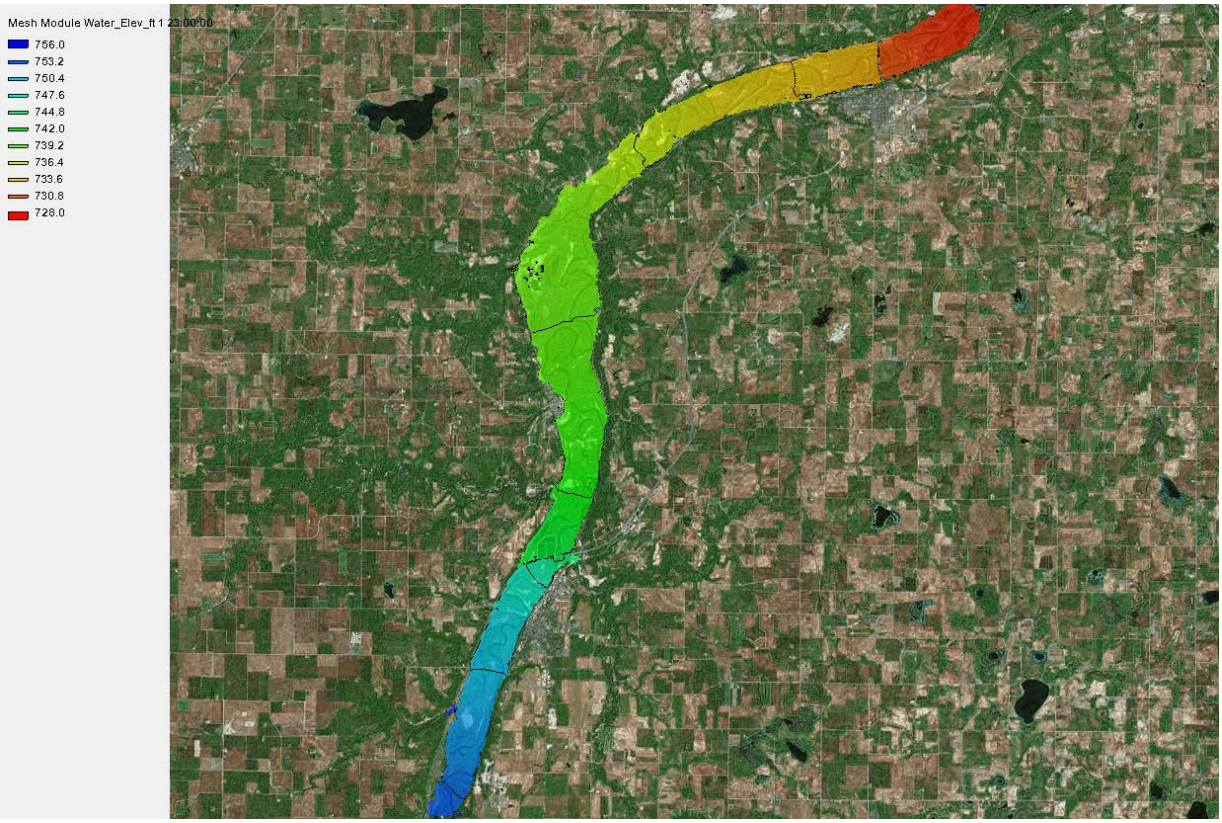


Figure 6: Existing Condition 100-yr water surface elevation contour map

Figure 7: Close-up at Hwy 19 of Existing Condition 100-yr water surface contour with velocity vectors.

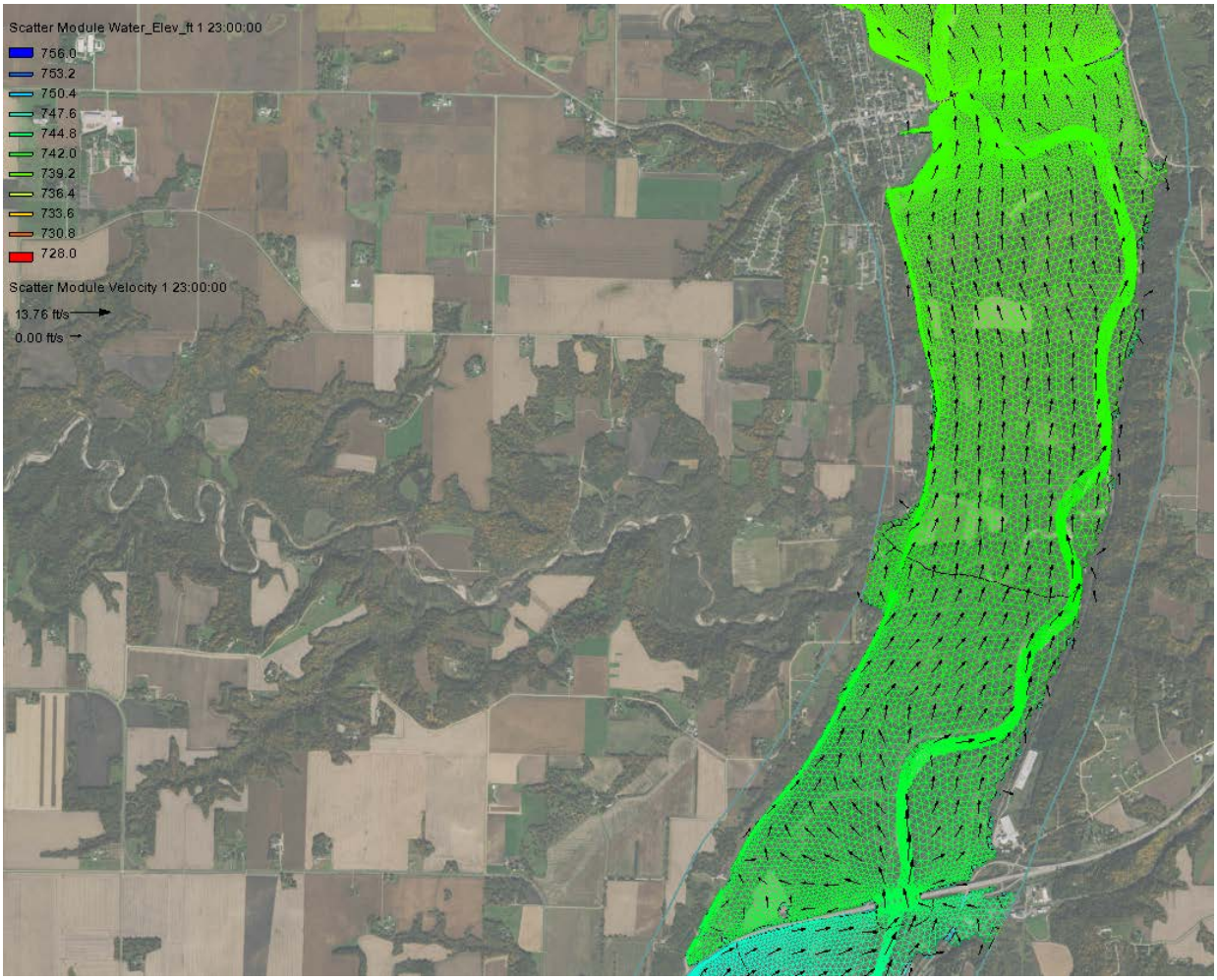


Figure 8: Close-up between Hwy 19 and Hwy 169 of Existing Condition 100-yr water surface contour with velocity vectors.

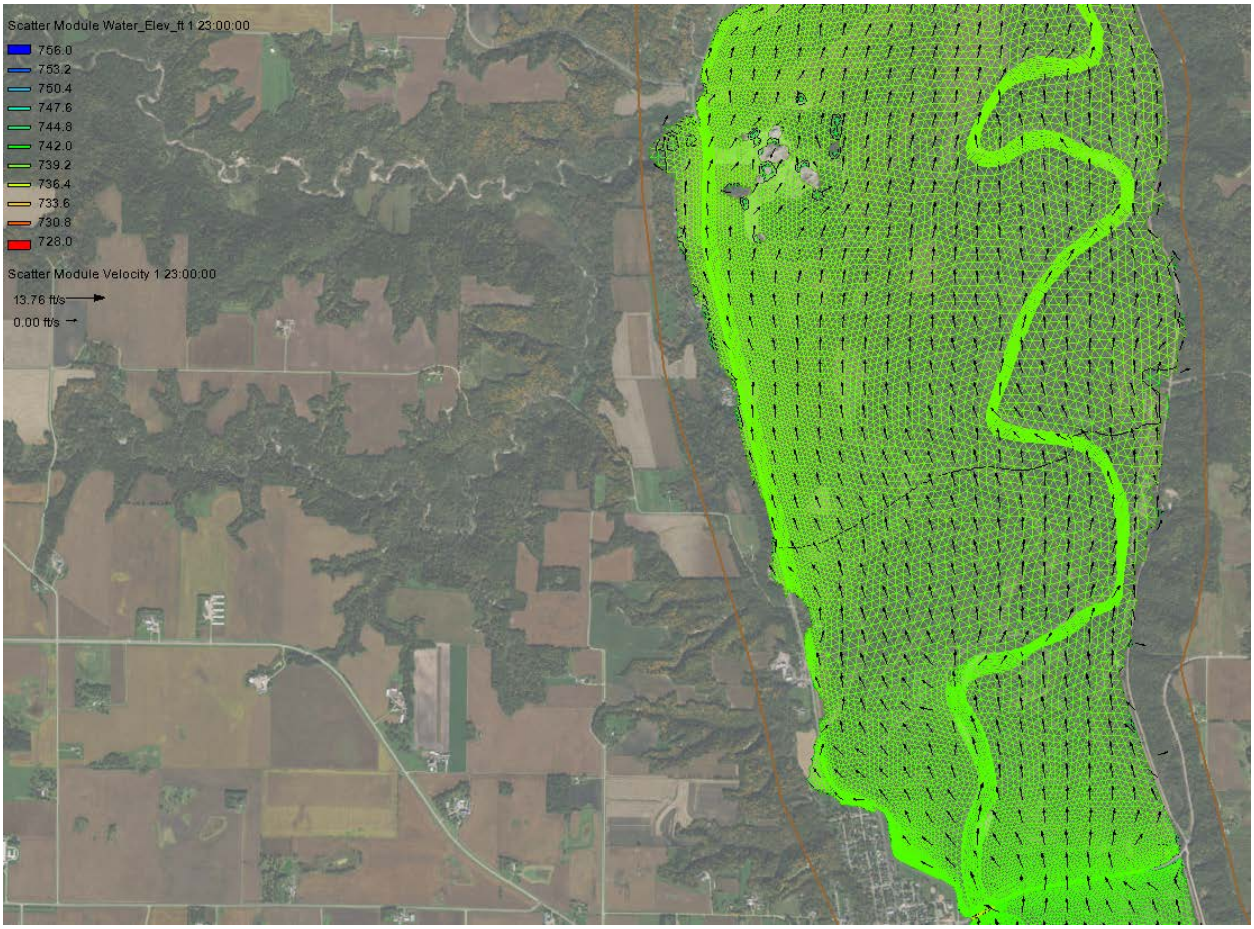


Figure 9: Close-up between Co Rd 6 and Hwy 19 of Existing Condition 100-yr water surface contour with velocity vectors.

Proposed Highway 19 Alternative Model Results

The proposed Highway 19 alternative is to raise Highway 19 above the Fall 2010 water surface elevations, using a land bridge which spans the main channel and most of the floodplain. A total bridge length of 2680-ft was required to satisfy the "no rise" criteria (0.00' rise in water surface elevation above existing water surface elevation). More details can be found in the SEH Hydraulic Memo dated June 19, 2017. The proposed Highway 19 alternative water surface contours for the model extent and at Hwy 19 are shown below in Figures 10 and 11.

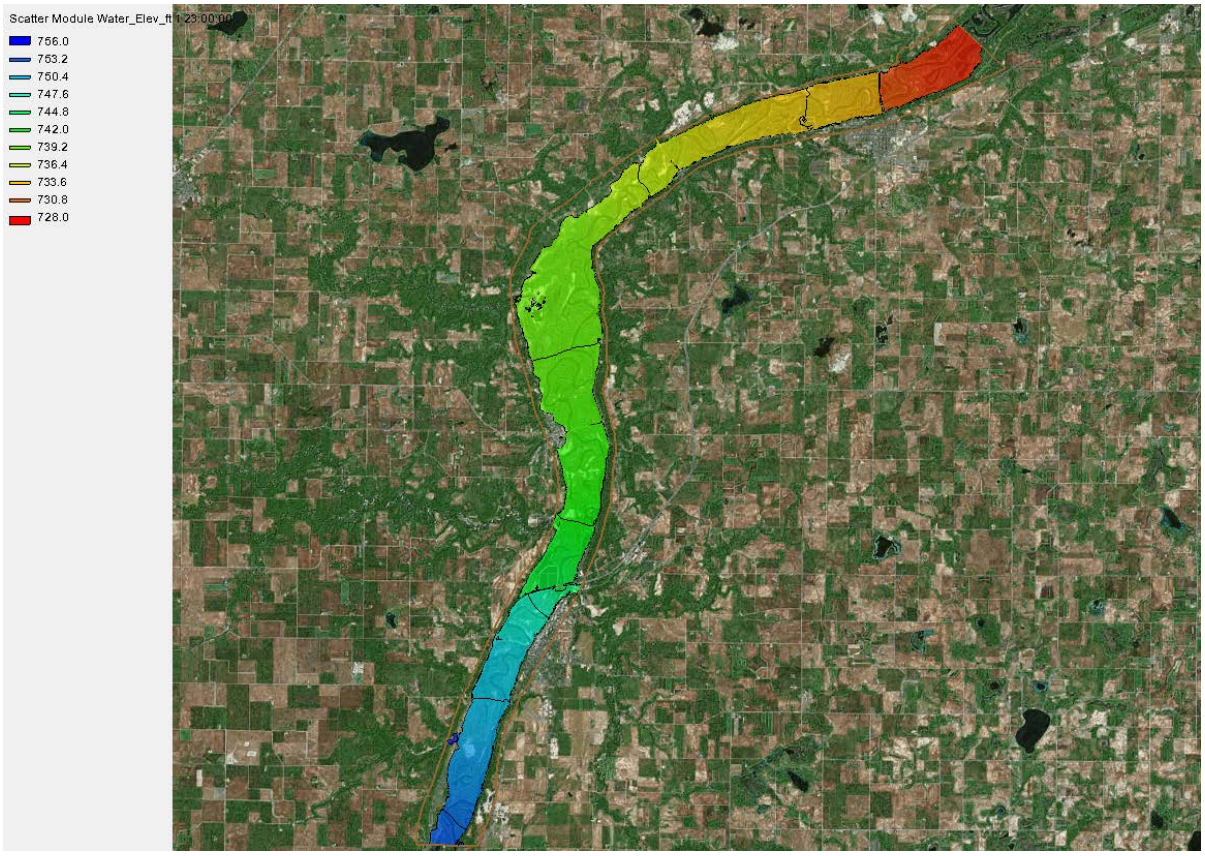


Figure 10: Proposed Hwy 19 alternative, 100-yr water surface elevation contour map

Figure 11: Close-up at Hwy 19 of Proposed Hwy 19 alternative, 100-yr water surface contour with velocity vectors.

Proposed Highway 93 Alternative Model Results

The proposed Highway 93 alternative is to raise Highway 93 above the Fall 2010 water surface elevations, and then mitigate the water surface elevation increase by "shaving down" approximately 1500' of Highway 19 to match the inplace Highway 19 low point elevation. More details can be found in the SEH Hydraulic Memo dated June 19, 2017. The proposed Highway 93 alternative water surface contours for the model extent and between Highway 19 and Highway 169 are shown below in Figures 12 and 13.

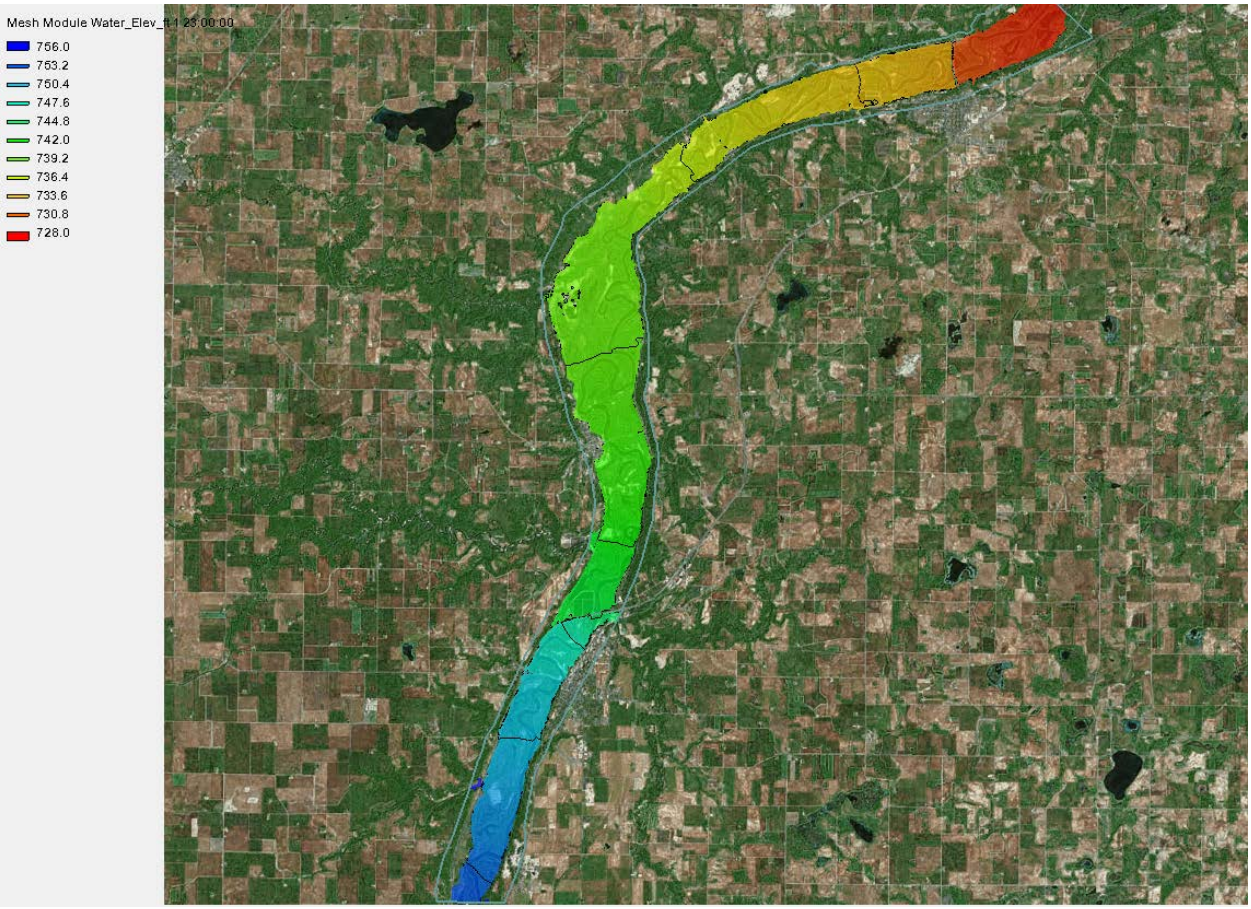


Figure 12: Proposed Hwy 93 alternative, 100-yr water surface elevation contour map

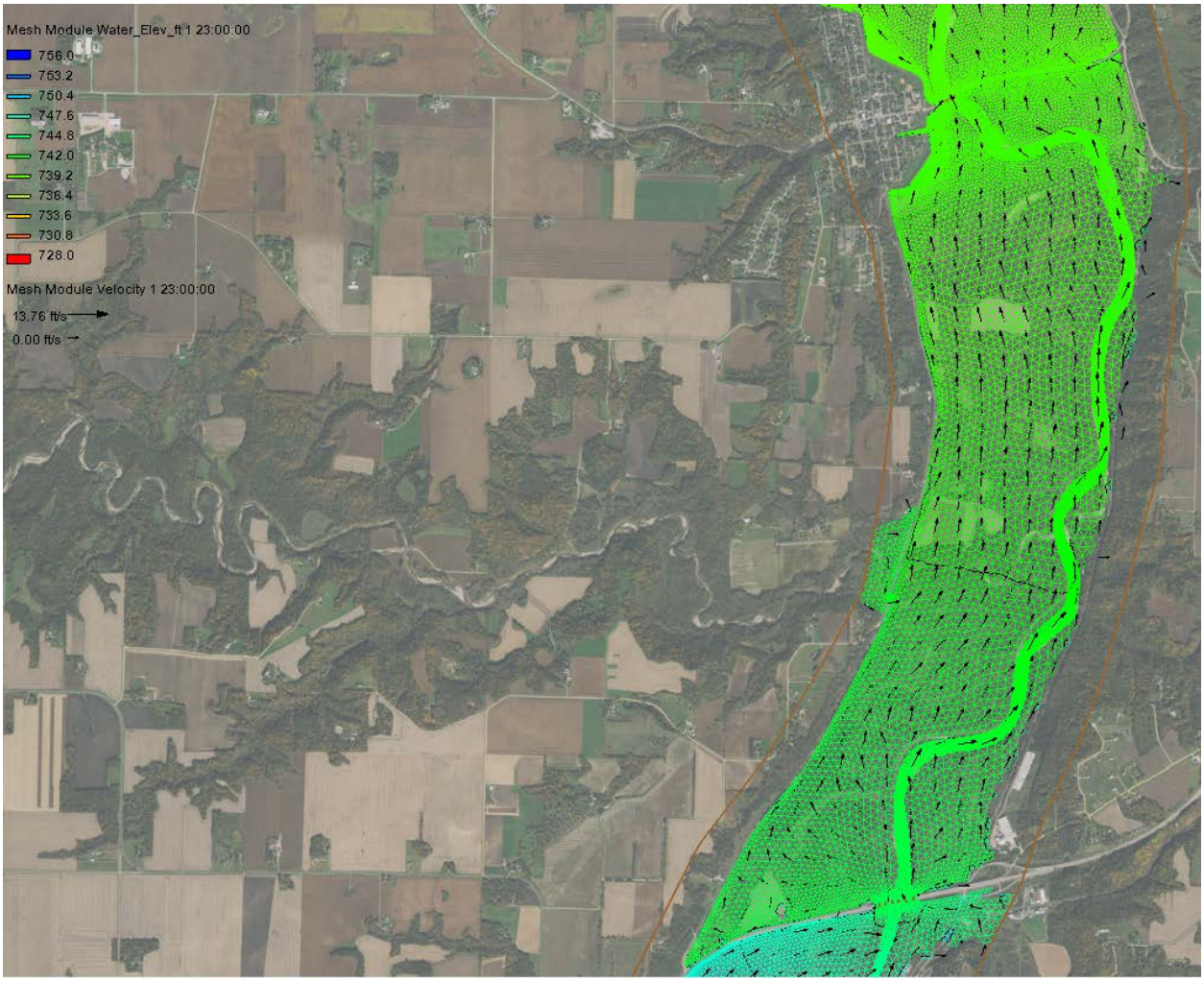


Figure 13: Close-up between Hwy 19 and Hwy 169 of Proposed Hwy 93 alternative, 100-yr water surface contour with velocity vectors.

Proposed County Road 6 Alternative Model Results

The proposed County Road 6 alternative is to raise Co Rd 6 above the Fall 2010 water surface elevations, and mitigate the water surface elevation increase in two ways. Proposed mitigation includes excavation of fill from within the floodplain (approximately 21,360 cyds) and lowering a portion of Co Rd 5. Further refinement of this mitigation option may allow for less excavation in the floodplain upstream of CSAH 5. Due to constraints of the HEC-RAS model, this proposed alternative was only analyzed in the SRH-2D model. More details can be found in the SEH Hydraulic Memo dated June 19, 2017. The proposed County Road 6 alternative water surface contours for the model extent and between Co Rd 6 and Highway 19 are shown below in Figures 14 and 15. This alternative as described meets the “no rise” criteria.

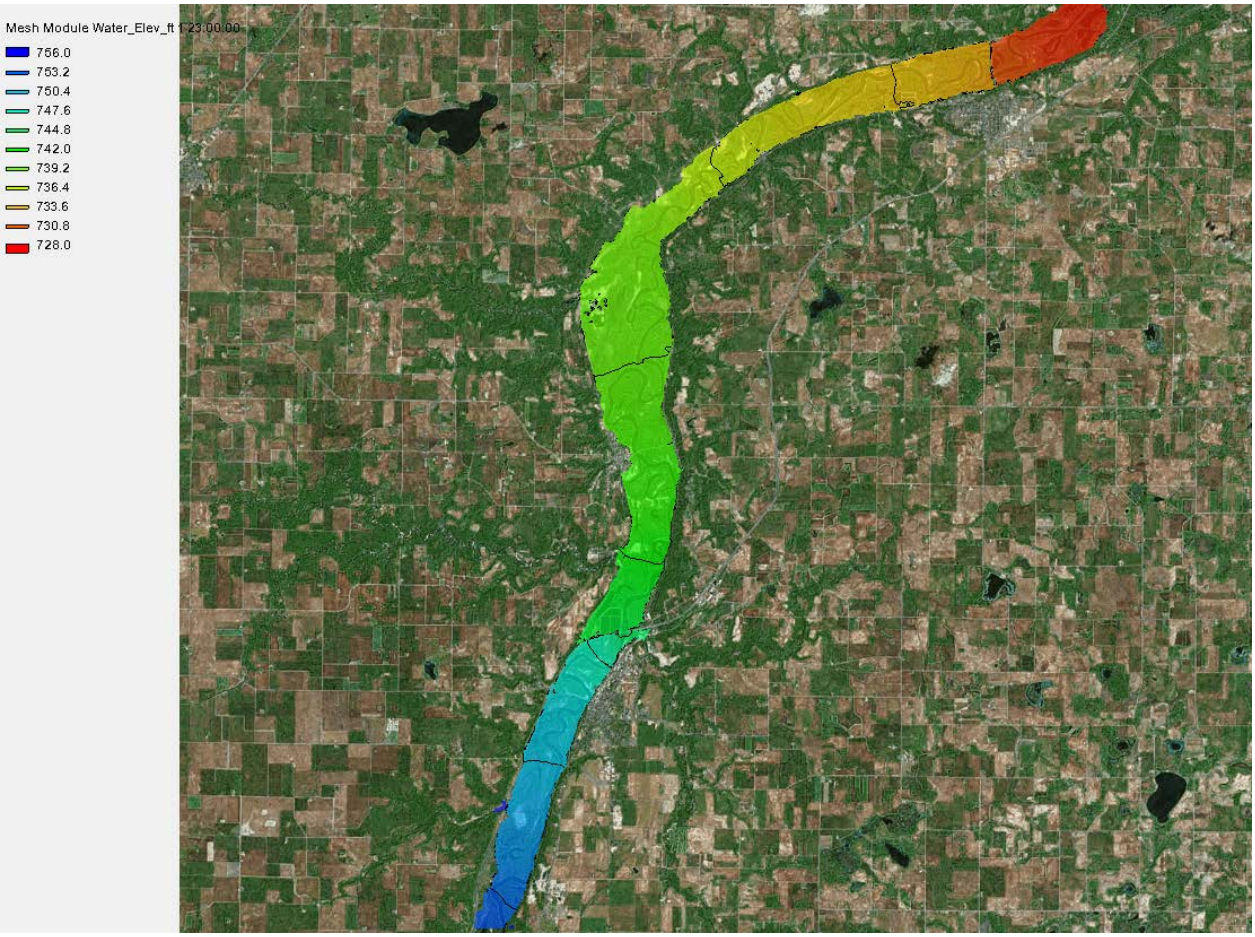


Figure 14: Proposed Co Rd 6 alternative, 100-yr water surface elevation contour map

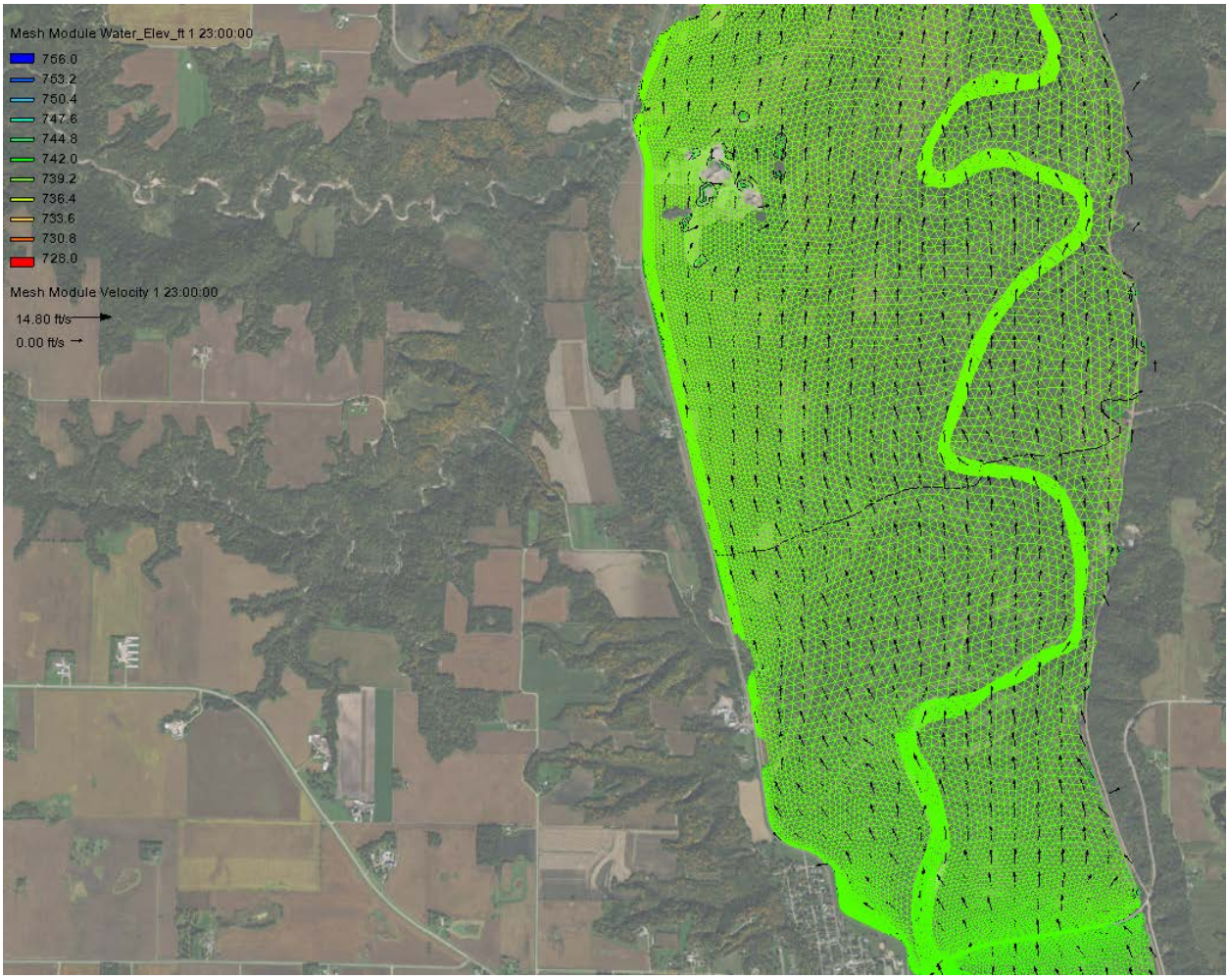


Figure 15: Close-up between Co Rd 6 and Hwy 19 of Proposed Co Rd 6 alternative 100-yr water surface contour with velocity vectors.

Summary and Conclusions

Each of the three concept alternatives, can provide a roadway alternative above the Fall 2010 water surface elevations, while meeting a "no rise" condition for the 100-yr event. A summary of the 2D modeling results with animation film loops of flood inundation and flow vectors is available online at https://youtu.be/zjypv7EXnMw. Further hydraulic modeling and alternative refinements will be necessary if and when a full design project progresses.

cc: M. Benson – SEH, Inc.
A. Hendrickson – State Hydraulics Engineer
P. DeWall – State Waterway Engineer
S. Morgan - District Hydraulics Engineer
P. Leete- DNR Liaison

Appendix C

Traffic Forecast Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Mark Benson, PE, Project Manager

FROM: Haifeng Xiao, PE

DATE: April 20, 2017

RE: Henderson Flood Mitigation Study: Traffic Forecast and Analysis
SEH No. MNT07 139855 4.00

PROJECT OVERVIEW

Flooding in the Minnesota River Valley has created mobility concerns for decades for local communities including the City of Henderson. In response to the concerns, Minnesota Department of Transportation District 7 hired SEH Inc. in late 2016 to conduct the Henderson Flood Mitigation Feasibility Study (SP 4004-124). This study included analyzing a range of alternatives which lower the flood risk for three major roadways in Henderson: Trunk Highway 19 (TH 19) east of Henderson, Trunk Highway 93 (TH 93) south of Henderson, and Sibley County Road 6 (CR 6) north of Henderson. The limits of the study, and the portions of the flood prone roadways are shown in the attached **Figure 1**.

This memorandum documents the traffic forecast methodology and analysis results for no-build and different flooding and build alternatives developed for the study.

STUDY ALTERNATIVES AND TRAFFIC FORECAST METHODOLOGY

A number of alternatives were analyzed for this study. The traffic analysis year is 2040 and the traffic analysis alternatives are described as following (closure roadways are illustrated in **Figure 1**):

- No-Build: no roadway closure, base alternative for comparison purpose.
- All-Closure: TH 19 MN River Bridge, CR 6, TH 93, TH 93 East and CR 5 MN River Bridge are closed
- TH 19 Only Closure: TH 19 MN River Bridge Closed with all others open
- CR 6 Open (Build): TH 19 MN River Bridge, TH 93, TH 93 East and CR 5 MN River Bridge are closed
- TH 19 Open (Build): CR 6, TH 93, TH 93 East and CR 5 MN River Bridge are closed
- TH 93 Open (Build): TH 19 MN River Bridge, CR 6, TH 93 East and CR 5 MN River Bridge are closed

It is noted that the first three alternatives (No-Build, All-Closure and TH 19 Only Closure) were included for traffic analysis as they were required for subsequent benefit cost analysis as compared scenarios due to different flooding closure events.

Credible traffic forecasts and corresponding Vehicle-Hours-Travelled (VHT) and Vehicle-Miles-Travelled (VMT) are critically important in determining road user benefits and costs for each alternative compared with the no-build and flooding alternatives. The latest Collar County Model has incorporated the most recent Thrive 2040 MSP and

it was recently refined in the Scott County area and thus named as the Scott County Model (SCM). We used the SCM to conduct traffic forecast and analysis for this study to achieve consistent results among different alternatives. The traffic forecast and analysis followed the steps below:

1. The base and 2040 networks in the SCM were refined to include major roadways and traffic analysis zones (TAZs) in the study area. The refined roadway networks and subarea TAZs are illustrated in the attached **Figure 2**.
2. The 2010 and 2040 socio-economic data in the SCM TAZs were reviewed and they remained unchanged for this study. However, the 2010 and 2040 SE data were re-allocated proportionally to the subdivided TAZs based on corresponding 2010 census data to develop the subarea model for this study.
3. The base 2010 and 2040 no-build subarea models were run to obtain the daily traffic outputs on major roadway segments as well as VMTs and VHTs within the influencing area bounded by TH 22 (West), US 212 (North), TH 21/TH 13 (East) and County Boundaries (South, model limits).
4. The 2010 and 2040 subarea model networks were revised accordingly to reflect different flooding and build alternatives as described previously and were rerun to obtain their daily traffic outputs on major roadway segments and VMTs and VHTs within the same influencing area.
5. The 2010 and 2040 VMTs and VHTs were directly provided for subsequent benefit cost analysis, considering the fact that the VHTs and VMTs benefits for any build alternative are calculated based on the relative changes to the no-build alternative.
6. The 2040 model daily traffic outputs on major roadways were adjusted to develop the final traffic forecasts based on differences between the 2010 base model daily outputs and actual counts to account for modeling errors.
7. All the daily traffic forecasts and VMTs and VHTs for different alternatives were reviewed for reasonableness based on engineering judgment.

TRAFFIC FORECASTS RESULTS

Following the methodology and steps described in the previous section, the resulting VHTs and VMTs are summarized in **Table 1**.

Table 1 – Subarea Daily VMTs and VHTs for Different Alternatives

Alternative	2010			2040		
	VMT	VHT	Speed	VMT	VHT	Speed
No-Build	2,082,087	46,467	44.81	3,412,480	81,301	41.97
All-Closure	2,158,803	48,569	44.45	3,481,211	84,385	41.25
TH 19 Only Closure	2,086,199	46,690	44.68	3,415,166	81,640	41.83
CR 6 Open (Build)	2,145,399	48,307	44.41	3,465,673	84,095	41.21
TH 19 Open (Build)	2,115,395	47,466	44.57	3,443,151	82,952	41.51
TH 93 Open (Build)	2,111,526	47,513	44.44	3,437,863	83,170	41.34

Note: the subarea bounded by TH 22 (West), US 212 (North), TH 21/TH 13 (East) and County Boundaries (South, model limits).

The exiting and forecasted daily traffic volumes for major roadways are summarized in **Table 2** and also illustrated in the attached **Figure 3**.

Table 2 – Existing and Forecasted 2040 Daily Traffic Volumes for Different Alternatives

Segment	2014 ADTs	2040 Alternative					
		No-Build	All-Closure	TH 19 Only Closure	CR 6 Open	TH 19 Open	TH 93 Open
CR 6	1,200	1,900	0	3,100	900	0	0
TH19 West	2,400	2,700	700	2,300	1,000	3,000	3,000
TH19 East	2,400	3,300	0	0	0	6,000	0
TH93 South	2,200	2,600	0	4,100	0	0	3,700
CSAH 9 North of TH 19	760	1,100	3,800	1,000	3,900	5,000	4,500
CSAH 17 South of TH 19	630	800	7,800	700	7,400	3,700	1,400
CSAH 8 West of US 169	2,650	3,800	5,800	4,500	5,700	4,600	4,600

HX
Attachments
c: Graham Johnson, PE
Bob Rogers, AICP
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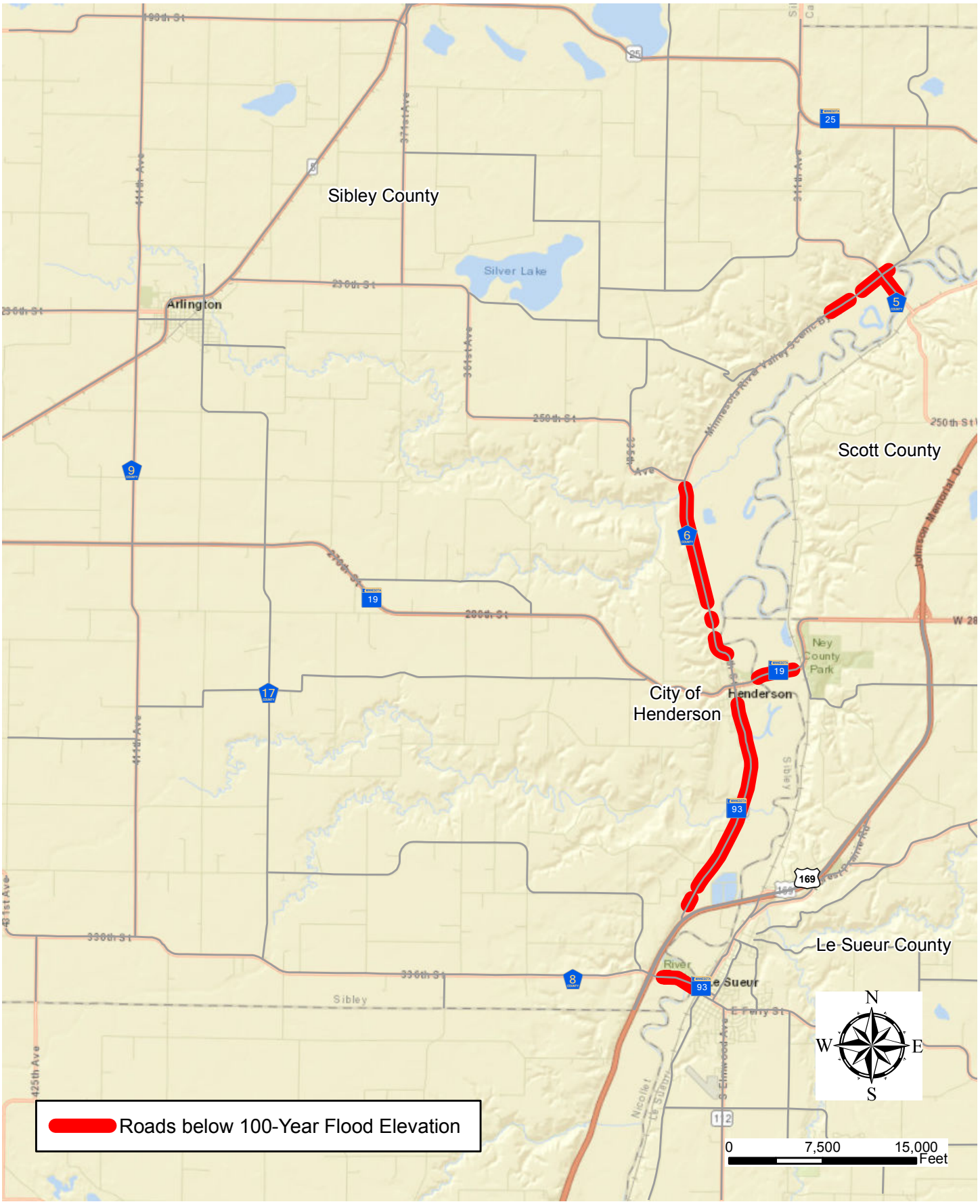

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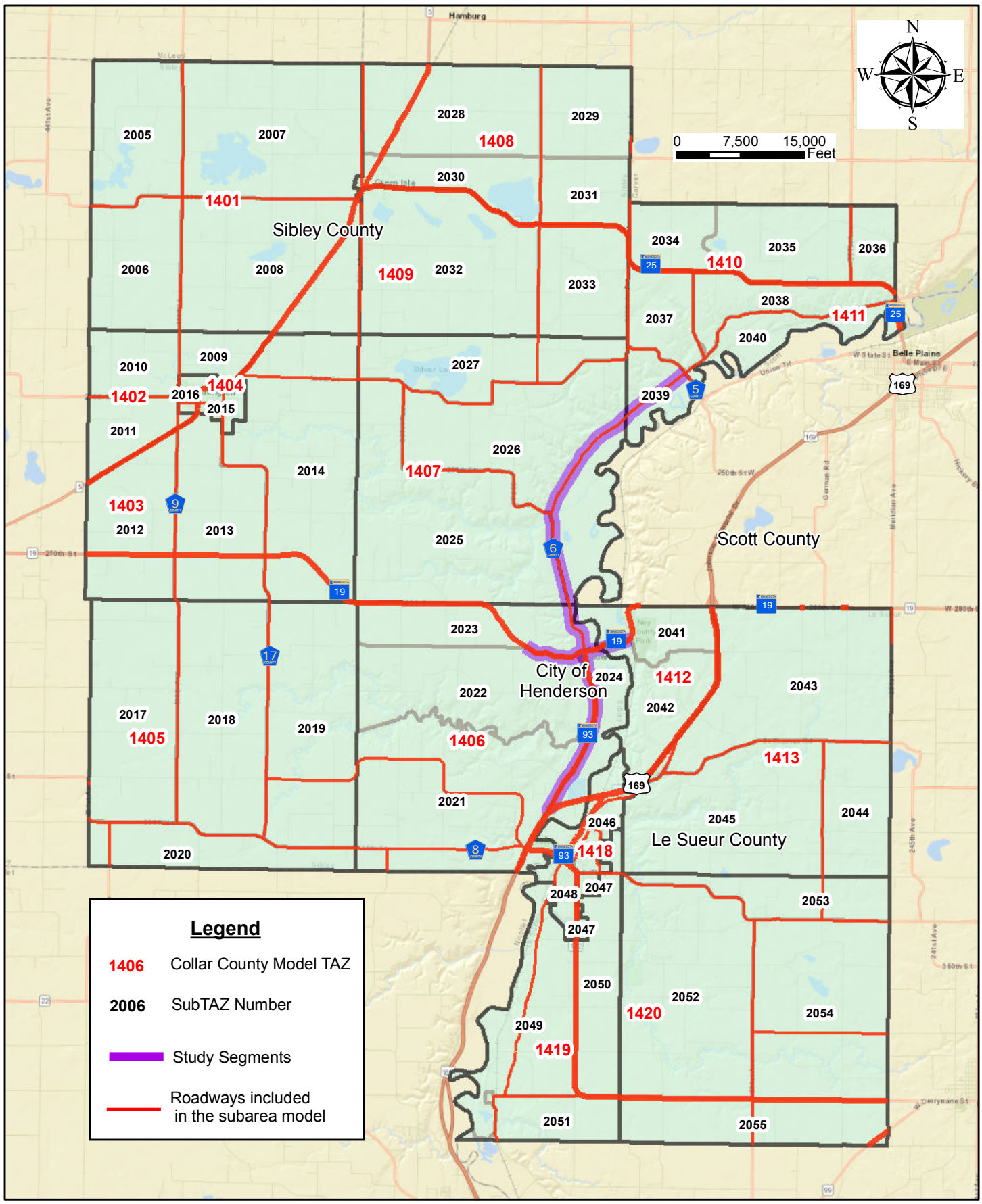
Project Number: MNT07 137843
Print Date: 4/19/2017

Map by: hxiao
Projection: UTM 15N
Source: MnTOPO, ESRI, SEH

MnDOT Flood Feasibility Study
Henderson, MN

FIGURE 1
Flood-Prone Roadways in the Study Area



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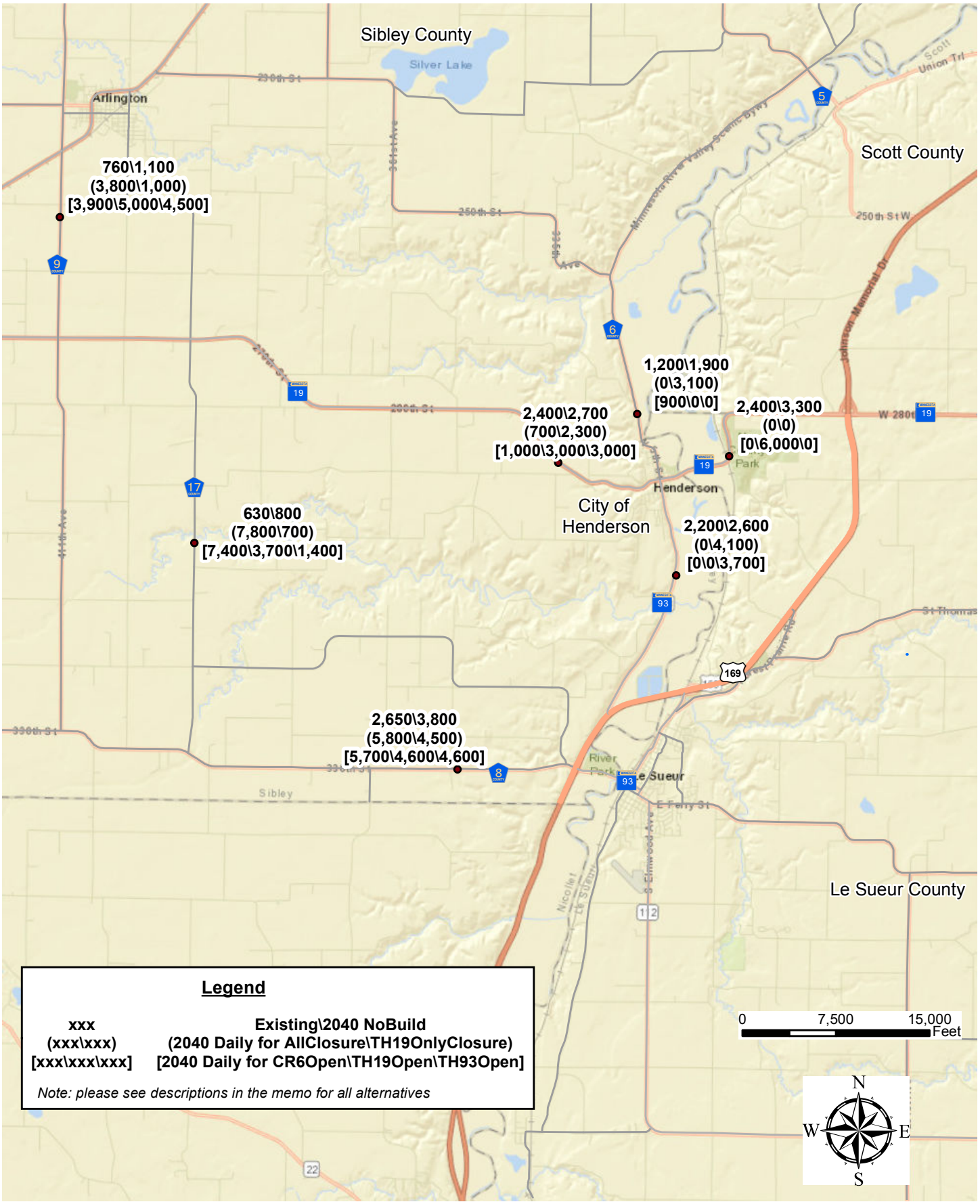
Project Number: MNT07 137843
Print Date: 4/19/2017

Map by: hxiao
Projection: UTM 15N
Source: MnTOPO, ESRI, SEH

MnDOT Flood Feasibility Study
Henderson, MN

FIGURE 2
Subarea Model Refinement



Legend

xxx	**Existing\2040 NoBuild**
(xxx\xxx)	**(2040 Daily for AllClosure\TH19OnlyClosure)**
[xxx\xxx\xxx]	**[2040 Daily for CR6Open\TH19Open\TH93Open]**

Note: please see descriptions in the memo for all alternatives

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Project Number: MNT07 137843
Print Date: 4/20/2017

Map by: hxiao
Projection: UTM 15N
Source: MnTOPO, ESRI, SEH

MnDOT Flood Feasibility Study
Henderson, MN

FIGURE 3
Existing and Forecasted
Daily Traffic Volumes

Appendix D

Screening Level Benefit-Cost Analysis

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MEMORANDUM

TO: John Wilson, MnDOT Central Office
Mattew Young, MnDOT District 7

FROM: Graham Johnson, PE

DATE: April 19, 2017

RE: Henderson Flood Mitigation Study - Screening Level Benefit Cost Analysis
SEH No. MNTD7 139855 14.00

PROJECT OVERVIEW

This memorandum documents the methodology and results of a screening level benefit-cost analysis for the build alternatives developed as part of the Henderson Flood Mitigation Study (SP 4004-124).

The Minnesota Department of Transportation (MnDOT), in cooperation with the City of Henderson, Sibley County, Scott County, and Le Sueur County, initiated this feasibility study to investigate transportation improvements in the Minnesota River Valley to determine possible improvements that would minimize roadway closures due to flood events. The study focuses on the bridges and approach roadways for state Highway 19, Highway 93, and Sibley County Road 6. The Highway 93 and County Road 6 alternatives will primarily be related to elevating the roadway profiles above the flood elevation and the Highway 19 alternatives will study raising the bridge and roadway approaches above the flood elevation.

For the study, four separate build alternatives were analyzed and compared to the No Build alternative. The alternatives are listed below:

1. No Build – do nothing alternative
2. CSAH 6 Improvement – reconstruct CSAH 6 to above flood levels
3. TH 19 Improvement – reconstruct TH 19 to above flood levels
    a. Full Bridge reconstruct with Trail
    b. Full Bridge reconstruct without Trail
4. TH 93 Improvement – reconstruct TH 93 to above flood levels

Table 1 represents the previous 7 Major flood events that have occurred near the City of Henderson during the past 25-years.

Table 1 – Flood Event Closure Days

Roadway	1993	1997	2001	2010 Spring	2010 Fall	2011	2014	Average
CSAH 6	32	13	32	16	11	26	12	20
TH 93	31	14	30	18	13	26	12	21
TH 19	40	21	37	20	13	31	15	25

With 7 major flood events during the last 25-years, this analysis will assume there will be 6 major flood events during this 20-year analysis. The average closure days from Table 1 will be used for the assumed flood event years in the VMT and VHT calculations.

It should also be noted that TH 19 closed for 3 additional days in 2001 and 4 additional days in 2010 as part of separate flood events. This will be included as a minor flood event that will be assumed to occur 2 times during this 20-year analysis.

Figure 1, below, shows the location and proximity of the three roadway closures in relation to the City of Henderson. From this image it is easy to see that during a major flooding event, the west leg of TH 19 becomes the only roadway into and out of the City of Henderson.

Figure 1 Project Location

ALTERNATIVE DESCRIPTION

The following is a brief description of each roadway and any pertinent information regarding the Build alternative.

- **TH 19 Reconstruction**: The TH 19 Bridge is the only Minnesota River crossing within the study area; the bridge structure itself and the low lying segment east of the bridge are prone to flood closures. TH 19 has an approximate flood closure at a river elevation of 732.9'. This is typically the first roadway to close a handful of days prior to the TH 93 and CSAH 6 routes. TH 19 has also closed and been reopened on two separate occasions when TH 93 and CSAH 6 were not closed from flooding events. TH 19 provides a direct connection from the City of Henderson to the east to access US 169; there is a full access freeway interchange at this location.
    - The proposed alternative is to reconstruct the existing TH 19 bridge structure to span the majority of the flood area, an approximately 2,500 foot long bridge structure with roadway approaches for a total project length of approximately 4,100 feet. The existing TH 19 roadway grade will be raised approximately 7' higher than the existing roadway elevation.
    - This alternative includes two options for the proposed bridge width; one with a proposed trial and one without a trail.
- **TH 93 Reconstruction**: TH 93 has an approximate flood closure at a river elevation of 733.7'; this roadway typically closes after TH 19 has already closed. TH 93 provides a direct connection from the City of Henderson to the south to access US 169; at US 169, TH 93 is a limited, ¾ access at-grade intersection. TH 93 traffic destined for northbound US 169 must travel south along US 169 and use the TH 93/Le Sueur interchange to make a U-turn maneuver to travel northbound.
    - The proposed alternative is to raise the existing roadway above the flood elevation for approximately 3.25 miles; there is a small bridge structure spanning Rush River that will also be reconstructed. The increased roadway elevation will range approximately between 5' and 7' higher than the existing roadway.
- **CSAH 6 Reconstruction**: CSAH 6 has an approximate flood closure at a river elevation of 733.8'; this roadway typically closes after TH 19 has closed and at generally the same time TH 93 closes. CSAH 6 provides a parallel connection along the Minnesota River from the City of Henderson to the north to access TH 25 near the City of Bell Plaine. This route provides the biggest benefit for traffic traveling to/from the north; while southerly traffic would not be benefited from this alternative.
    - The proposed alternative is to raise the existing roadway above the flood elevation for approximately 4.2 miles; there is a small bridge structure spanning High Island Creek that will also be reconstructed. The increased roadway elevation will range between approximately 5' and 7.5' higher than the existing roadway.

PURPOSE

The purpose of a benefit-cost analysis is to express the effects of an investment (or closure) into a common measure (dollars). This allows for the fact that the benefit or costs of a project are often accrued over a long period of time, while the initial investment is incurred during the initial years of the project.

In this analysis approach, any quantified benefits that are greater than or equal to the quantified costs (benefit-to-cost ratio greater than one) represents an economically viable project.

BENEFIT-COST METHODOLOGY

The monetary benefit for the project is quantified in terms of reduced vehicle miles traveled (VMT), vehicle hours traveled (VHT), and estimated crashes over the analysis period between the No-Build and the Build option. The costs typically include construction, bridges and structures, right-of-way, and engineering/project delivery costs. Remaining capital values of these roadway features at the end of the analysis period are subtracted from the total cost of the project.

The screening level of this analysis did not take into account crash reductions or general operating and maintenance costs. However, it did take into account the different maintenance costs due to the bridge closures and temporary mitigations and repairs that occur during and after a flood event.

The results of the analysis provide input for evaluating the overall benefit of the proposed improvements to the corridor. Due to the planning level of detail in the calculations, the magnitude of the value is not as important as the value being greater or less than one.

General Assumptions

- All monetary values are discounted to the 2017 analysis year. Inflation is not included.
- The 20-year benefit period is based on a 2020 day-of-opening through 2040
- Yearly Build and No-Build benefits are calculated based on linear interpolation over the 20-year analysis period.
- The number of days per year used in the analysis was 365.
- Longer travel times and rerouting of trips during construction years are not included.
- Preliminary cost estimates were developed using current estimation methodology. The cost estimates are based on documented construction costs. The cost estimates include all roadway sections including local street connections due to access changes.
- Operating and Maintenance (O&M) values were estimated based on MnDOT and Sibley County guidance.

Specific Assumptions

The values shown in ***Table 2*** are from the MnDOT Office of Transportation Management. These values are typically adjusted on a yearly basis; however these are the most current values as of March 2017.

Table 2 – Specific Assumptions (MnDOT)

Operating Costs (Vehicle Miles Traveled)	
Automobile (per mile)	$0.30
Heavy Vehicle (per mile)	$1.08
Time Costs (Vehicle Hours Traveled)	
Automobile (per occupant)	$16.80
Heavy Commercial (per occupant)	$28.30
Vehicle Occupancy Rates	
Automobile (passengers per vehicle)	1.60
Heavy Commercial (passengers per vehicle)	1.02
Capital Cost Estimate – see Preliminary Cost Estimate Table A2	
Component Service Life (years)	
Program Development and Delivery	0
Right-of-way, per acre	100
Major Structure	60
Grading and Drainage	50
Sub-base and Base	40
Surface	25
Analysis Period for Roadway projects (years)	20
Discount Rate (annual)	1.6%

Source: MnDOT Office of Transportation System Management, July 2016 update

Traffic Assumptions

As part of the Henderson Flood Mitigation Study, the Collar County Travel Demand Model (CCTDM) was used to develop traffic forecast data for all roadways in the study area. The CCTDM includes the 12 counties surrounding the 7-County Twin Cities metropolitan area. The latest version of the CCTDM was utilized and a refined subarea model was developed around the study area, including the potential detour routes that traffic would utilize during flood events and roadway closures.

For each alternative and flood closure event, a separate model was created to include both local and regional trip rerouting. Below are the traffic assumptions used in the VMT and VHT calculations for all alternatives:

- Daily VMT and VHT for all scenarios and possible closure combinations were calculated from the CCTDM model results for the entire 12-County model area network. The CCTDM modeled years were 2010 and 2040; this information was extrapolated out to the 2020 year of opening. The different model scenarios include:
    - No Build
    - CSAH 6, TH 19, TH 93 Closure (Major Flood Event)
    - TH 19 Closure Only (Minor Flood Event)
    - CSAH 6 Build Alternative; TH 93 and TH 19 Closures
    - TH 19 Build Alternative; TH 93 and CSAH 6 Closures
    - TH 93 Build Alternative; TH 19 and CSAH 6 Closures
- Yearly values for each alternative were calculated based on a non-flood event, a major flood event year, and a minor flood event year.
    - For non-flood event years, the calculations only use the No Build VMT and VHT data. So there is no potential benefit for days the roadway would normally be open.
    - For major and minor flood event years, the average number of days of closure (***Table 1***) was used in conjunction with the remaining days in the year to compile a yearly VMT and VHT. The daily values for each closure scenario were combined with the No Build scenario daily values to create a yearly VMT and VHT value.
- Yearly values for each alternative, for both non-flood event and flood event years were carried forward and interpolated for the 20-year analysis.
- The VMT and VHT information for a flood event year would replace the information in the non-flood event. This ensures that the only benefit occurs during the flood event year.
- Six major flood events are assumed to occur during the 20-year analysis (based on historical data). The years for the assumed flood events are 2021, 2025, 2029, 2033, and 2037.
- Two minor flood events are assume to occur during the 20-year analysis (based on historical data). The years for the assumed flood events are 2023 and 2031.

Table 3 represents the resulting VMT and VHT values for all alternatives for the year of opening and the design year during a non-flood event year.

Table 3 – Non-Flood Event Yearly VMT and VHT

ITEM	No Build	CSAH 6 Reconstruction	TH 19 Reconstruction	TH 93 Reconstruction
2010 VMT	760,482,277	760,482,277	760,482,277	760,482,277
2020 VMT	922,457,620	922,457,620	922,457,620	922,457,620
2040 VMT	1,246,408,320	1,246,408,320	1,246,408,320	1,246,408,320
2010 VHT	16,972,072	16,972,072	16,972,072	16,972,072
2020 VHT	21,213,110	21,213,110	21,213,110	21,213,110
2040 VHT	29,695,190	29,695,190	29,695,190	29,695,190

Table 4 represents the resulting VMT and VHT values for all alternatives for the year of opening and the design year during a major flood event year.

Table 4 – Major Flood Event Yearly VMT and VHT

ITEM	No Build	CSAH 6 Reconstruction	TH 19 Reconstruction	TH 93 Reconstruction
2010 VMT	762,109,761	761,828,277	761,181,745	761,091,617
2020 VMT	924,027,310	923,730,890	923,138,630	923,037,550
2040 VMT	1,247,862,415	1,247,536,117	1,247,052,411	1,246,929,410
2010 VHT	17,017,106	17,011,604	16,993,051	16,994,107
2020 VHT	21,265,170	21,259,480	21,238,650	21,240,830
2040 VHT	29,761,310	29,755,220	29,729,861	29,734,265

Table 5 represents the resulting VMT and VHT values for all alternatives for the year of opening and the design year during a minor flood event year.

Table 5 – Minor Flood Event Yearly VMT and VHT

ITEM	No Build	CSAH 6 Reconstruction	TH 19 Reconstruction	TH 93 Reconstruction
2010 VMT	760,498,725	760,498,725	760,482,277	760,498,725
2020 VMT	922,472,170	922,472,170	922,457,620	922,472,170
2040 VMT	1,246,419,064	1,246,419,064	1,246,408,320	1,246,419,064
2010 VHT	16,972,964	16,972,964	16,972,072	16,972,964
2020 VHT	21,214,160	21,214,160	21,213,110	21,214,160
2040 VHT	29,696,546	29,696,546	29,695,190	29,696,546

BENEFIT-COST ANALYSIS RESULTS

Table 6, below, summarizes the results of the benefit-cost analysis for the screening level build alternatives for the Henderson Flood Mitigation Study.

Table 6 – Summary of Benefit-Cost Analysis

Scenario	CSAH 6 Reconstruct	TH 19 Reconstruct (with Trail)	TH 19 Reconstruct (without Trail)	TH 93 Reconstruct
VMT & VHT Benefit	$1,288,050	$5,008,651	$5,008,651	$4,813,876
Operating/Maintenance	$198,589	$116,819	$116,819	$106,560
Total Benefit	**$1,486,638**	**$5,125,470**	**$5,125,470**	**$4,920,436**
Total Construction Costs (PV)	$15,698,113	$40,013,768	$33,506,709	$13,926,523
Remaining Capital Value (RCV)	$2,858,966	$12,904,852	$10,687,309	$3,041,144
Total Cost minus RCV	**$12,839,147**	**$27,108,916**	**$22,819,400**	**$10,885,379**
BC RATIO	**0.12**	**0.19**	**0.22**	**0.45**

The preliminary analysis indicates that none of the Build Alternative have a benefit-cost ratio greater than one. The VMT and VHT benefits of the projects are estimated to be less than the costs associated with the construction of the project. At this level of screening analysis, the magnitude of the benefit-cost ratio is not as important as the overall relative comparison of the benefit-cost ratio.

Based on the screening level analysis, the following assessment of each alternative can be made:

- *CSAH 6 Reconstruction* – This option provides the least amount of benefit for the roadway network. With one of the least expensive project costs, the low benefit numbers keep the Benefit-Cost ratio at the lowest value of the three alternatives.

- *TH 19 Reconstruction* – This option provides the highest benefit to the roadway network; however it also incurs the most expensive project costs which are almost 4 times as high as the other build alternatives. Due to the high costs, with or without the trail provided, the Benefit-Cost ratio is only slightly better than CSAH 6 and well below TH 93.

- *TH 93 Reconstruction* – This option provides a significant benefit to the roadway network, just below the TH 19 benefits. With one of the least expensive project costs, this build alternative provides the highest Benefit-Cost ratio of the three alternatives.

Several tables are attached in ***Appendix A*** that provide additional detail on the Benefit Cost calculations.

COST EFFECTIVENESS POLICY

The Minnesota Statewide Transportation Plan established a cost-effectiveness policy for MnDOT as outlined in the Highway Project Development Process (HDPD) under the Cost-Effectiveness Policy dated April 2, 2012. The cost-effectiveness evaluation is a three-step process: (1) benefit-cost analysis; (2) best value assessment; and (3) social, environmental, and community goals and business impacts.

Step 1: Benefit-Cost Analysis - The benefit-cost analysis described in this technical memorandum meets the requirements described in Step 1 of the policy. Since the project results in a benefit-cost ratio less than one, a best value assessment (Step 2) was completed.

Step 2: Best Value Assessment – this step asks the following questions of the proposed project:

- Are the project alternatives with the highest benefit/cost ratio being carried forward?
  - Henderson Flood Mitigation Study response: Yes, the TH 93 alternative has the highest b/c ratio and this alternative is continuing to be considered in the feasibility study process.

- Can the project alternatives be re-scoped to yield a benefit/cost ratio greater than 1.0?
  - Henderson Flood Mitigation Study response: No, several design refinements have been made to the conceptual layouts and none of the alternatives result in a b/c greater than 1.0.

- Is the project being evaluated as an essential component of a larger project whose benefit/cost ratio exceeds 1.0?
  - Henderson Flood Mitigation Study response: No, there are no other roadway or flood mitigation improvements being considered at this time.

Step 3: Social, Environmental, and Community Goals and Business Impacts – this final step requires an assessment of how the proposed improvements address or affect the project goals, either positively or adversely. Step 3 was completed as part of the development of the project purpose and alternatives development.

During a flood event, the City of Henderson is severely limited in route choice into and out of the City as three of the four roadways in/out of Henderson can be flooded and closed to traffic for upwards of 3-weeks at a time. During these flood events, residents and other community members must use long detour routes to travel to any destination outside of the city limits. During this time, the businesses within the community can be severely impacted as the traffic traveling through the city is completely removed.

Each Build Alternative would provide a benefit during a flood event to the roadway users, residents, and business within the City of Henderson.

Steps 2 and 3 of the Cost-Effectiveness Policy also require that when the preferred alternative has a benefit/cost ratio between 0.5 and 1.0, approval from the District Engineer or Office Director is required to proceed with project development.

At the time a flood mitigation project were to be pursued, a letter of approval from the MnDOT District 7 Engineer would need to be prepared and submitted along with an updated benefit-cost technical memorandum.

gtj
Appendix Tables A1 through A10

c: Henderson Flood Mitigation Study Project Management Team (PMT)
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Benefit Cost

Table A1

Summary

ITEM	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
Operating Benefit (VMT)	$ 630,347	$ 1,724,333	$ 1,724,333	$ 1,944,181
Travel Time Benefit (VHT)	$ 657,703	$ 3,284,317	$ 3,284,317	$ 2,869,696
Crash Benefit (Not Analyzed)	$ -	$ -	$ -	$ -
Operating and Maintenance Benefit	$ 198,589	$ 116,819	$ 116,819	$ 106,560
TOTAL BENEFIT	**$ 1,486,638**	**$ 5,125,470**	**$ 5,125,470**	**$ 4,920,436**
Major Structures (Bridge)	$ 768,000	$ 23,922,752	$ 19,719,226	$ 1,800,000
Grading/Drainage	$ 3,144,994	$ 367,843	$ 367,843	$ 2,136,006
Surfacing	$ 2,055,954	$ 196,952	$ 196,952	$ 1,235,813
Subbase/Base	$ 1,372,545	$ 118,143	$ 118,143	$ 822,670
Miscellaneous	$ 3,636,928	$ 3,536,274	$ 3,157,957	$ 3,203,000
Right of Way	$ 106,742	$ 47,014	$ 47,014	$ 864,402
Risk Factor (Included in Estimate)	$ 2,014,389	$ 5,163,663	$ 4,322,958	$ 1,687,613
Engineering (Included in Estimate)	$ 2,598,562	$ 6,661,126	$ 5,576,616	$ 2,177,020
TOTAL CONSTRUCTION COST ESTIMATES	**$ 15,698,113**	**$ 40,013,768**	**$ 33,506,709**	**$ 13,926,523**
Project Remaining Capital Value	$ 2,858,966	$ 12,904,852	$ 10,687,309	$ 3,041,144
TOTAL COST - REMAINING CAPITAL VALUE	**$ 12,839,147**	**$ 27,108,916**	**$ 22,819,400**	**$ 10,885,379**
Benefit-Cost Ratio	**0.12**	**0.19**	**0.22**	**0.45**

Benefit Cost

Table A2

Itemized Costs

ITEM	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
Major Structures (Bridge)	$ 768,000	$ 23,922,752	$ 19,719,226	$ 1,800,000
Grading/Drainage	$ 3,144,994	$ 367,843	$ 367,843	$ 2,136,006
Surfacing	$ 2,055,954	$ 196,952	$ 196,952	$ 1,235,813
Subbase/Base	$ 1,372,545	$ 118,143	$ 118,143	$ 822,670
Mobilization	$ 906,475	$ 2,323,648	$ 1,945,331	$ 759,426
Erosion Control	$ 285,804	$ 47,522	$ 47,522	$ 184,860
Signing/Striping	$ 228,643	$ 38,017	$ 38,017	$ 147,888
Removals	$ 400,126	$ 66,530	$ 66,530	$ 258,805
Miscellaneous	$ 1,815,880	$ 1,060,556	$ 1,060,556	$ 1,852,021
Right of Way	$ 106,742	$ 47,014	$ 47,014	$ 864,402
Risk Factor (Included in Estimate)	$ 2,014,389	$ 5,163,663	$ 4,322,958	$ 1,687,613
Engineering (Included in Estimate)	$ 2,598,562	$ 6,661,126	$ 5,576,616	$ 2,177,020
TOTAL COST (2017 Dollars)	**$ 15,698,113**	**$ 40,013,768**	**$ 33,506,709**	**$ 13,926,523**

Benefit Cost

Table A3

Assumptions Used in the Benefit-Cost Study

Alternatives

Base Condition	No Build
Build Option 1	CSAH 6 Reconstruct
Build Option 2	TH 19 Reconstruct
Build Option 3	TH 19 Reconstruct (w/o Trail)
Build Option 4	TH 93 Reconstruct

Analysis Timeframe

Existing Year	2017
Duration of Benefit Cost Analysis (years)	20
Year of Opening	2020
Design Year	2040
Days Per Year	365.25

Crash Costs

Due to the unknown nature of crash rate changes during flood times, a Crash Benefit will not be calculated for this feasibility study.

Estimating change in crashes	Fatal Type K	$	10,700,000
Mn/DOT Standard Values [1]	Injury Type A	$	570,000
	Injury B	$	170,000
	Injury C	$	84,000
	Property Damage Only	$	7,600

Operating Costs

Estimating change in travel costs (Vehicle Miles of Travel)			
	Automobile (per mile) [1]	$	0.30
	Heavy Vehicle (per mile) [1]	$	1.08

Time Costs

Estimating change in time costs (Vehicle Hours of Travel)			
	Automobile (per person-hour) [1]	$	16.80
	Heavy Commercial (per person-hour) [1]	$	28.30

Vehicle Occupancy

Automobile (Greater Minnesota) [2]	1.31
Truck Occupancy Rate (State-wide Average) [2]	1.02
Percent automobiles [4]	84.91%
Percent heavy vehicles [4]	15.09%

Component Service Life (years) [1]

Engineering	0
Right-of-Way	100
Bridge	60
Mass Grading and Drainage	50
Base	40
Surface	25
Signal System	20

Depreciation Method	**Discount Rate (annual)**
Real Discount Rate	1.6%

NOTES:

(1) MnDOT Office of Transportation System Management recommended value (July 2015)

(2) 2009 National Household Travel Survey (NHTS)

(3) 2010 Metropolitan Council Travel Behavior Inventory (TBI) Home Interview Study

(4) MnDOT Traffic Mapping Application Data; 2012 AADT and HCAADT Data; average of the available Trunk Highway data.

- 2012 TH 19: 940 HCAADT and 3,250 AADT; 2012 TH 19: 275 HCAADT and 2,750 AADT; 2012 TH 93: 130 HCAADT and 2,050 AADT.

Benefit Cost

Table A4

Salvage Values

Service Life	Remaining Capitol Value Factor	Item (2017 Dollars)	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
50	69.0%	Grading and Drainage	$ 3,144,994	$ 367,843	$ 367,843	$ 2,136,006
40	58.0%	Subbase/Base	$ 1,372,545	$ 118,143	$ 118,143	$ 822,670
25	23.0%	Surfacing	$ 2,055,954	$ 196,952	$ 196,952	$ 1,235,813
		Construction RCV	**$ 3,438,991**	**$ 367,634**	**$ 367,634**	**$ 2,235,230**
60	76.0%	Major Structures	$ 768,000	$ 23,922,752	$ 19,719,226	$ 1,800,000
		Major Structures RCV	**$ 583,680**	**$ 18,181,292**	**$ 14,986,611**	**$ 1,368,000**
100	90.0%	Right of Way	$ 106,742	$ 47,014	$ 47,014	$ 864,402
		R/W RCV	**$ 96,068**	**$ 42,313**	**$ 42,313**	**$ 777,962**
		Other Costs	$ 8,249,879	$ 15,361,063	$ 13,057,531	$ 7,067,632
		TOTAL PROJECT COST	$ 15,698,113	$ 40,013,768	$ 33,506,709	$ 13,926,523
		TOTAL RCV YR 2040	$ 4,118,739	$ 18,591,238	$ 15,396,558	$ 4,381,191
		REMAINING CAPITAL VALUE 2017	**$ 2,858,966**	**$ 12,904,852**	**$ 10,687,309**	**$ 3,041,144**

Benefit Cost
Table A5A
Daily VMT / VHT

Table 5A.1 - Minnesota River Crossing - 25 Year Historical Days of Road Closures

Roadway	Summer 1993	April 1997	April 2001	March 2010	October 2010	March 2011	June 2014	25-Year Average
								3.57
CR 6 (Total Major Flood Event Days)**	32	13	32	16	11	26	12	20.0
TH 93 (Total Major Flood Event Days)*	31	14	30	18	13	26	12	21.0
TH 19 (Total Major Flood Event Days)*	40	21	37	20	13	31	15	25.0
TH 19 (Minor Flood Event Closure Days)***			3	4				4.0

Notes: CR 6 Closure Elevation at Gage 733.8; TH 93 Closure Elevation at Gage 733.7; TH 19 Closure Elevation at Gage 732.9

*MnDOT Provided Data for TH 19 and TH 93 roadway Closures; except floods for 1993 and 1997 which are based on Gage data

**CR 6 closures based on Gage data and similar flood events compared to TH 93

***TH 19 has closed an additional 2 times in the previous 20 years without closures to CR 6 or TH 93; June 2001 and July 2010.

Table 5A.2 - Major Flood Event Assumptions

Description	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
Total Days Per Year	365.25	365.25	365.25	365.25	365.25
Non-Flood Days (Total)	340.25	340.25	344.25	344.25	340.25
Days of Separate Roadway Closures					
CR 6, TH 19, & TH 93 Closed	21.0	0.0	0.0	0.0	0.0
TH 19 Closed (CR 6 & TH 93 Open)	4.0	4.0	0.0	0.0	5.0
TH 19 & TH 93 Closed (CR 6 Open)	0.0	21.0	0.0	0.0	0.0
CR 6 & TH 93 Closed (TH 19 Open)	0.0	0.0	21.0	21.0	0.0
CR 6 & TH 19 Closed (TH 93 Open)	0.0	0.0	0.0	0.0	20.0
Flood Days (Total)	25.00	25.00	21.00	21.00	25.00

**Minor Flood Event, TH 19 Only, assumes TH 19 would incur a closure on average for 4 days with CR 6 and TH 93 open.

Table 5A.3 - Daily VMT and VHT Results by Roadway Closure Scenario

Daily Value	No Closure (Non-Flood)	CR 6, TH 19, TH 93 Closed	CR 6, TH 93 Open (TH 19 Closed)	CR 6 Open (TH 19/TH 93 Closed)	TH 19 Open (CR 6/TH 93 Closed)	TH 93 Open (TH 19/CR 6 Closed)
2010 VMT	2,082,087	2,158,803	2,086,199	2,145,399	2,115,395	2,111,526
2040 VMT	3,412,480	3,481,211	3,415,166	3,465,673	3,443,151	3,437,863
2010 VHT	46,467	48,569	46,690	48,307	47,466	47,513
2040 VHT	81,301	84,385	81,640	84,095	82,952	83,170

(2010 and 2040 numbers were obtained from the Collar County Travel Demand Model)

Model subarea bounded by TH 22 (W), US 212 (N), TH 21/TH 13 (E) and County Boundaries (S, model limits)

Table 5A.4 - Resultant Yearly VMT & VHT based on a Major Flood Event Year

Yearly Value	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2010 VMT	762,109,761	761,828,277	761,181,745	761,181,745	761,091,617
2040 VMT	1,247,862,415	1,247,536,117	1,247,052,411	1,247,052,411	1,246,929,410
2010 VHT	17,017,106	17,011,604	16,993,051	16,993,051	16,994,107
2040 VHT	29,761,310	29,755,220	29,729,861	29,729,861	29,734,265

*Yearly VMT and VHT data is a sumation of the number of days per year that each Roadway Closure Scenario includes.

Table 5A.5 - Resultant Yearly VMT & VHT based on a Minor Flood Event Year (TH 19 Only)

Yearly Value	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2010 VMT	760,498,725	760,498,725	760,482,277	760,482,277	760,498,725
2040 VMT	1,246,419,064	1,246,419,064	1,246,408,320	1,246,408,320	1,246,419,064
2010 VHT	16,972,964	16,972,964	16,972,072	16,972,072	16,972,964
2040 VHT	29,696,546	29,696,546	29,695,190	29,695,190	29,696,546

*Yearly VMT and VHT data is a sumation of the number of days per year that each Roadway Closure Scenario includes.

Table 5A.6 - Estimated Existing (2017) Daily Flood Closure User Costs

	Existing Flood Closure Scenarios			Build Alternative Closure Scenarios		
Yearly Value	No Closure (Non-Flood)	CR 6, TH 19, TH 93 Closed	CR 6, TH 93 Open (TH 19 Closed)	CR 6 Open (TH 19/TH 93 Closed)	TH 19 Open (CR 6/TH 93 Closed)	TH 93 Open (TH 19/CR 6 Closed)
2017 VMT	2,392,512	2,467,365	2,396,291	2,453,463	2,425,205	2,421,005
2017 VHT	54,595	56,926	54,845	56,658	55,746	55,833
VMT Cost		$ 31,265	$ 1,579	$ 25,458	$ 13,655	$ 11,901
VHT Cost		$ 53,716	$ 5,762	$ 47,528	$ 26,525	$ 28,528
Total User Cost		**$ 85,000**	**$ 7,300**	**$ 73,000**	**$ 40,200**	**$ 40,400**
Build Alternative User Cost Savings				**$ 12,000**	**$ 44,800**	**$ 44,600**

*2017 Daily VMT and VHT assumes linear growth between 2010 and 2040

**VMT and VHT Assumptions and Costs from Table A3: *Assumptions Used in Benefit-Cost Study*

Benefit Cost

Table A5B

Yearly VMT / VHT

Table 5B.1 - Non-Flood Event Years

ITEM	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2010 VMT	760,482,277	760,482,277	760,482,277	760,482,277	760,482,277
2020 VMT	922,457,620	922,457,620	922,457,620	922,457,620	922,457,620
2040 VMT	1,246,408,320	1,246,408,320	1,246,408,320	1,246,408,320	1,246,408,320
2010 VHT	16,972,072	16,972,072	16,972,072	16,972,072	16,972,072
2020 VHT	21,213,110	21,213,110	21,213,110	21,213,110	21,213,110
2040 VHT	29,695,190	29,695,190	29,695,190	29,695,190	29,695,190

NOTES: This table provides the VMT/VHT calculations for the Non-flood event years. If a scenario has no capacity improvement, during a non-flood year, there will be no change in traffic values. Daily values are pulled from table 5A.3 and multiplied by 365.25 days/year. 2010 and 2040 numbers were obtained from the Collar County Travel Demand Model; 2020 assumed linear growth.

Table 5B.2 - Major Flood Event Years

ITEM	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2010 VMT	762,109,761	761,828,277	761,181,745	761,181,745	761,091,617
2020 VMT	924,027,310	923,730,890	923,138,630	923,138,630	923,037,550
2040 VMT	1,247,862,415	1,247,536,117	1,247,052,411	1,247,052,411	1,246,929,410
2010 VHT	17,017,106	17,011,604	16,993,051	16,993,051	16,994,107
2020 VHT	21,265,170	21,259,480	21,238,650	21,238,650	21,240,830
2040 VHT	29,761,310	29,755,220	29,729,861	29,729,861	29,734,265

NOTES: This table provides the VMT/VHT calculations for the Major Flood event years. Yearly values are pulled from table 5A.4 and are the result of using the flood assumptions from Table 5A.2 and Daily values from Table 5A.3. 2010 and 2040 numbers were obtained from the Collar County Travel Demand Model; 2020 assumed linear growth.

Table 5B.2 - Minor Flood Event Years

ITEM	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2010 VMT	760,498,725	760,498,725	760,482,277	760,482,277	760,498,725
2020 VMT	922,472,170	922,472,170	922,457,620	922,457,620	922,472,170
2040 VMT	1,246,419,064	1,246,419,064	1,246,408,320	1,246,408,320	1,246,419,064
2010 VHT	16,972,964	16,972,964	16,972,072	16,972,072	16,972,964
2020 VHT	21,214,160	21,214,160	21,213,110	21,213,110	21,214,160
2040 VHT	29,696,546	29,696,546	29,695,190	29,695,190	29,696,546

NOTES: This table provides the VMT/VHT calculations for the Minor Flood event (TH 19 Only) years. Yearly values are pulled from table 5A.5 and are the result of using the flood assumptions from Table 5A.2 and Daily values from Table 5A.3. 2010 and 2040 numbers were obtained from the Collar County Travel Demand Model; 2020 assumed linear growth.

Benefit Cost

Table A6

Operating Benefits

Year	Yearly VMT (Only Non-Flood Event Years)					Yearly VMT (Only Major Flood Event Years)					Yearly VMT (Only Minor Flood Event Years)					Combined Yearly Vehicle Miles Traveled (VMT)				
	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2020	**922,457,620**	**922,457,620**	**922,457,620**	**922,457,620**	**922,457,620**	**924,027,310**	**923,730,890**	**923,138,630**	**923,138,630**	**923,037,550**	**922,472,170**	**922,472,170**	**922,457,620**	**922,457,620**	**922,472,170**	922,457,620	922,457,620	922,457,620	922,457,620	922,457,620
2021	938,655,155	938,655,155	938,655,155	938,655,155	938,655,155	940,219,065	939,921,151	939,334,319	939,334,319	939,232,143	877,409,270	877,409,270	877,395,395	877,395,395	877,409,270	**940,219,065**	**939,921,151**	**939,334,319**	**939,334,319**	**939,232,143**
2022	954,852,690	954,852,690	954,852,690	954,852,690	954,852,690	956,410,821	956,111,413	955,530,008	955,530,008	955,426,736	832,346,369	832,346,369	832,333,169	832,333,169	832,346,369	954,852,690	954,852,690	954,852,690	954,852,690	954,852,690
2023	971,050,225	971,050,225	971,050,225	971,050,225	971,050,225	972,602,576	972,301,674	971,725,697	971,725,697	971,621,329	787,283,469	787,283,469	787,270,944	787,270,944	787,283,469	787,283,469	787,283,469	787,270,944	787,270,944	787,283,469
2024	987,247,760	987,247,760	987,247,760	987,247,760	987,247,760	988,794,331	988,491,935	987,921,386	987,921,386	987,815,922	742,220,568	742,220,568	742,208,718	742,208,718	742,220,568	987,247,760	987,247,760	987,247,760	987,247,760	987,247,760
2025	1,003,445,295	1,003,445,295	1,003,445,295	1,003,445,295	1,003,445,295	1,004,986,086	1,004,682,197	1,004,117,075	1,004,117,075	1,004,010,515	697,157,668	697,157,668	697,146,493	697,146,493	697,157,668	**1,004,986,086**	**1,004,682,197**	**1,004,117,075**	**1,004,117,075**	**1,004,010,515**
2026	1,019,642,830	1,019,642,830	1,019,642,830	1,019,642,830	1,019,642,830	1,021,177,842	1,020,872,458	1,020,312,764	1,020,312,764	1,020,205,108	652,094,767	652,094,767	652,084,267	652,084,267	652,094,767	1,019,642,830	1,019,642,830	1,019,642,830	1,019,642,830	1,019,642,830
2027	1,035,840,365	1,035,840,365	1,035,840,365	1,035,840,365	1,035,840,365	1,037,369,597	1,037,062,719	1,036,508,453	1,036,508,453	1,036,399,701	607,031,867	607,031,867	607,022,042	607,022,042	607,031,867	1,035,840,365	1,035,840,365	1,035,840,365	1,035,840,365	1,035,840,365
2028	1,052,037,900	1,052,037,900	1,052,037,900	1,052,037,900	1,052,037,900	1,053,561,352	1,053,252,981	1,052,704,142	1,052,704,142	1,052,594,294	561,968,966	561,968,966	561,959,816	561,959,816	561,968,966	1,052,037,900	1,052,037,900	1,052,037,900	1,052,037,900	1,052,037,900
2029	1,068,235,435	1,068,235,435	1,068,235,435	1,068,235,435	1,068,235,435	1,069,753,107	1,069,443,242	1,068,899,831	1,068,899,831	1,068,788,887	516,906,066	516,906,066	516,897,591	516,897,591	516,906,066	**1,069,753,107**	**1,069,443,242**	**1,068,899,831**	**1,068,899,831**	**1,068,788,887**
2030	1,084,432,970	1,084,432,970	1,084,432,970	1,084,432,970	1,084,432,970	1,085,944,863	1,085,633,504	1,085,095,521	1,085,095,521	1,084,983,480	471,843,165	471,843,165	471,835,365	471,835,365	471,843,165	1,084,432,970	1,084,432,970	1,084,432,970	1,084,432,970	1,084,432,970
2031	1,100,630,505	1,100,630,505	1,100,630,505	1,100,630,505	1,100,630,505	1,102,136,618	1,101,823,765	1,101,291,210	1,101,291,210	1,101,178,073	426,780,265	426,780,265	426,773,140	426,773,140	426,780,265	426,780,265	426,780,265	426,773,140	426,773,140	426,780,265
2032	1,116,828,040	1,116,828,040	1,116,828,040	1,116,828,040	1,116,828,040	1,118,328,373	1,118,014,026	1,117,486,899	1,117,486,899	1,117,372,666	381,717,364	381,717,364	381,710,914	381,710,914	381,717,364	1,116,828,040	1,116,828,040	1,116,828,040	1,116,828,040	1,116,828,040
2033	1,133,025,575	1,133,025,575	1,133,025,575	1,133,025,575	1,133,025,575	1,134,520,128	1,134,204,288	1,133,682,588	1,133,682,588	1,133,567,259	336,654,464	336,654,464	336,648,689	336,648,689	336,654,464	**1,134,520,128**	**1,134,204,288**	**1,133,682,588**	**1,133,682,588**	**1,133,567,259**
2034	1,149,223,110	1,149,223,110	1,149,223,110	1,149,223,110	1,149,223,110	1,150,711,884	1,150,394,549	1,149,878,277	1,149,878,277	1,149,761,852	291,591,563	291,591,563	291,586,463	291,586,463	291,591,563	1,149,223,110	1,149,223,110	1,149,223,110	1,149,223,110	1,149,223,110
2035	1,165,420,645	1,165,420,645	1,165,420,645	1,165,420,645	1,165,420,645	1,166,903,639	1,166,584,810	1,166,073,966	1,166,073,966	1,165,956,445	246,528,663	246,528,663	246,524,238	246,524,238	246,528,663	1,165,420,645	1,165,420,645	1,165,420,645	1,165,420,645	1,165,420,645
2036	1,181,618,180	1,181,618,180	1,181,618,180	1,181,618,180	1,181,618,180	1,183,095,394	1,182,775,072	1,182,269,655	1,182,269,655	1,182,151,038	201,465,762	201,465,762	201,462,012	201,462,012	201,465,762	1,181,618,180	1,181,618,180	1,181,618,180	1,181,618,180	1,181,618,180
2037	1,197,815,715	1,197,815,715	1,197,815,715	1,197,815,715	1,197,815,715	1,199,287,149	1,198,965,333	1,198,465,344	1,198,465,344	1,198,345,631	156,402,862	156,402,862	156,399,787	156,399,787	156,402,862	**1,199,287,149**	**1,198,965,333**	**1,198,465,344**	**1,198,465,344**	**1,198,345,631**
2038	1,214,013,250	1,214,013,250	1,214,013,250	1,214,013,250	1,214,013,250	1,215,478,905	1,215,155,594	1,214,661,033	1,214,661,033	1,214,540,224	111,339,961	111,339,961	111,337,561	111,337,561	111,339,961	1,214,013,250	1,214,013,250	1,214,013,250	1,214,013,250	1,214,013,250
2039	1,230,210,785	1,230,210,785	1,230,210,785	1,230,210,785	1,230,210,785	1,231,670,660	1,231,345,856	1,230,856,722	1,230,856,722	1,230,734,817	66,277,061	66,277,061	66,275,336	66,275,336	66,277,061	1,230,210,785	1,230,210,785	1,230,210,785	1,230,210,785	1,230,210,785
2040	**1,246,408,320**	**1,246,408,320**	**1,246,408,320**	**1,246,408,320**	**1,246,408,320**	**1,247,862,415**	**1,247,536,117**	**1,247,052,411**	**1,247,052,411**	**1,246,929,410**	**21,214,160**	**21,214,160**	**21,213,110**	**21,213,110**	**21,214,160**	**1,247,862,415**	**1,247,536,117**	**1,247,052,411**	**1,247,052,411**	**1,246,929,410**

Major Flood Year Calculation

Minor Flood Year Calculation

Year	VMT Annual Operating Cost					Operating Benefit					Present Value Operating Benefit (2017 dollars)				
	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2020															
2021	$ 392,718,037	$ 392,593,602	$ 392,348,490	$ 392,348,490	$ 392,305,812	$ -	$ 124,435	$ 369,548	$ 369,548	$ 412,225	$ -	$ 116,780	$ 346,813	$ 346,813	$ 386,865
2022	$ 398,830,324	$ 398,830,324	$ 398,830,324	$ 398,830,324	$ 398,830,324	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2023	$ 328,838,704	$ 328,838,704	$ 328,833,472	$ 328,833,472	$ 328,838,704	$ -	$ -	$ 5,232	$ 5,232	$ -	$ -	$ -	$ 4,756	$ 4,756	$ -
2024	$ 412,361,350	$ 412,361,350	$ 412,361,350	$ 412,361,350	$ 412,361,350	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2025	$ 419,770,432	$ 419,643,501	$ 419,407,457	$ 419,407,457	$ 419,362,948	$ -	$ 126,931	$ 362,975	$ 362,975	$ 407,484	$ -	$ 111,794	$ 319,689	$ 319,689	$ 358,890
2026	$ 425,892,375	$ 425,892,375	$ 425,892,375	$ 425,892,375	$ 425,892,375	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2027	$ 432,657,888	$ 432,657,888	$ 432,657,888	$ 432,657,888	$ 432,657,888	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2028	$ 439,423,401	$ 439,423,401	$ 439,423,401	$ 439,423,401	$ 439,423,401	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2029	$ 446,822,827	$ 446,693,400	$ 446,466,424	$ 446,466,424	$ 446,420,084	$ -	$ 129,427	$ 356,403	$ 356,403	$ 402,743	$ -	$ 106,979	$ 294,589	$ 294,589	$ 332,892
2030	$ 452,954,427	$ 452,954,427	$ 452,954,427	$ 452,954,427	$ 452,954,427	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2031	$ 178,260,912	$ 178,260,912	$ 178,257,936	$ 178,257,936	$ 178,260,912	$ -	$ -	$ 2,976	$ 2,976	$ -	$ -	$ -	$ 2,383	$ 2,383	$ -
2032	$ 466,485,452	$ 466,485,452	$ 466,485,452	$ 466,485,452	$ 466,485,452	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2033	$ 473,875,222	$ 473,743,299	$ 473,525,391	$ 473,525,391	$ 473,477,220	$ -	$ 131,923	$ 349,830	$ 349,830	$ 398,002	$ -	$ 102,334	$ 271,368	$ 271,368	$ 308,735
2034	$ 480,016,478	$ 480,016,478	$ 480,016,478	$ 480,016,478	$ 480,016,478	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2035	$ 486,781,991	$ 486,781,991	$ 486,781,991	$ 486,781,991	$ 486,781,991	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2036	$ 493,547,504	$ 493,547,504	$ 493,547,504	$ 493,547,504	$ 493,547,504	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2037	$ 500,927,617	$ 500,793,198	$ 500,584,359	$ 500,584,359	$ 500,534,356	$ -	$ 134,419	$ 343,258	$ 343,258	$ 393,261	$ -	$ 97,856	$ 249,889	$ 249,889	$ 286,290
2038	$ 507,078,529	$ 507,078,529	$ 507,078,529	$ 507,078,529	$ 507,078,529	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2039	$ 513,844,042	$ 513,844,042	$ 513,844,042	$ 513,844,042	$ 513,844,042	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2040	$ 521,216,913	$ 521,080,622	$ 520,878,584	$ 520,878,584	$ 520,827,208	$ -	$ 136,291	$ 338,329	$ 338,329	$ 389,705	$ -	$ 94,604	$ 234,846	$ 234,846	$ 270,508
						$ -	**$ 783,425**	**$ 2,128,551**	**$ 2,128,551**	**$ 2,403,420**	**$ -**	**$ 630,347**	**$ 1,724,333**	**$ 1,724,333**	**$ 1,944,181**

Benefit Cost

Table A7

Travel Time Benefits

	Yearly VHT (Only Non-Flood Event Year)					Yearly VMT (Only Major Flood Event Years)					Yearly VMT (Only Minor Flood Event Years)					Combined Yearly Vehicle Hours Traveled (VHT)				
Year	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2020	**21,213,110**	**21,213,110**	**21,213,110**	**21,213,110**	**21,213,110**	**21,265,170**	**21,259,480**	**21,238,650**	**21,238,650**	**21,240,830**	**21,214,160**	**21,214,160**	**21,213,110**	**21,213,110**	**21,214,160**	21,213,110	21,213,110	21,213,110	21,213,110	21,213,110
2021	21,637,214	21,637,214	21,637,214	21,637,214	21,637,214	21,689,977	21,684,267	21,663,211	21,663,211	21,665,502	21,638,279	21,638,279	21,637,214	21,637,214	21,638,279	**21,689,977**	**21,684,267**	**21,663,211**	**21,663,211**	**21,665,502**
2022	22,061,318	22,061,318	22,061,318	22,061,318	22,061,318	22,114,784	22,109,054	22,087,771	22,087,771	22,090,174	22,062,399	22,062,399	22,061,318	22,061,318	22,062,399	22,061,318	22,061,318	22,061,318	22,061,318	22,061,318
2023	22,485,422	22,485,422	22,485,422	22,485,422	22,485,422	22,539,591	22,533,841	22,512,332	22,512,332	22,514,845	22,486,518	22,486,518	22,485,422	22,485,422	22,486,518	22,486,518	22,486,518	22,485,422	22,485,422	22,486,518
2024	22,909,526	22,909,526	22,909,526	22,909,526	22,909,526	22,964,398	22,958,628	22,936,892	22,936,892	22,939,517	22,910,637	22,910,637	22,909,526	22,909,526	22,910,637	22,909,526	22,909,526	22,909,526	22,909,526	22,909,526
2025	23,333,630	23,333,630	23,333,630	23,333,630	23,333,630	23,389,205	23,383,415	23,361,453	23,361,453	23,364,189	23,334,757	23,334,757	23,333,630	23,333,630	23,334,757	**23,389,205**	**23,383,415**	**23,361,453**	**23,361,453**	**23,364,189**
2026	23,757,734	23,757,734	23,757,734	23,757,734	23,757,734	23,814,012	23,808,202	23,786,013	23,786,013	23,788,861	23,758,876	23,758,876	23,757,734	23,757,734	23,758,876	23,757,734	23,757,734	23,757,734	23,757,734	23,757,734
2027	24,181,838	24,181,838	24,181,838	24,181,838	24,181,838	24,238,819	24,232,989	24,210,574	24,210,574	24,213,532	24,182,995	24,182,995	24,181,838	24,181,838	24,182,995	24,181,838	24,181,838	24,181,838	24,181,838	24,181,838
2028	24,605,942	24,605,942	24,605,942	24,605,942	24,605,942	24,663,626	24,657,776	24,635,135	24,635,135	24,638,204	24,607,115	24,607,115	24,605,942	24,605,942	24,607,115	24,605,942	24,605,942	24,605,942	24,605,942	24,605,942
2029	25,030,046	25,030,046	25,030,046	25,030,046	25,030,046	25,088,433	25,082,563	25,059,695	25,059,695	25,062,876	25,031,234	25,031,234	25,030,046	25,030,046	25,031,234	**25,088,433**	**25,082,563**	**25,059,695**	**25,059,695**	**25,062,876**
2030	25,454,150	25,454,150	25,454,150	25,454,150	25,454,150	25,513,240	25,507,350	25,484,256	25,484,256	25,487,548	25,455,353	25,455,353	25,454,150	25,454,150	25,455,353	25,454,150	25,454,150	25,454,150	25,454,150	25,454,150
2031	25,878,254	25,878,254	25,878,254	25,878,254	25,878,254	25,938,047	25,932,137	25,908,816	25,908,816	25,912,219	25,879,472	25,879,472	25,878,254	25,878,254	25,879,472	25,879,472	25,879,472	25,878,254	25,878,254	25,879,472
2032	26,302,358	26,302,358	26,302,358	26,302,358	26,302,358	26,362,854	26,356,924	26,333,377	26,333,377	26,336,891	26,303,592	26,303,592	26,302,358	26,302,358	26,303,592	26,302,358	26,302,358	26,302,358	26,302,358	26,302,358
2033	26,726,462	26,726,462	26,726,462	26,726,462	26,726,462	26,787,661	26,781,711	26,757,937	26,757,937	26,761,563	26,727,711	26,727,711	26,726,462	26,726,462	26,727,711	**26,787,661**	**26,781,711**	**26,757,937**	**26,757,937**	**26,761,563**
2034	27,150,566	27,150,566	27,150,566	27,150,566	27,150,566	27,212,468	27,206,498	27,182,498	27,182,498	27,186,235	27,151,830	27,151,830	27,150,566	27,150,566	27,151,830	27,150,566	27,150,566	27,150,566	27,150,566	27,150,566
2035	27,574,670	27,574,670	27,574,670	27,574,670	27,574,670	27,637,275	27,631,285	27,607,058	27,607,058	27,610,906	27,575,950	27,575,950	27,574,670	27,574,670	27,575,950	27,574,670	27,574,670	27,574,670	27,574,670	27,574,670
2036	27,998,774	27,998,774	27,998,774	27,998,774	27,998,774	28,062,082	28,056,072	28,031,619	28,031,619	28,035,578	28,000,069	28,000,069	27,998,774	27,998,774	28,000,069	27,998,774	27,998,774	27,998,774	27,998,774	27,998,774
2037	28,422,878	28,422,878	28,422,878	28,422,878	28,422,878	28,486,889	28,480,859	28,456,180	28,456,180	28,460,250	28,424,188	28,424,188	28,422,878	28,422,878	28,424,188	**28,486,889**	**28,480,859**	**28,456,180**	**28,456,180**	**28,460,250**
2038	28,846,982	28,846,982	28,846,982	28,846,982	28,846,982	28,911,696	28,905,646	28,880,740	28,880,740	28,884,922	28,848,308	28,848,308	28,846,982	28,846,982	28,848,308	28,846,982	28,846,982	28,846,982	28,846,982	28,846,982
2039	29,271,086	29,271,086	29,271,086	29,271,086	29,271,086	29,336,503	29,330,433	29,305,301	29,305,301	29,309,593	29,272,427	29,272,427	29,271,086	29,271,086	29,272,427	29,271,086	29,271,086	29,271,086	29,271,086	29,271,086
2040	**29,695,190**	**29,695,190**	**29,695,190**	**29,695,190**	**29,695,190**	**29,761,310**	**29,755,220**	**29,729,861**	**29,729,861**	**29,734,265**	**29,696,546**	**29,696,546**	**29,695,190**	**29,695,190**	**29,696,546**	**29,761,310**	**29,755,220**	**29,729,861**	**29,729,861**	**29,734,265**

Major Flood Year Calculation

Minor Flood Year Calculation

	Annual Time Cost					Travel Time Benefit					Present Value Travel Time Benefit (2017 dollars)				
Year	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2020															
2021	$ 499,796,661.24	$ 499,665,087.15	$ 499,179,888.69	$ 499,179,888.69	$ 499,232,684.24	$ -	$ 131,574	$ 616,773	$ 616,773	$ 563,977	$ -	$ 123,480	$ 578,829	$ 578,829	$ 529,281
2022	$ 508,353,378.39	$ 508,353,378.39	$ 508,353,378.39	$ 508,353,378.39	$ 508,353,378.39	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2023	$ 518,151,152.56	$ 518,151,152.56	$ 518,125,900.02	$ 518,125,900.02	$ 518,151,152.56	$ -	$ -	$ 25,253	$ 25,253	$ -	$ -	$ -	$ 22,958	$ 22,958	$ -
2024	$ 527,898,421.64	$ 527,898,421.64	$ 527,898,421.64	$ 527,898,421.64	$ 527,898,421.64	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2025	$ 538,951,543.96	$ 538,818,126.45	$ 538,312,055.87	$ 538,312,055.87	$ 538,375,100.83	$ -	$ 133,418	$ 639,488	$ 639,488	$ 576,443	$ -	$ 117,507	$ 563,226	$ 563,226	$ 507,700
2026	$ 547,443,464.90	$ 547,443,464.90	$ 547,443,464.90	$ 547,443,464.90	$ 547,443,464.90	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2027	$ 557,215,986.53	$ 557,215,986.53	$ 557,215,986.53	$ 557,215,986.53	$ 557,215,986.53	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2028	$ 566,988,508.16	$ 566,988,508.16	$ 566,988,508.16	$ 566,988,508.16	$ 566,988,508.16	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2029	$ 578,106,426.68	$ 577,971,165.75	$ 577,444,223.05	$ 577,444,223.05	$ 577,517,517.42	$ -	$ 135,261	$ 662,204	$ 662,204	$ 588,909	$ -	$ 111,802	$ 547,352	$ 547,352	$ 486,770
2030	$ 586,533,551.41	$ 586,533,551.41	$ 586,533,551.41	$ 586,533,551.41	$ 586,533,551.41	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2031	$ 596,334,146.02	$ 596,334,146.02	$ 596,306,073.04	$ 596,306,073.04	$ 596,334,146.02	$ -	$ -	$ 28,073	$ 28,073	$ -	$ -	$ -	$ 22,479	$ 22,479	$ -
2032	$ 606,078,594.67	$ 606,078,594.67	$ 606,078,594.67	$ 606,078,594.67	$ 606,078,594.67	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2033	$ 617,261,309.39	$ 617,124,205.05	$ 616,576,390.23	$ 616,576,390.23	$ 616,659,934.01	$ -	$ 137,104	$ 684,919	$ 684,919	$ 601,375	$ -	$ 106,354	$ 531,300	$ 531,300	$ 466,494
2034	$ 625,623,637.92	$ 625,623,637.92	$ 625,623,637.92	$ 625,623,637.92	$ 625,623,637.92	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2035	$ 635,396,159.55	$ 635,396,159.55	$ 635,396,159.55	$ 635,396,159.55	$ 635,396,159.55	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2036	$ 645,168,681.18	$ 645,168,681.18	$ 645,168,681.18	$ 645,168,681.18	$ 645,168,681.18	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2037	$ 656,416,192.11	$ 656,277,244.34	$ 655,708,557.40	$ 655,708,557.40	$ 655,802,350.60	$ -	$ 138,948	$ 707,635	$ 707,635	$ 613,842	$ -	$ 101,153	$ 515,151	$ 515,151	$ 446,871
2038	$ 664,713,724.44	$ 664,713,724.44	$ 664,713,724.44	$ 664,713,724.44	$ 664,713,724.44	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2039	$ 674,486,246.06	$ 674,486,246.06	$ 674,486,246.06	$ 674,486,246.06	$ 674,486,246.06	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2040	$ 685,782,354.15	$ 685,642,023.82	$ 685,057,682.79	$ 685,057,682.79	$ 685,159,163.05	$ -	$ 140,330	$ 724,671	$ 724,671	$ 623,191	$ -	$ 97,408	$ 503,021	$ 503,021	$ 432,580
						$ -	**$ 816,635**	**$ 4,089,015**	**$ 4,089,015**	**$ 3,567,737**	**$ -**	**$ 657,703**	**$ 3,284,317**	**$ 3,284,317**	**$ 2,869,696**

Benefit Cost

Table A8

Operating & Maintenance Benefits

	Operating & Maintenance Costs					Operating & Maintenance Benefit					Present Value Operating and Maintenance Benefit (2017 dollars)				
Year	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct	No Build	CSAH 6 Reconstruct	TH 19 Reconstruct	TH 19 Reconstruct (w/o Trail)	TH 93 Reconstruct
2020	$ -	$ -	$ -	$ -	$ -										
2021	$ 89,000	$ 48,000	$ 67,000	$ 67,000	$ 67,000	$ -	$ 41,000	$ 22,000	$ 22,000	$ 22,000	$ -	$ 38,478	$ 20,647	$ 20,647	$ 20,647
2022	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2023	$ 6,000	$ 6,000	$ -	$ -	$ 6,000	$ -	$ -	$ 6,000	$ 6,000	$ -	$ -	$ -	$ 5,455	$ 5,455	$ -
2024	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2025	$ 89,000	$ 48,000	$ 67,000	$ 67,000	$ 67,000	$ -	$ 41,000	$ 22,000	$ 22,000	$ 22,000	$ -	$ 36,111	$ 19,376	$ 19,376	$ 19,376
2026	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2027	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2028	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2029	$ 89,000	$ 48,000	$ 67,000	$ 67,000	$ 67,000	$ -	$ 41,000	$ 22,000	$ 22,000	$ 22,000	$ -	$ 33,889	$ 18,184	$ 18,184	$ 18,184
2030	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2031	$ 6,000	$ 6,000	$ -	$ -	$ 6,000	$ -	$ -	$ 6,000	$ 6,000	$ -	$ -	$ -	$ 4,804	$ 4,804	$ -
2032	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2033	$ 89,000	$ 48,000	$ 67,000	$ 67,000	$ 67,000	$ -	$ 41,000	$ 22,000	$ 22,000	$ 22,000	$ -	$ 31,804	$ 17,066	$ 17,066	$ 17,066
2034	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2035	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2036	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2037	$ 89,000	$ 48,000	$ 67,000	$ 67,000	$ 67,000	$ -	$ 41,000	$ 22,000	$ 22,000	$ 22,000	$ -	$ 29,848	$ 16,016	$ 16,016	$ 16,016
2038	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2039	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2040	$ 89,000	$ 48,000	$ 67,000	$ 67,000	$ 67,000	$ -	$ 41,000	$ 22,000	$ 22,000	$ 22,000	$ -	$ 28,460	$ 15,271	$ 15,271	$ 15,271
Total						$ -	$ 246,000	$ 144,000	$ 144,000	$ 132,000	$ -	$ 198,589	$ 116,819	$ 116,819	$ 106,560

Major Flood Year **Minor Flood Year**

NOTES: Operations and Maintenance cost include any work to close, open, repair, provide detours, and maintain any flooded roadways

Maintenance and Repair Costs:

	Estimate Costs
CR 6 Closure Repairs	$ 35,000
TH 93 Closure Repairs	$ 20,000
TH 19 Closure Repairs	$ 20,000
MnDOT Detour Costs (2 Closures)	$ 8,000
MnDOT Detour Costs (1 Closures)	$ 6,000
County Detour Costs	$ 6,000

NOTES: CR 6 Closure Repair Costs provided by Sibley County for 2014 flood conditions.
MnDOT provided estimated closure repair costs for each flood event.
MnDOT Detour Costs ranges from $3,000 to $8,000; a conservative $8,000 was used for this analysis.

Appendix E

Henderson Flood Study Cost Estimates

Henderson Flood Study Cost Estimate - SP 4004-124

Full Reconstruction - TH 93

2/21/2017

Item Description	Units	Unit Cost	Quantity		Total
PAVING AND GRADING (P & G) COSTS					
Bituminous Pavement	ton	$60.00	20,430	$	1,225,813
Concrete Pavement	sq yd	$55.00	0	$	-
Class 5 Aggregate Base	cu yd	$23.00	10,744	$	247,120
Excavation Subgrade	cu yd	$8.00	41,111	$	328,886
Excavation Common	cu yd	$4.00	36,025	$	144,100
Common Embankment	cu yd	$4.00	277,110	$	1,108,439
Select Granular Borrow (CV)	cu yd	$14.00	41,111	$	575,550
Curb and Gutter Design B624	lin ft	$20.00	500	$	10,000
Guardrail	lin ft	$20.00	2,865	$	57,300
Geotechnical Correction (RSS)	sq yd	$400.00		$	-
(a) Subtotal Paving and Grading				**$**	**3,697,208**
UTILITIES, REMOVALS, DRAINAGE, ETC.					
Removals/Clear and Grub		7.0%		$	258,805
Utilities		10.0%		$	369,721
Signing, Striping, Traffic Control		4.0%		$	147,888
Erosion Control and Turf Establishment		5.0%		$	184,860
Wetland Replacement (2:1 ratio)	Acre	$40,000	10	$	400,000
Levee Modification	each	$500,000	1	$	500,000
Flood Storage Mitigation	each	$525,000	1	$	525,000
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$**	**2,386,274**
DRAINAGE					
Drainage and Infiltration Basins		15.0%		$	554,581
(c) Subtotal Drainage				**$**	**554,581**
STRUCTURES/SIGNALS/MISC. COST					
Bridge - Rush River	sq ft	$200	9,000	$	1,800,000
				$	-
(d) Subtotal Structural				**$**	**1,800,000**
(a+b+c+d) Subtotal Construction				**$**	**8,438,063**
Risk & Contingency		20.0%		$	1,687,613
TMP		5.0%		$	421,903
Mobilization		4.0%		$	337,523
(e) Subtotal Miscellaneous				**$**	**2,447,038**
(a+b+c+d+e) Total Construction				**$**	**10,885,101**
Administrative & Engineering					
Business	each				$0
Residence	total	$680,400	1	$	680,400
RW Cost		$184,002	1	$	184,002
Project Engineering		20%		$	2,177,020.18
Total A&E				**$**	**3,041,422**
Total Estimated Cost				**$**	**13,926,523**
2018 Inflation Adjusted Cost (1.07)				**$**	**14,901,380**

Henderson Flood Study Cost Estimate - SP 4004-124

Full Reconstruction - TH 19 With Trail

2/21/2017

Item Description	Units	Unit Cost	Quantity	Total
PAVING AND GRADING (P & G) COSTS				
Bituminous Pavement	ton	$60.00	2,935	$ 176,072
Concrete Pavement	sq yd	$55.00	0	$ -
Class 5 Aggregate Base	cu yd	$23.00	1,543	$ 35,483
Excavation Subgrade	cu yd	$8.00	5,904	$ 47,234
Excavation Common	cu yd	$4.00	136	$ 544
Common Embankment	cu yd	$4.00	56,255	$ 225,022
Select Granular Borrow (CV)	cu yd	$14.00	5,904	$ 82,660
Curb and Gutter Design B624	lin ft	$20.00	1,044	$ 20,880
Sidewalk	sq ft	$5.00	3,130	$ 15,650
Rip Rap class 2	cu yd	$100.00	1,510	$ 151,030
Rip Rap class 4	cu yd	$100.00	1,959	$ 195,859
Geotechnical Correction (RSS)	cu yd	$400.00		$ -
(a) Subtotal Paving and Grading				**$ 950,434**
UTILITIES, REMOVALS, DRAINAGE, ETC.				
Removals/Clear and Grub		7.0%		$ 66,530
Utilities		4.0%		$ 38,017
Signing, Striping, Traffic Control		4.0%		$ 38,017
Erosion Control and Turf Establishment		5.0%		$ 47,522
Wetland Replacement (2:1 ratio)	Acre	$40,000	4	$ 160,000
Levee Modification	each	$500,000	1	$ 500,000
				$ -
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$ 850,087**
DRAINAGE				
Drainage and Infiltration Basins		10.0%		$ 95,043
(c) Subtotal Drainage				**$ 95,043**
STRUCTURES/SIGNALS/MISC. COST				
Bridge	sq ft	$160	149,517	$ 23,922,752
				$ -
(d) Subtotal Structural				**$ 23,922,752**
(a+b+c+d) Subtotal Construction				**$ 25,818,316**
Risk & Contingency		20.0%		$ 5,163,663
TMP		5.0%		$ 1,290,916
Mobilization		4.0%		$ 1,032,733
(e) Subtotal Miscellaneous				**$ 7,487,312**
(a+b+c+d+e) Total Construction				**$ 33,305,628**
Administrative & Engineering				
Business	each			$0
Residence	each			$ -
RW Cost		$47,014	1	$ 47,014
Project Engineering		20%		$ 6,661,125.63
Total A&E				**$ 6,708,140**
Total Estimated Cost				**$ 40,013,768**
2018 Inflation Adjusted Cost (1.07)				**$ 42,814,732**

Henderson Flood Study Cost Estimate - SP 4004-124

Full Reconstruction - TH 19 W/O Trail

2/21/2017

Item Description	Units	Unit Cost	Quantity		Total
PAVING AND GRADING (P & G) COSTS					
Bituminous Pavement	ton	$60.00	2,935	$	176,072
Concrete Pavement	sq yd	$55.00	0	$	-
Class 5 Aggregate Base	cu yd	$23.00	1,543	$	35,483
Excavation Subgrade	cu yd	$8.00	5,904	$	47,234
Excavation Common	cu yd	$4.00	136	$	544
Common Embankment	cu yd	$4.00	56,255	$	225,022
Select Granular Borrow (CV)	cu yd	$14.00	5,904	$	82,660
Curb and Gutter Design B624	lin ft	$20.00	1,044	$	20,880
Sidewalk	sq ft	$5.00	3,130	$	15,650
Rip Rap class 2	cu yd	$100.00	1,510	$	151,030
Rip Rap class 4	cu yd	$100.00	1,959	$	195,859
Geotechnical Correction (RSS)	cu yd	$400.00		$	-
(a) Subtotal Paving and Grading				**$**	**950,434**
UTILITIES, REMOVALS, DRAINAGE, ETC.					
Removals/Clear and Grub		7.0%		$	66,530
Utilities		4.0%		$	38,017
Signing, Striping, Traffic Control		4.0%		$	38,017
Erosion Control and Turf Establishment		5.0%		$	47,522
Wetland Replacement (2:1 ratio)	Acre	$40,000	4	$	160,000
Levee Modification	each	$500,000	1	$	500,000
				$	-
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$**	**850,087**
DRAINAGE					
Drainage and Infiltration Basins		10.0%		$	95,043
(c) Subtotal Drainage				**$**	**95,043**
STRUCTURES/SIGNALS/MISC. COST					
Bridge	sq ft	$160	123,245	$	19,719,226
				$	-
(d) Subtotal Structural				**$**	**19,719,226**
(a+b+c+d) Subtotal Construction				**$**	**21,614,790**
Risk & Contingency		20.0%		$	4,322,958
TMP		5.0%		$	1,080,740
Mobilization		4.0%		$	864,592
(e) Subtotal Miscellaneous				**$**	**6,268,289**
(a+b+c+d+e) Total Construction				**$**	**27,883,079**
Administrative & Engineering					
Business	each				$0
Residence	each			$	-
RW Cost		$47,014	1	$	47,014
Project Engineering		20%		$	5,576,615.82
Total A&E				**$**	**5,623,630**
Total Estimated Cost				**$**	**33,506,709**
2018 Inflation Adjusted Cost (1.07)				**$**	**35,852,179**

Henderson Flood Study Cost Estimate - SP 4004-124

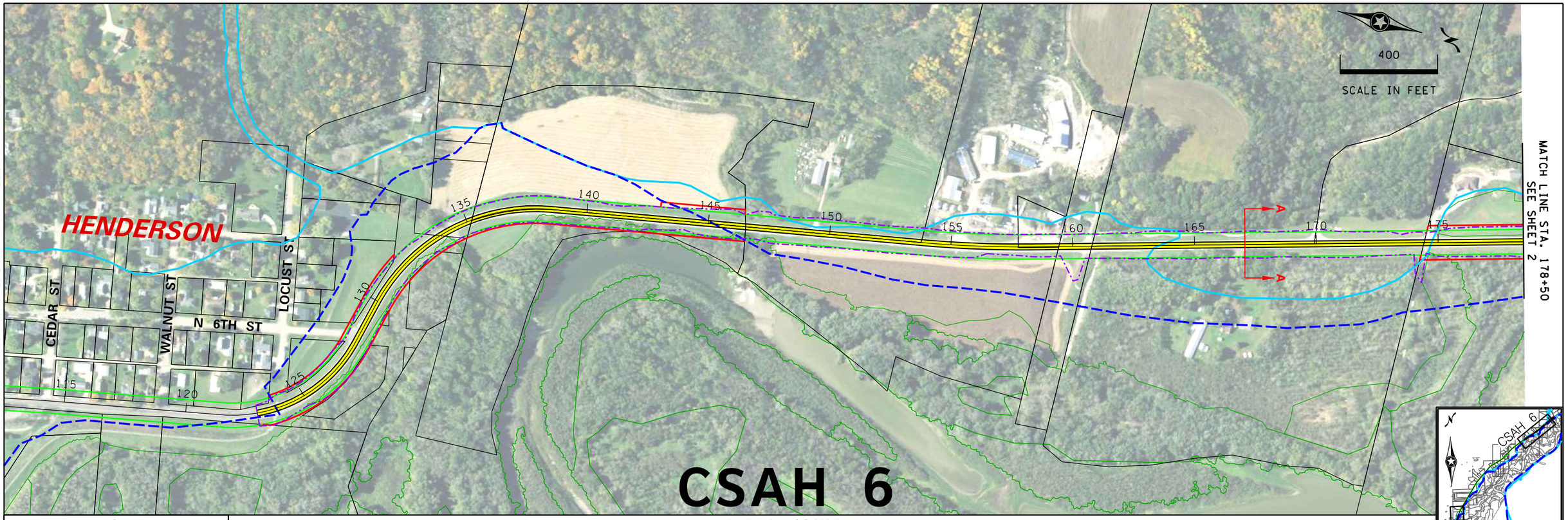
Full Reconstruction - County Road 6

2/21/2017

Item Description	Units	Unit Cost	Quantity		Total
PAVING AND GRADING (P & G) COSTS					
Bituminous Pavement	ton	$60.00	34,266	$	2,055,954
Concrete Pavement	sq yd	$55.00	0	$	-
Class 5 Aggregate Base	cu yd	$23.00	17,847	$	410,471
Excavation Subgrade	cu yd	$8.00	68,720	$	549,756
Excavation Common	cu yd	$4.00	36,360	$	145,440
Common Embankment	cu yd	$4.00	398,096	$	1,592,385
Select Granular Borrow (CV)	cu yd	$14.00	68,720	$	962,074
Curb and Gutter Design B624	lin ft	$20.00		$	-
Geotechnical Correction (RSS)	sq yd	$400.00		$	-
(a) Subtotal Paving and Grading				**$**	**5,716,080**
UTILITIES, REMOVALS, DRAINAGE, ETC.					
Removals/Clear and Grub		7.0%		$	400,126
Utilities		4.0%		$	228,643
Signing, Striping, Traffic Control		4.0%		$	228,643
Erosion Control and Turf Establishment		5.0%		$	285,804
Wetland Replacement (2:1 ratio)	Acre	$40,000	16	$	640,000
Levee Modification	each	$500,000	1	$	500,000
Flood Storage Mitigation		$447,237	1	$	447,237
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$**	**2,730,453**
DRAINAGE					
Drainage and Infiltration Basins		15.0%		$	857,412
(c) Subtotal Drainage				**$**	**857,412**
STRUCTURES/SIGNALS/MISC. COST					
Bridge - High Island Creek	sq ft	$200	3,840	$	768,000
				$	-
(d) Subtotal Structural				**$**	**768,000**
(a+b+c+d) Subtotal Construction				**$**	**10,071,945**
Risk & Contingency		20.0%		$	2,014,389
TMP		5.0%		$	503,597
Mobilization		4.0%		$	402,878
(e) Subtotal Miscellaneous				**$**	**2,920,864**
(a+b+c+d+e) Total Construction				**$**	**12,992,809**
Administrative & Engineering					
Business	each				$0
Residence	each			$	-
RW Cost	acre	$106,742	1	$	106,742
Project Engineering		20%		$	2,598,561.78
Total A&E				**$**	**2,705,304**
Total Estimated Cost				**$**	**15,698,113**
2018 Inflation Adjusted Cost (1.07)				**$**	**16,796,981**

Appendix F

Highway 19, Highway 93 and County Road 6 Preferred Design Alternatives



LEGEND

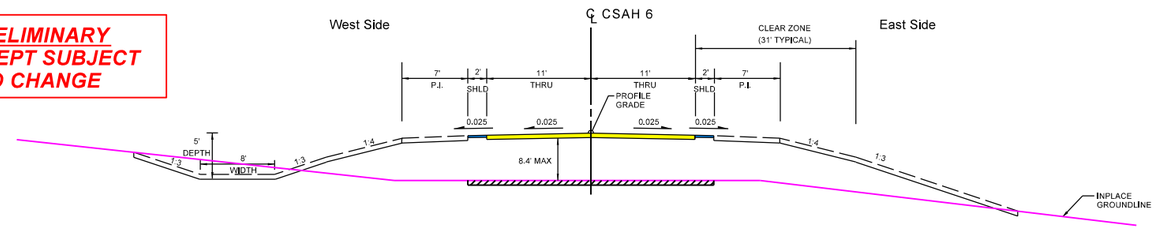
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- CONSTRUCTION LIMITS
- EXISTING RIGHT OF WAY
- PROPOSED RIGHT OF WAY
- PARCEL LINES (GIS)
- WETLANDS (GIS)
- FLOODPLAIN
- FLOODWAY

PRELIMINARY CONCEPT SUBJECT TO CHANGE

TYPICAL SECTION CSAH 6

A–A

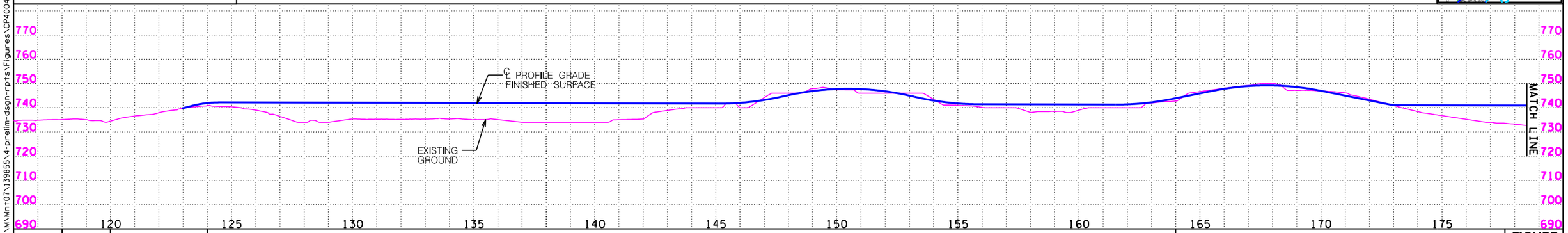
Looking North



CSAH 6 SUMMARY

COST (2017$) -	$15.7 million
BENEFIT COST -	0.12

Mitigation Required to Achieve No Rise (0.00'):
Acquire propery and excavate upto 576,700 cu ft of fill from floodway and lower a portion of CSAH 5 to offset raising the CSAH 5 intersection



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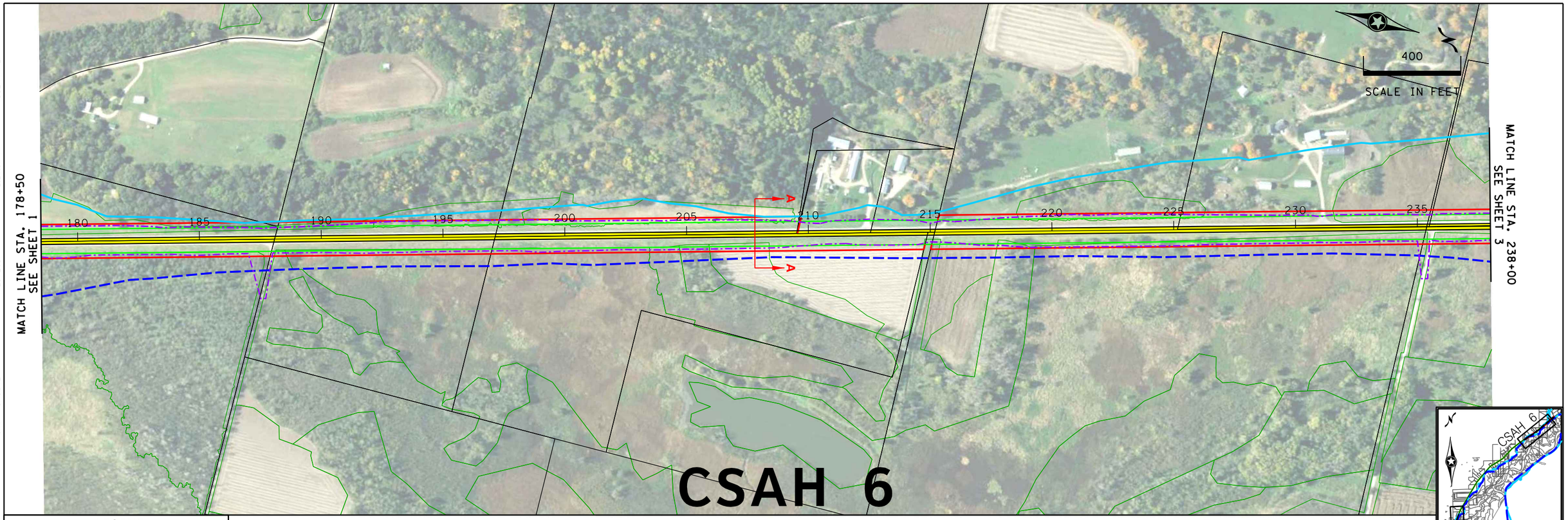
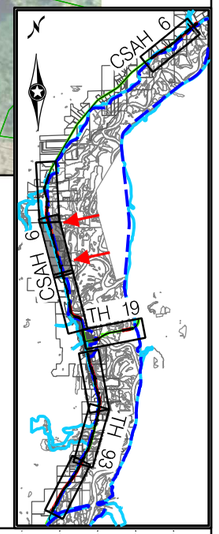
MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

CSAH 6 ALTERNATIVE

FIGURE NO. 1





LEGEND

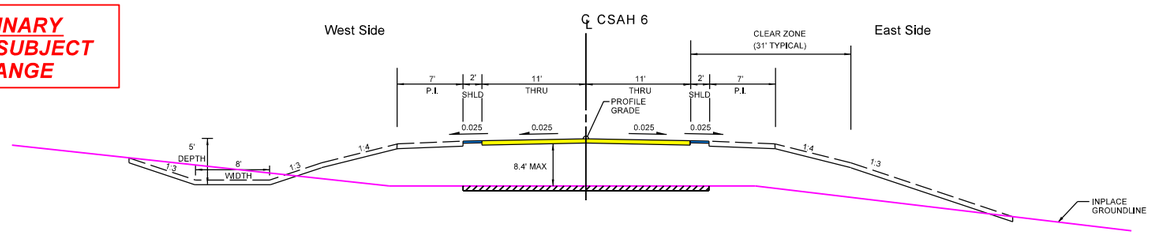
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- CONSTRUCTION LIMITS
- EXISTING RIGHT OF WAY
- PROPOSED RIGHT OF WAY
- PARCEL LINES (GIS)
- WETLANDS (GIS)
- FLOODPLAIN
- FLOODWAY

PRELIMINARY CONCEPT SUBJECT TO CHANGE

TYPICAL SECTION CSAH 6

A–A

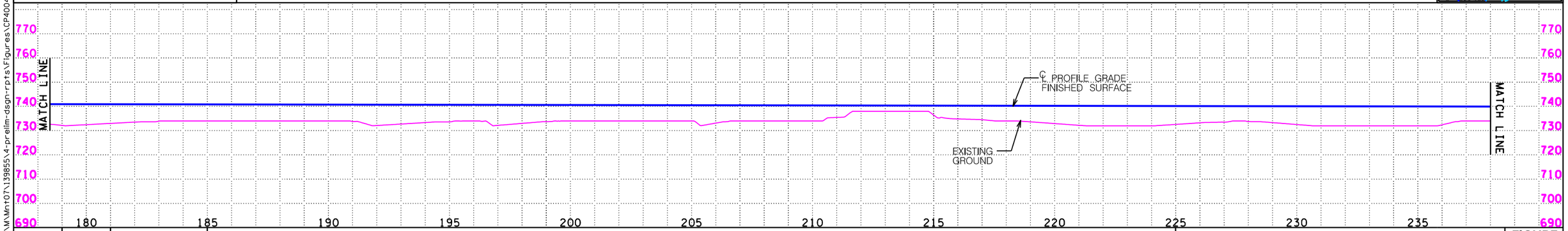
Looking North



CSAH 6 SUMMARY

COST (2017$) -	$15.7 million
BENEFIT COST -	0.12

Mitigation Required to Achieve No Rise (0.00'):
Acquire propery and excavate upto 576,700 cu ft of fill from floodway and lower a portion of CSAH 5 to offset raising the CSAH 5 intersection



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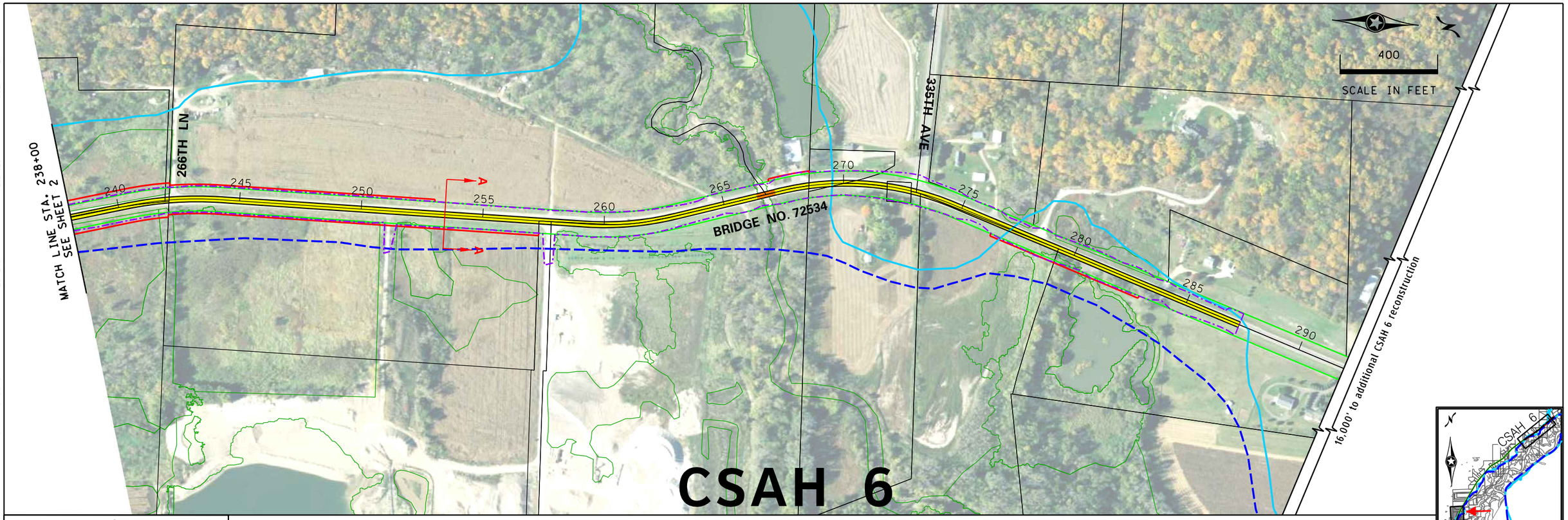
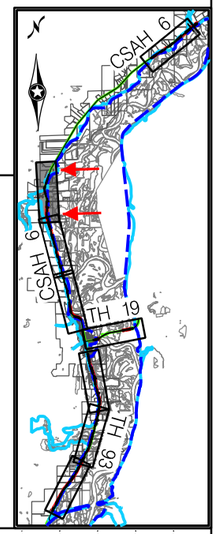
MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

CSAH 6 ALTERNATIVE

FIGURE NO. 2





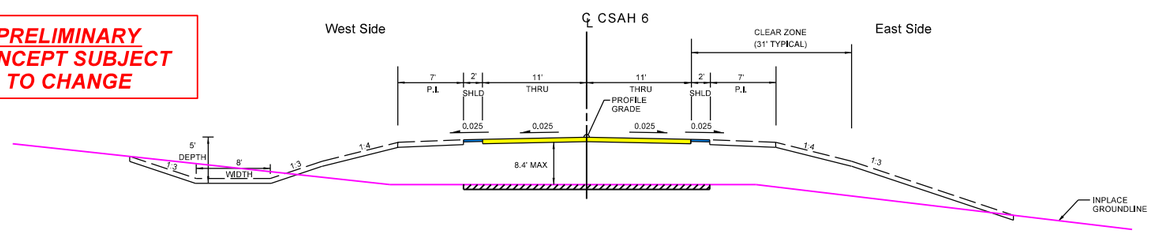
LEGEND

- PROPOSED ROADWAY
- PROPOSED BRIDGE
- CONSTRUCTION LIMITS
- EXISTING RIGHT OF WAY
- PROPOSED RIGHT OF WAY
- PARCEL LINES (GIS)
- WETLANDS (GIS)
- FLOODPLAIN
- FLOODWAY

PRELIMINARY CONCEPT SUBJECT TO CHANGE

TYPICAL SECTION CSAH 6

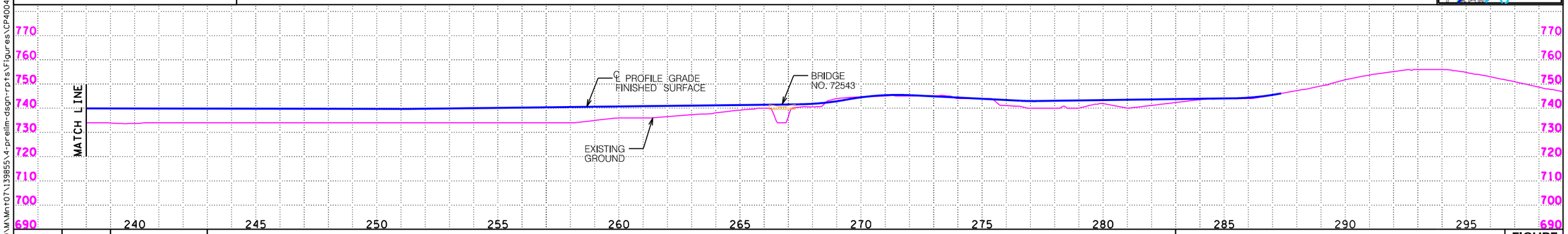
A–A
Looking North



CSAH 6 SUMMARY

COST (2017$) -	$15.7 million
BENEFIT COST -	0.12

Mitigation Required to Achieve No Rise (0.00'):
Acquire propery and excavate upto 576,700 cu ft of fill from floodway and lower a portion of CSAH 5 to offset raising the CSAH 5 intersection



4/25/2017

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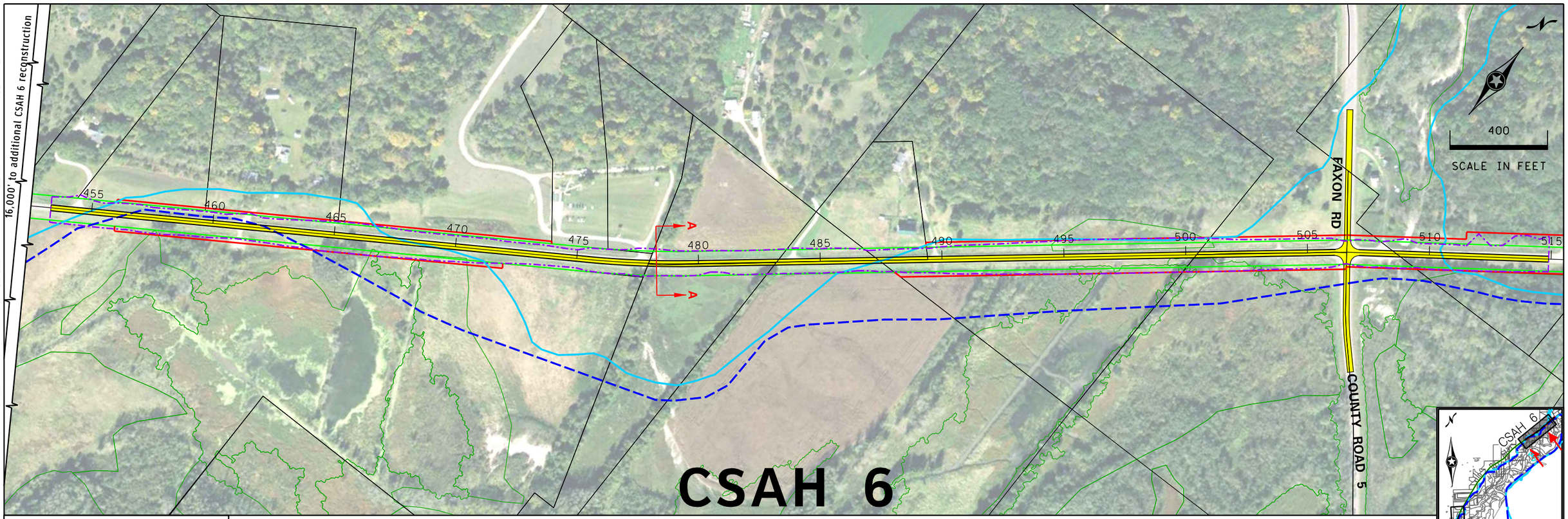
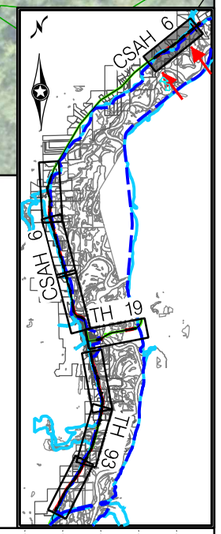
MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

CSAH 6 ALTERNATIVE

FIGURE NO. 3





LEGEND

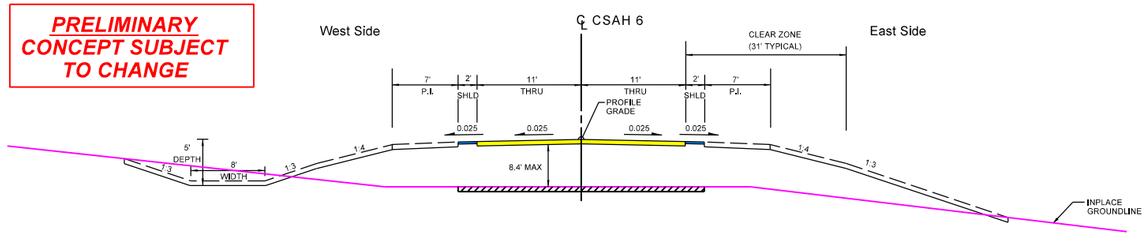
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- CONSTRUCTION LIMITS
- EXISTING RIGHT OF WAY
- PROPOSED RIGHT OF WAY
- PARCEL LINES (GIS)
- WETLANDS (GIS)
- FLOODPLAIN
- FLOODWAY

TYPICAL SECTION CSAH 6

A–A

Looking North

PRELIMINARY CONCEPT SUBJECT TO CHANGE

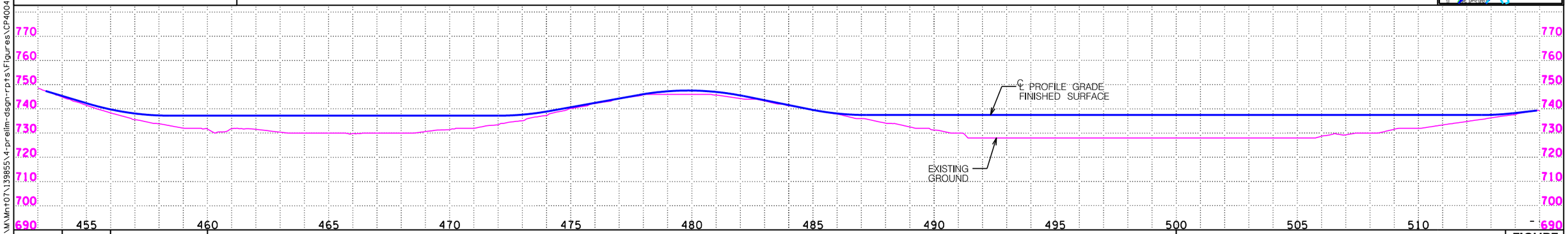


CSAH 6 SUMMARY

COST (2017$) - $15.7 million

BENEFIT COST - 0.12

Mitigation Required to Achieve No Rise (0.00'):
Acquire propery and excavate upto 576,700 cu ft of fill from floodway and lower a portion of CSAH 5 to offset raising the CSAH 5 intersection



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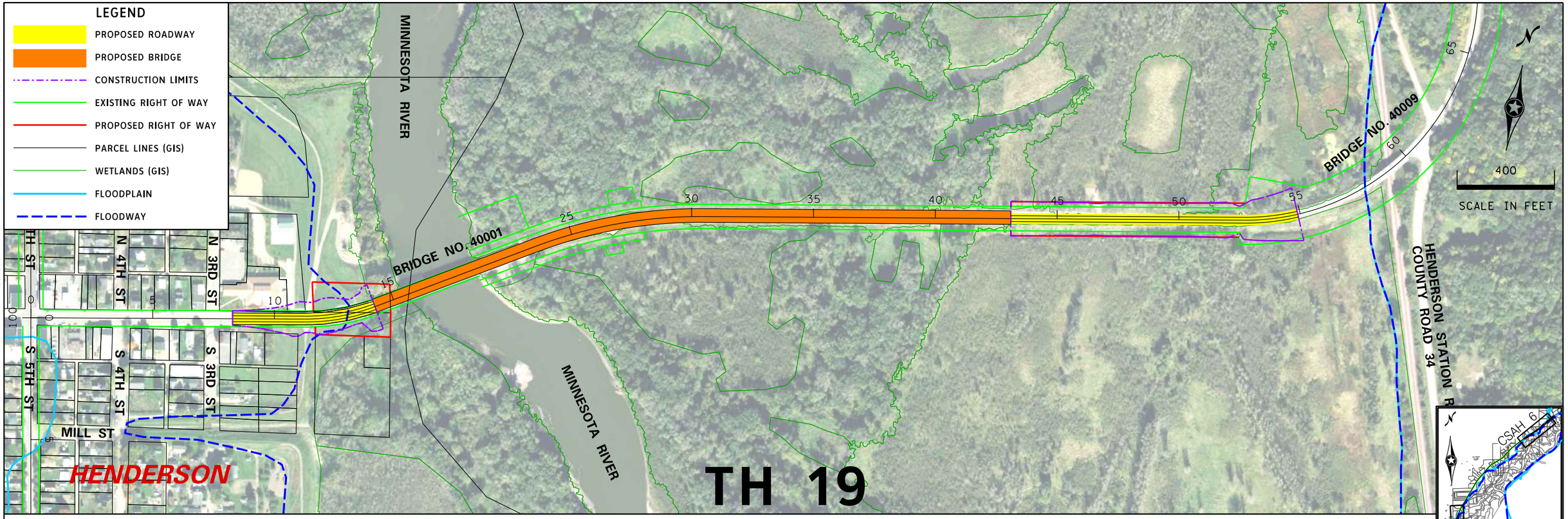
DEPARTMENT OF TRANSPORTATION

MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

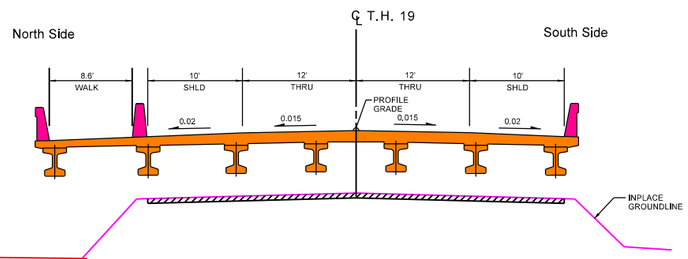
CSAH 6 ALTERNATIVE

FIGURE NO. 4



TYPICAL SECTION T.H. 19

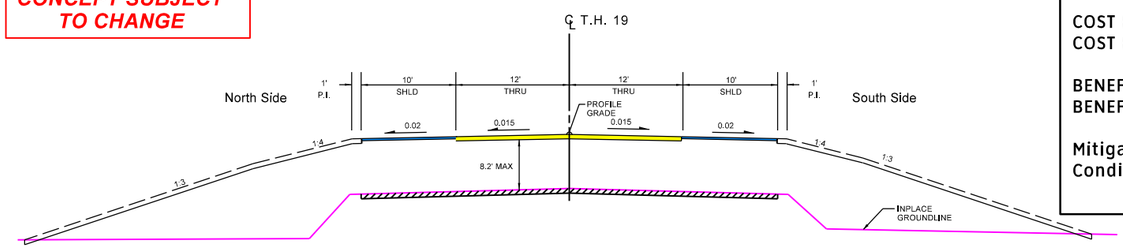
Looking East



PRELIMINARY CONCEPT SUBJECT TO CHANGE

TYPICAL SECTION T.H. 19

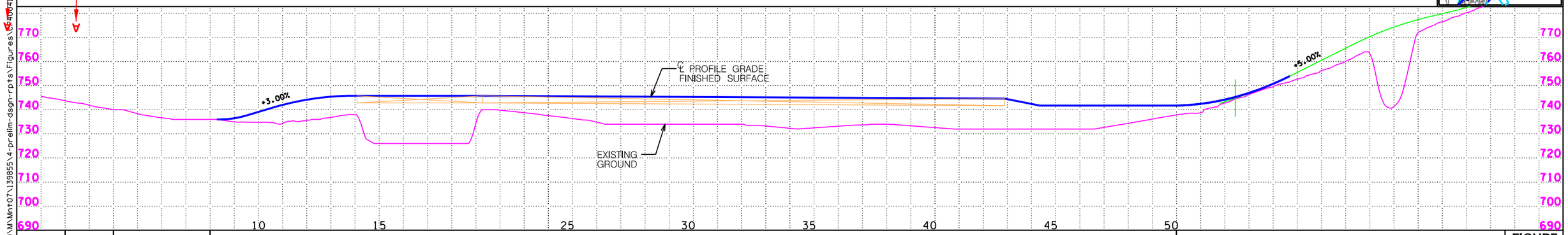
Looking East



TH 19 SUMMARY

COST (2017$) with Trail -	$40.0 million
COST (2017$) without Trail -	$33.5 million
BENEFIT COST with Trail -	0.19
BENEFIT COST without Trail -	0.22

Mitigation Required to Achieve No Rise (0.00')
Condition is a 2680' long bridge



4/25/2017

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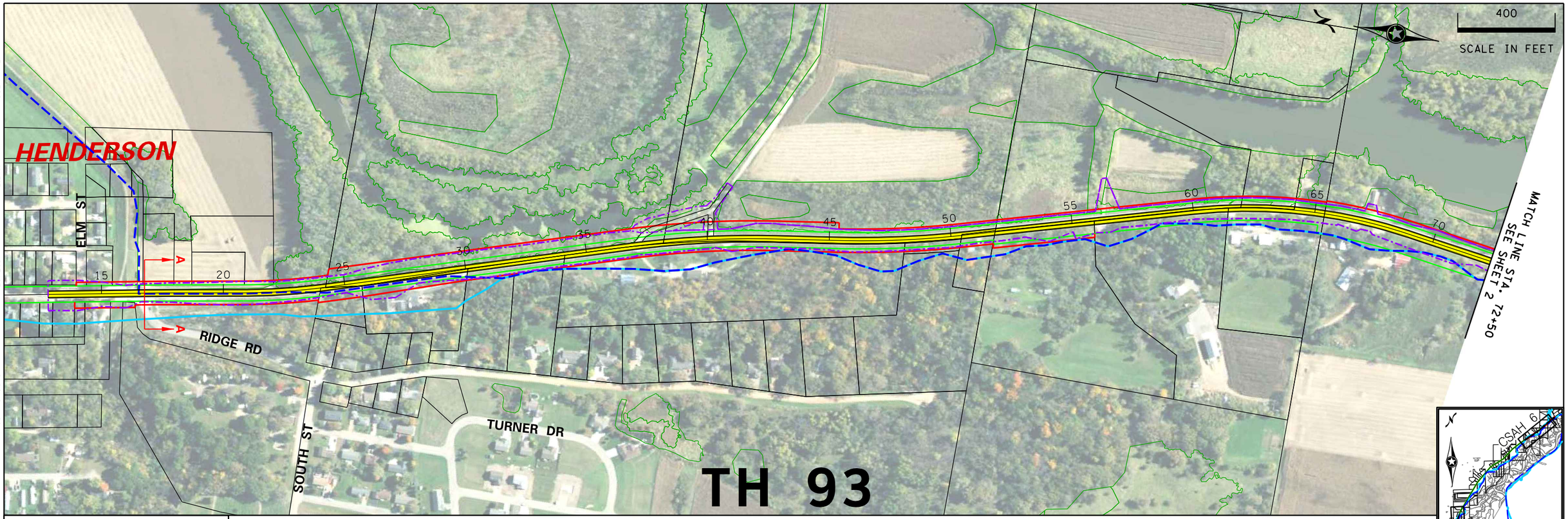
DEPARTMENT OF TRANSPORTATION

MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

TH 19 ALTERNATIVE

FIGURE NO. 1



LEGEND

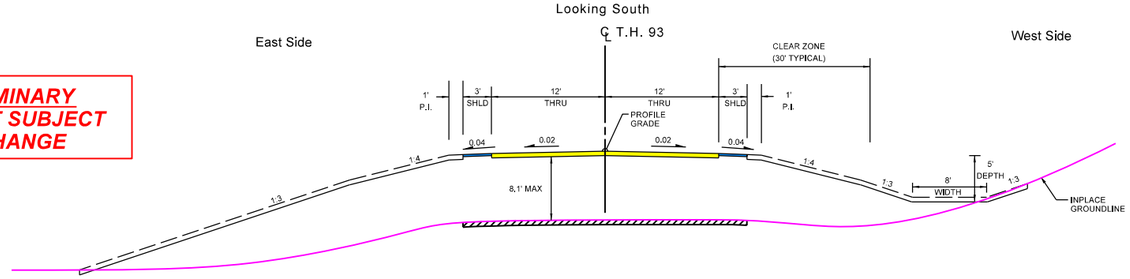
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- CONSTRUCTION LIMITS
- EXISTING RIGHT OF WAY
- PROPOSED RIGHT OF WAY
- PARCEL LINES (GIS)
- WETLANDS (GIS)
- FLOODPLAIN
- FLOODWAY

PRELIMINARY CONCEPT SUBJECT TO CHANGE

TYPICAL SECTION T.H. 93

A–A

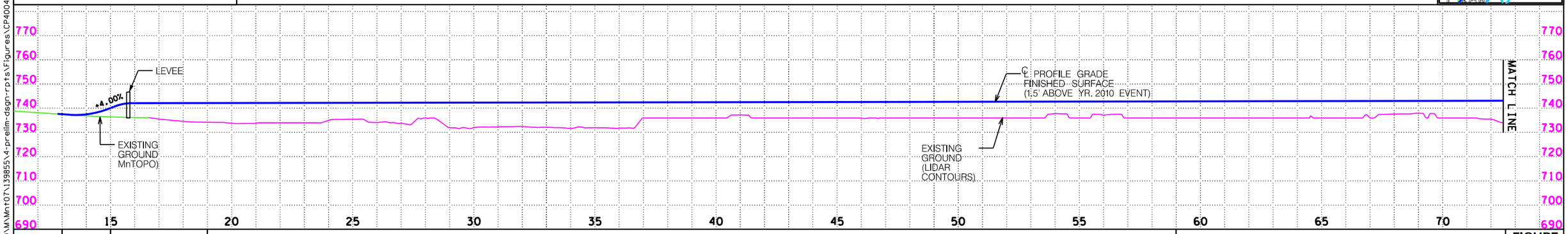
Looking South



TH 93 SUMMARY

COST (2017$) -	$13.9 million
BENEFIT COST -	0.45

Mitigation Required to Achieve No Rise (0.00'):
Lowering 1500 feet of TH 19 causeway to existing low point (approx. 732.9') to improve conveyance.



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TH93 - Sheet1
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4/25/2017

SEH

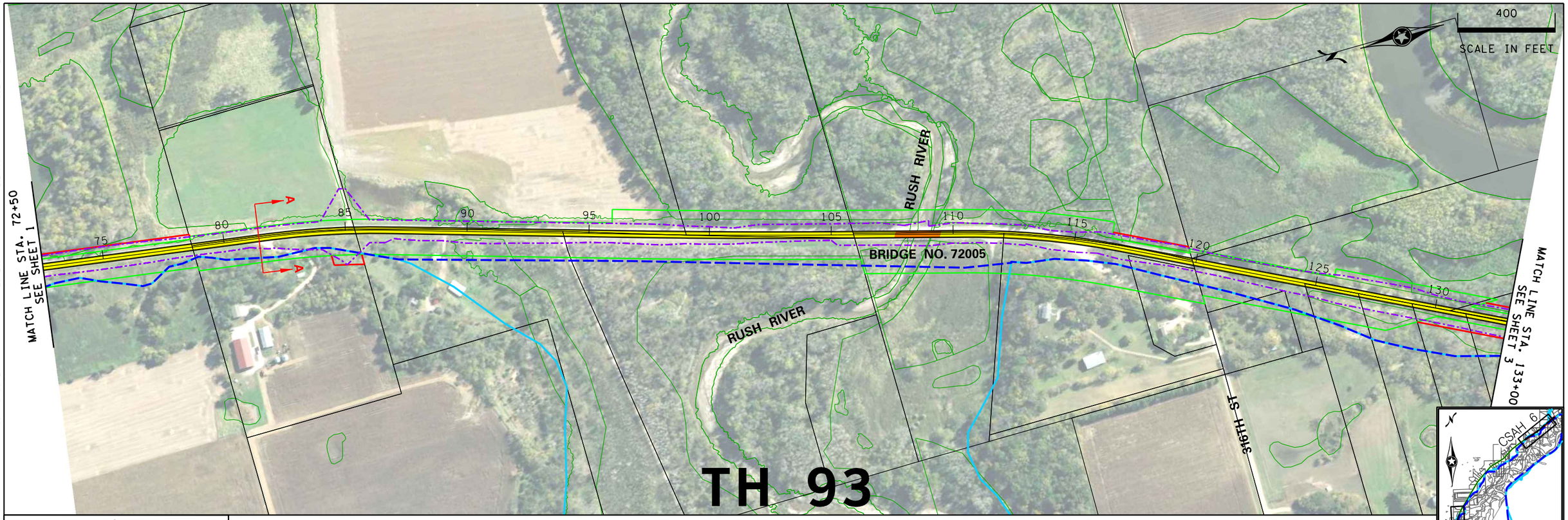
DEPARTMENT OF TRANSPORTATION

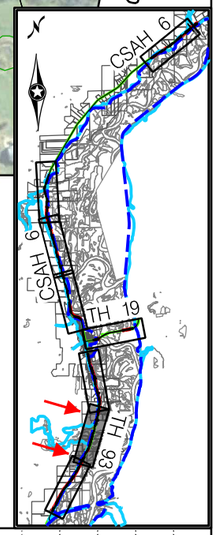
MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

TH 93 ALTERNATIVE

FIGURE NO. 1





LEGEND

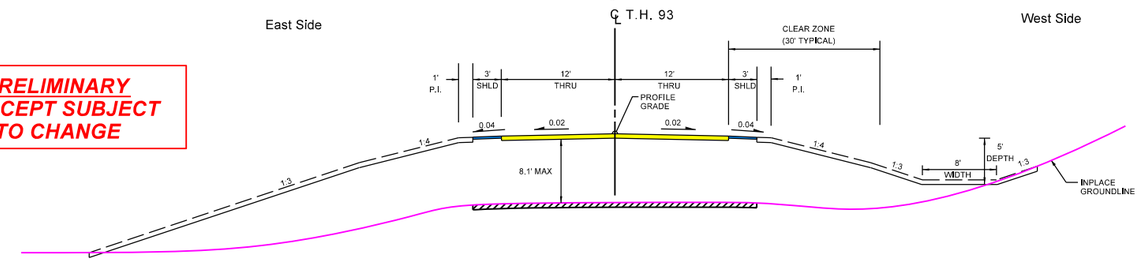
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- CONSTRUCTION LIMITS
- EXISTING RIGHT OF WAY
- PROPOSED RIGHT OF WAY
- PARCEL LINES (GIS)
- WETLANDS (GIS)
- FLOODPLAIN
- FLOODWAY

PRELIMINARY CONCEPT SUBJECT TO CHANGE

TYPICAL SECTION T.H. 93

A–A

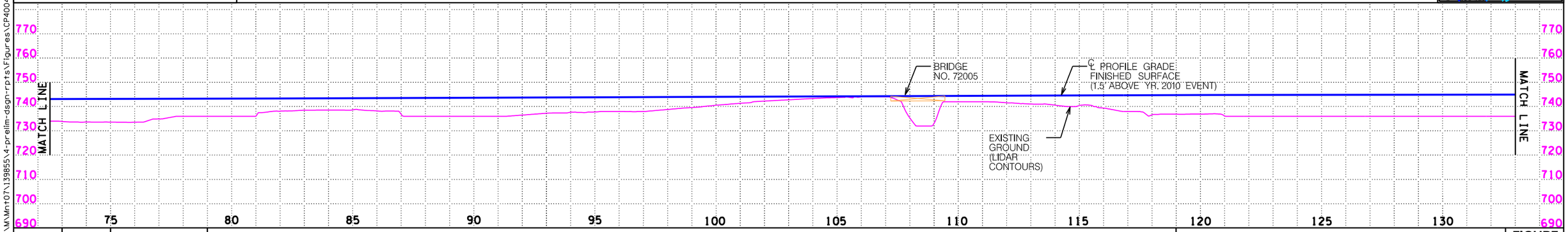
Looking South



TH 93 SUMMARY

COST (2017$) -	$13.9 million
BENEFIT COST -	0.45

Mitigation Required to Achieve No Rise (0.00'):
Lowering 1500 feet of TH 19 causeway to existing low point (approx. 732.9') to improve conveyance.



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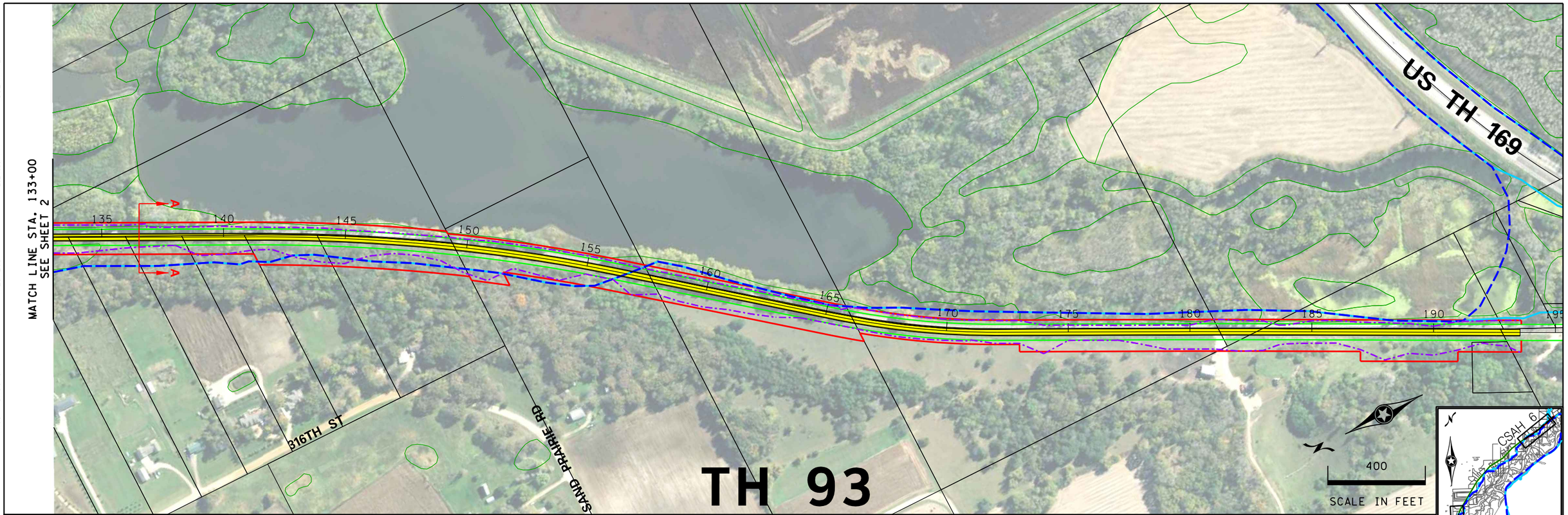
MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

TH 93 ALTERNATIVE

FIGURE NO. 2



LEGEND

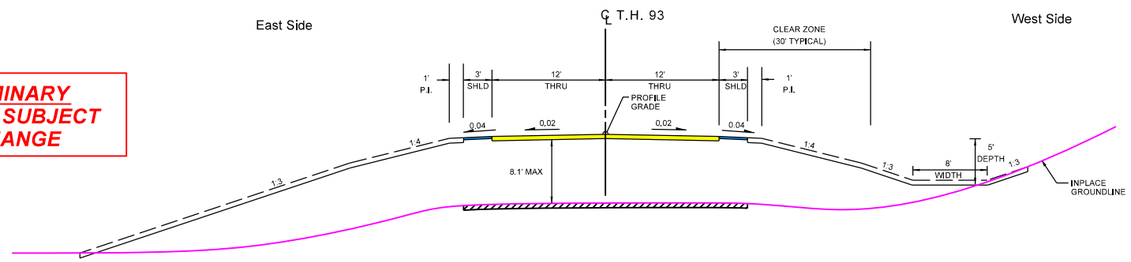
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- CONSTRUCTION LIMITS
- EXISTING RIGHT OF WAY
- PROPOSED RIGHT OF WAY
- PARCEL LINES (GIS)
- WETLANDS (GIS)
- FLOODPLAIN
- FLOODWAY

PRELIMINARY CONCEPT SUBJECT TO CHANGE

TYPICAL SECTION T.H. 93

A–A

Looking South



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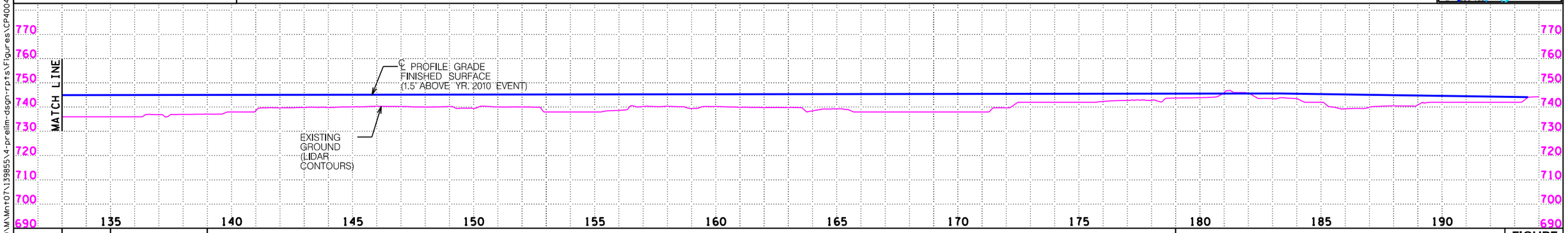

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MINNESOTA RIVER FLOOD MITIGATION STUDY IN HENDERSON, MN.

S.P. 4004–124

TH 93 ALTERNATIVE

FIGURE NO. 3

Appendix G

Better Detour Routes Memorandum

Building a Better World
for All of Us®

TECHNICAL MEMORANDUM

TO: Matt Young, P.E.
MnDOT District 7 – Project Manager

FROM: Bob Rogers, AICP
SEH – Transportation Planner

Mark Benson, P.E.
SEH – Project Manager

DATE: March 13, 2017

RE: Henderson Flood Mitigation Study – Reconstruction of "Better Detour Routes" to 10-ton Structural Capacity
SEH No. MNT07 139855

BACKGROUND

This technical memorandum summarizes the process and findings associated with a review of potential improvements needed to existing routes in order to provide a 10-ton network in/out of Henderson when flood events along the Minnesota River close other area roadways (e.g. TH 19, TH 93, and Sibley CSAH 6).

Both a northern and southern "better detour" route was identified by the Henderson Feasibility Study Project Management Team (PMT). Each route is described below and depicted on the attached figure:

- Northern Detour Route – beginning at the intersection of TH 19/TH 93 in downtown Henderson, this detour route travels west along TH 19 for approximately 10.1 miles to the intersection of TH 19 and Sibley CSAH 9 (411th Avenue). This route follows CSAH 9 north approximately 2.8 miles to TH 5 near Arlington. TH 5 is an existing 10-ton roadway providing access to northern destinations (e.g. TH 25 or US 212). An existing 38' by 78' timber slab span bridge is present along CSAH 9.

- Southern Detour Route – beginning at the intersection of TH 19/TH 93 in downtown Henderson, this detour route travels west along TH 19 for approximately 8.1 miles to the intersection of TH 19 and Sibley CSAH 17 (391st Avenue). This route follows CSAH 17 south approximately 6.3 miles to the intersection of CSAH 8 (336th Street). This route then follows CSAH 8 approximately 5.9 miles to US Highway 169 near Le Sueur. US 169 is an existing 10-ton roadway providing access to both south and northern destinations.

MnDOT District 7 and Sibley County provided guidance on the reconstruction costs related to upgrading these roadways to a 10-ton structural capacity. These values along with the estimated reconstruction costs of each detour route is presented on the following page.

Reconstruction of "Better Detour Routes" to 10-ton Structural Capacity

North Detour Route		
Roadway	*Distance (miles)*	*Reconstruction Cost[a]*
TH 19 Bluff Area (TH 93 to top of bluff)	*1.0*	*$4 million*
TH 19 top of bluff to CSAH 9	*9.1*	*$18.2 million*
CSAH 9 to TH 5	*2.8*	*$1.4 million*
Replace CSAH 9 timber slab span bridge[b]	*n/a*	*$600,000*
Total	***12.9 miles***	***$24.2 million***
South Detour Route		
Roadway	*Distance*	*Reconstruction Cost[a]*
TH 19 Bluff Area (TH 93 to top of bluff)	*1.0*	*$4 million*
TH 19 top of bluff to CSAH 17	*7.1*	*$14.2 million*
CSAH 17 to CSAH 8[c]	*6.3*	*$3.15 million*
CSAH 8 to US 169[d]	*5.9*	*$2.95 million*
Total	***20.3 miles***	***$24.3 million***

[a] Reconstruction Costs per/mile

- *TH 19 Bluff Area = $4M/mi.*
- *TH 19 (non-bluff area) = $2M/mi.*
- *Sibley CSAH routes = $500K/mi.*

[b] CSAH 9 Bridge Reconstruction Cost= 78'x38'x$200=$600k

[c] Assumes CSAH 17 bridge over North Branch of Rush River is sufficient

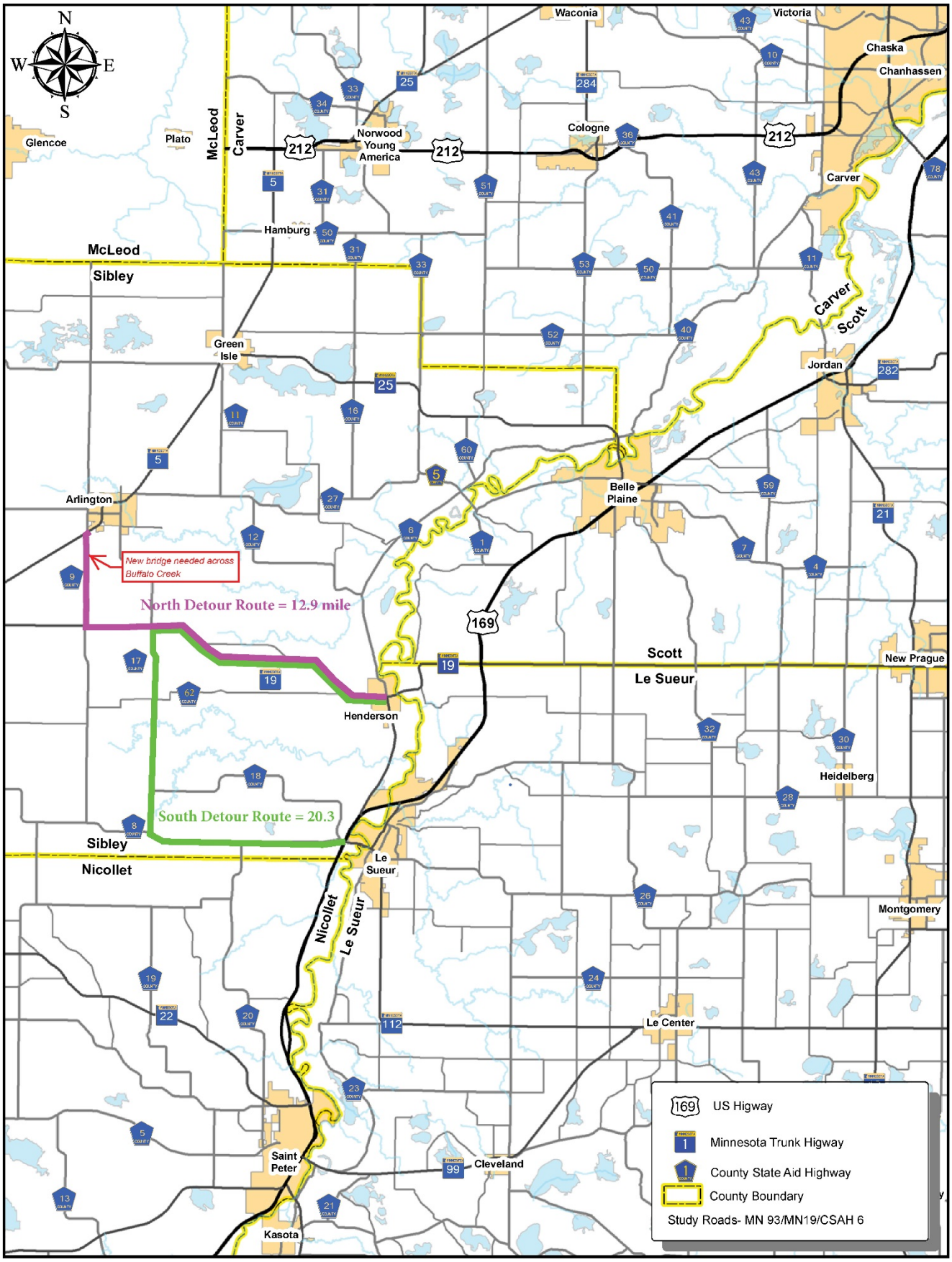
[d] Assumes CSAH 8 bridge over South Branch of Rush River is sufficient

A review of the traffic analysis and the Collar County Travel Demand Model outputs indicates that the southern detour route (CSAH 17 to CSAH 8 to US 169) serves substantially higher levels of traffic compared to the north detour route (CSAH 9 to TH 5), when the three flood prone roadways in/out of Henderson (e.g. TH 19 east, CSAH 93, and CSAH 6) are closed during flood events.

Attachment:

Figure 1 – Better Detour Route Figure

FIGURE 1 – IMPROVED DETOUR ROUTES



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We're confident in our ability to balance these requirements.

SEH