Technical Memorandum

To: Merissa Lore, Ditch Inspector
Faribault County

From: Joe Lewis, PE
Houston Engineering, Inc.

Subject: County Ditch 60 Repair Project

Date: July 12, 2019

Project: 6255-0011

INTRODUCTION

The open channel segment of Faribault County Ditch 60 (CD 60), located in Sections 1, 10, 11, and 12 of Jo Daviess Township, is in disrepair. There is significant sedimentation and, in some locations, bank sloughing affecting the function of the drainage system. In addition, segments of the ditch suffering from eroded side slopes will likely cause additional sedimentation in the channel in the near future, if not corrected. Faribault County requested Houston Engineering (HEI) to perform a field and aerial drone survey, prepare plan and profile drawings from the field survey, and develop a repair report. The purpose of this repair report is to provide an overview of drainage conditions, determine the As Constructed and Subsequently Improved Condition (ACSIC), analyze repair alternatives, and provide an opinion of probable cost to repair CD 60.

LOCATION OF THE PUBLIC DRAINAGE SYSTEM

The CD 60 public drainage system, shown in **Figure 1,** is located north and west of the City of Blue Earth in Faribault County. The portion of CD 60 requested for review is the Main Trunk open channel, located in Sections 1, 10, 11, and 12 of Jo Daviess Township (T102, R28W), which is the most downstream portion of the system. The proposed repair segment, 14,000 feet in length, begins immediately south of I-90 and extends west and south before it ends in Section 10. The multiple tile branches that outlet into the open channel are not evaluated in this report. The system outlets to the I-90 culvert structures which drain into a natural watercourse eventually entering the Blue Earth River approximately 1-mile further east. The drainage area that contributes runoff to the system is approximately 1,926 acres (3.01 square miles) and is located Sections 1, 2, 3, 4, 9, 10, 11 and 12, all in Jo Daviess Township, Minnesota. The drainage area consists predominantly of agricultural (row crop) land use with some wetland areas.

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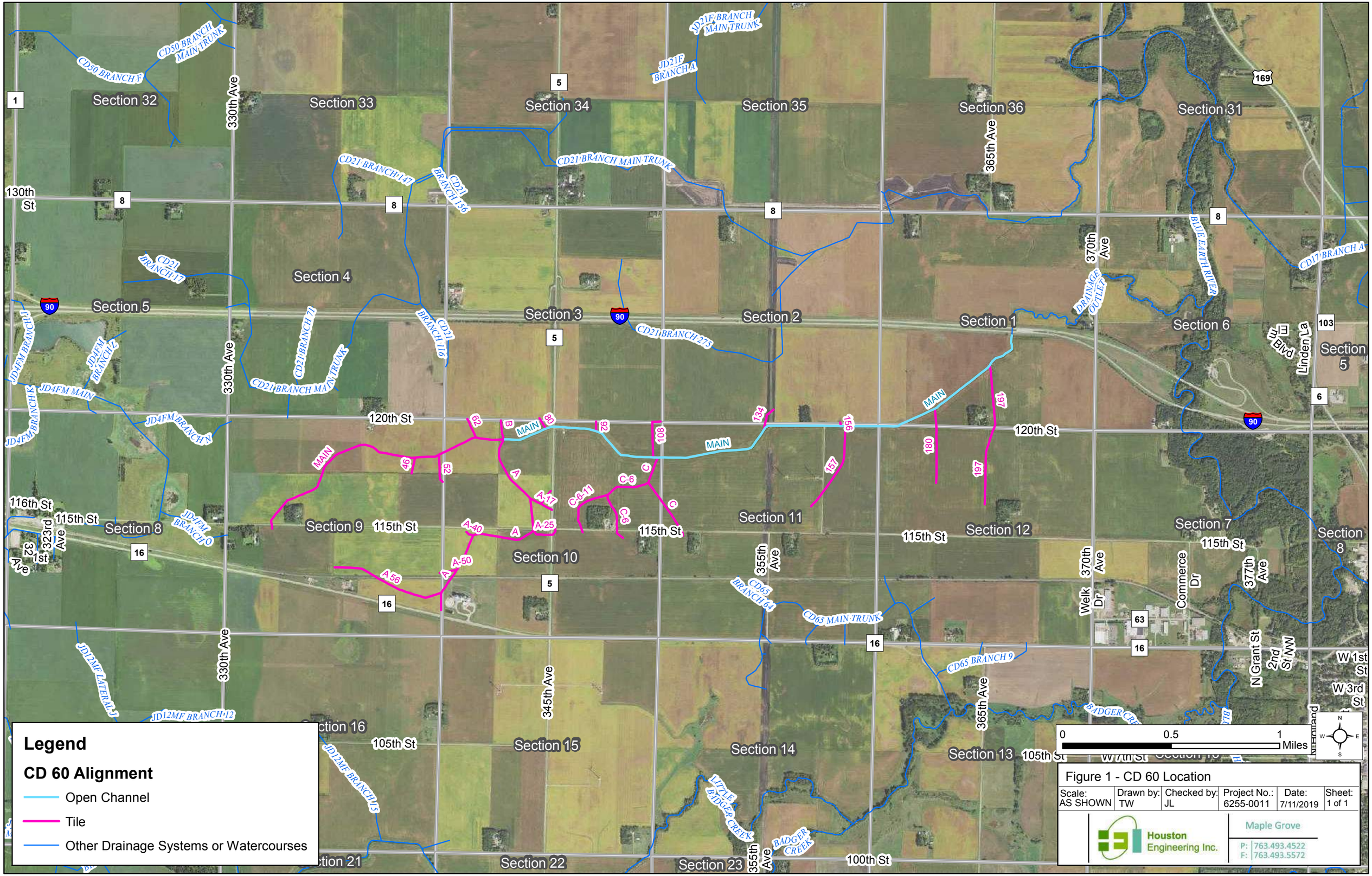

Legend

CD 60 Alignment

- Open Channel
- Tile
- Other Drainage Systems or Watercourses

0 0.5 1 Miles

N W E S

Figure 1 - CD 60 Location

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FIELD AND DRONE SURVEY

Survey data, including ground photos and topographic elevations, was collected in April 2019 to determine the existing condition of the repair segment. Numerous tile outlets enter the repair segment were surveyed, but no other survey of the tile portions of the system was completed. All survey data collected utilizes the Faribault County Coordinate System and North American Vertical Datum 1988 (NAVD88). (Note: Unless otherwise noted, all elevations provided herein are based on NAVD88 vertical datum). Site photos of key features are shown in **Attachment A**. A drone survey was performed in May of 2019 where video footage and photos were collected. The footage was filmed west to east along the CD 60 ditch and has been previously provided to County staff. Select drone photos are included in this memo as **Attachment B** to highlight the current conditions.

AS CONSTRUCTED AND SUBSEQUENTLY IMPROVED CONDITION PROFILE

The As Constructed and Subsequently Improved Condition (ACSIC) profile was determined from analyzing historical plans and from soil borings collected during the field survey. The soil borings identified the elevation of the interface between sediment (generally organic) soils and native (generally clay) soils, which are an indication of the historic channel bottom as originally constructed. A historical 1917 design profile was available but references a local datum. A comparison of the soil borings and historical design profile indicated that consistent datum adjustment factor of 1024.47 yielded a strong correlation for much of the open channel length. At the very upstream and downstream segments of the open channel, the datum adjusted design profile deviated from the soil borings. Between stations 0+00 to 23+45 at the downstream end, and 130+18 to 140+02 at the upstream end, the soil borings are approximately 1.09-feet to 2.24-feet below the historical design profile showing that these segments were likely either over-excavated when constructed and/or subsequently repaired, or have experienced downcutting by erosion over time. **Table 1** shows a comparison summary of the soil borings and historical design profiles. **Attachment C** contains plan-profile drawings showing the ACSIC and current profiles and soil borings.

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Table 1: Comparison of 1917 Design Profile to 2019 Soil Boring Results

Station	1917 Profile Elevation*	Soil Boring Elevation	Deviation from Datum Adjustment
1+89**	1070.58	1068.34	2.24
10+83**	1071.92	1070.20	1.72
23+45	1073.82	1073.66	0.16
34+18	1075.34	1075.33	0.01
38+23	1075.75	1075.74	0.01
48+81	1076.81	1077.11	-0.31
57+72	1077.70	1077.81	-0.11
67+75	1078.70	1078.64	0.06
78+73**	1079.80	1080.50	-0.70
88+88	1080.81	1080.87	-0.06
98+94	1081.79	1082.12	-0.33
108+09	1083.16	1083.31	-0.15
117+00	1084.50	1084.38	0.12
124+56	1085.63	1085.02	0.61
130+18	1086.47	1085.38	1.09
138+13**	1087.67	1085.52	2.15

* Adjusted to NAVD'88 using datum adjustment of 1024.47
** Denotes outlier

CURRENT CONDITION

The field survey data, drone video and photos were used to determine the condition of the open channel ditch. The drone survey corroborated the results of the field survey and provided a bird's eye view to accompany field survey points and photos. Based on the survey information, the CD 60 open channel is in disrepair for nearly its entire length. Most of the system has accumulated sediment in excess of 0.5-foot, and some segments have 1-2 feet of accumulated sediment.

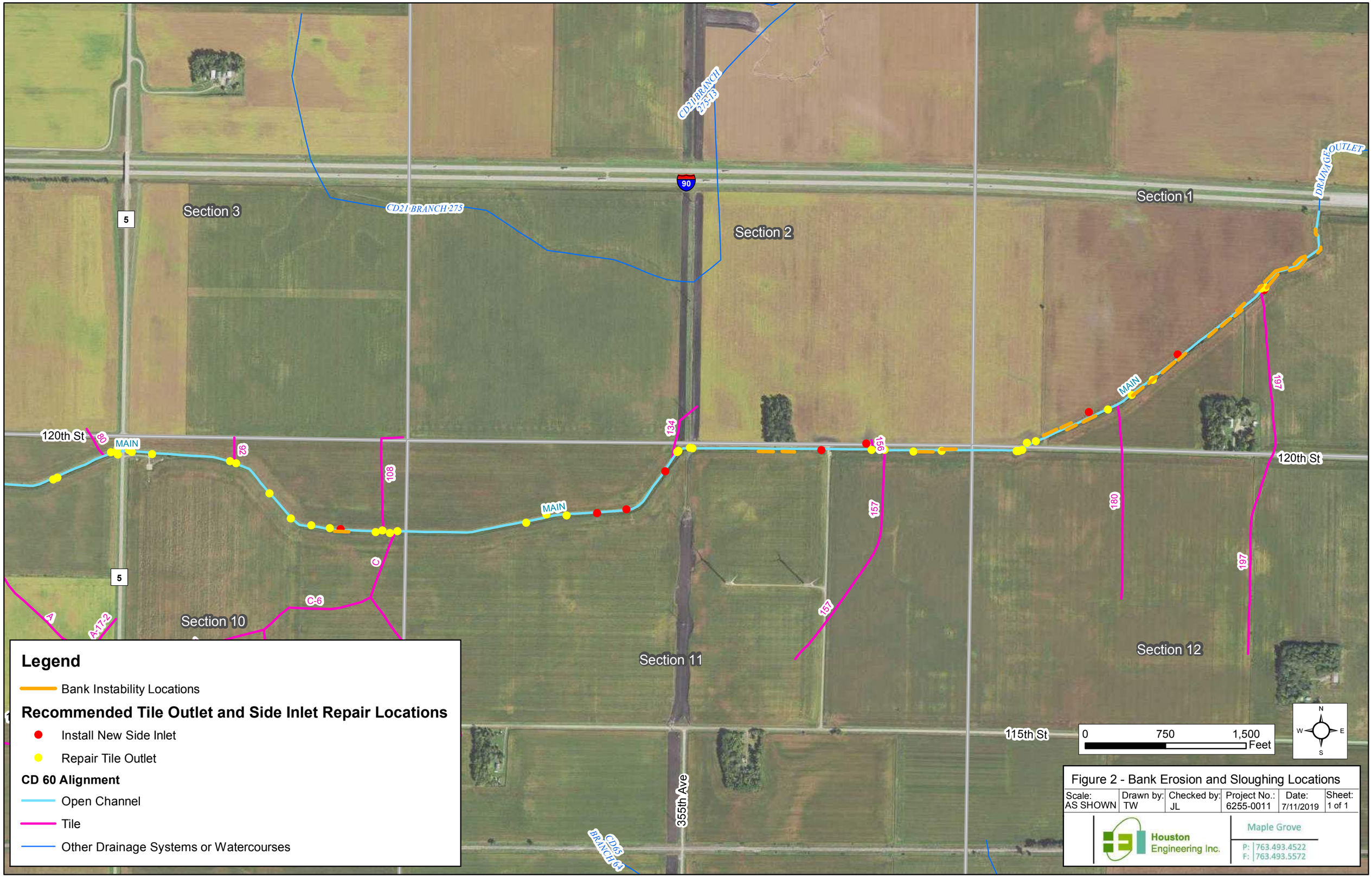
Additionally, several culverts are also above the ACSIC profile. In total, CD 60 has six culverts along the open channel detailed in **Table 2**. Culvert inverts at several crossings are elevated significantly higher than the ACSIC profile.

Table 2: County Ditch 60 Culverts

Crossing	Station	Existing Crossing	Notes	Drainage Coefficient (inches/day)
Field Crossing	35+49	60-inch CMP	Upstream invert is 0.5-feet above the ACSIC profile. It is a new crossing installed approximately 2013-2015 based on aerial photography.	1.51
120th Street	37+62	60-inch CMP	Approximately 0.8-feet above the ACSIC.	1.68
357th Avenue	56+07	48-inch CMP 30-inch CMP	Both culverts are approximately 2-feet above the ACSIC	1.29
Field Crossing	108+80	60-inch CMP	Downstream invert is 1-foot above the ACSIC. Field crossing has no fill over the pipe.	2.59
345th Avenue	127+23	78-inch RCP	Approximately 0.8-feet below the ACSIC.	6.42

Along the open channel ditch, there are numerous tile outlets from both private and public laterals. Many of these outlets have caused bank erosion by discharging onto the unprotected channel bank or the tile itself is in poor condition. There are also several locations where bank erosion is being caused by concentrated surface flow entering the open channel from adjacent fields. These locations are adding sediment to the ditch which is reducing the functionality of the ditch and reducing downstream water quality. **Figure 2** shows a map of the locations.

Additionally, there is bank sloughing along some portions of the open channel. The most widespread and severe sloughing is located between I-90 and 120th Street. Bank sloughing leads to a widening of the channel and deposition of sediment in the channel over time impacting the function of the drainage system and contributes to the degradation of water quality downstream. The locations of bank sloughing are shown on **Figure 2**.


Section 3
Section 2
Section 1
Section 10
Section 11
Section 12
CD21 BRANCH 275
CD21 BRANCH 275-1
DRAINAGE OUTLET
MAIN
MAIN
MAIN
120th St
120th St
115th St
355th Ave
CD65 BRANCH 16-1
5
5
90
80
82
108
134
156
157
157
180
197
197
C
C-6
A
A-17-2
Legend
Bank Instability Locations
Recommended Tile Outlet and Side Inlet Repair Locations
Install New Side Inlet
Repair Tile Outlet
CD 60 Alignment
Open Channel
Tile
Other Drainage Systems or Watercourses
0
750
1,500
Feet
N
W
E
S
Figure 2 - Bank Erosion and Sloughing Locations
Scale: AS SHOWN
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PROPOSED REPAIR

The goal of the proposed repair is to restore CD 60 to its ACSIC function and stabilize the open channel banks to reduce the amount of sediment entering CD 60, protecting its long-term function. The best way to achieve this is to remove accumulated sediment from the open channel to the engineer's recommended ACSIC profile elevations, modify culvert crossings, install erosion control measures and implement channel bank stability measures where necessary. The following sections provide further details.

OPEN CHANNEL EXCAVATION

The proposed repair profiles are indicated as the ACSIC profile shown in **Attachment C**. The current channel bottom of the ditch is higher than the ACSIC profile due to sediment accumulation in the channel along most of its length. Accumulated sediment in the channel bottom should be excavated, placed at the top of the ditch bank, and leveled. A 1953 repair profile drawing includes a typical cross section with the dimensions of a 4-foot bottom width and 1.5:1 side slopes. To be consistent with the definition of "repair" under Minnesota Statute 103E, excavation of the channel bottom should not exceed a 4-foot width and should be consistent with the ACSIC grade identified in **Attachment C**.

CULVERT CROSSINGS

It is recommended that the 30-inch and 48-inch culverts underneath 357th Avenue be removed and replaced with one 60-inch culvert set at the ACSIC profile elevation. The 60-inch culvert diameter matches the upstream and downstream culvert sizes and meets design criteria for open channel systems from the Minnesota Drainage Guide. It is also recommended that the 120th St. crossing be removed, and a new culvert be installed at the ACSIC profile elevation. The field crossing culvert pipe at station 108+80 should be removed as it serves no functional purpose and only acts as an obstruction in the ditch. The other two culvert crossings at 345th Avenue and the field crossing at station 35+49 are recommended to be left in place as they are properly sized and are consistent with the ACSIC profile.

TILE OUTLETS AND SIDE INLETS

Bank erosion occurring from tile outlets, side inlets and surface flow also need to be addressed. Specifically, rip rap is recommended to be installed at the outlets to prevent further erosion. Furthermore, where the tile pipe is or close to deteriorating to a condition where it may fail in the near future, it is recommended that the last 20-feet of pipe be replaced with Corrugated Plastic Pipe (CPP) of the same size. This will extend the life of the tile and decrease the likelihood that a failed outlet will impact upstream drainage. Likewise, we recommend that a drop inlet be installed at locations where erosion is being caused by surface flow into the channel from adjacent fields.

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BANK REPAIR

Forthcoming repairs should include work to address the sloughing banks to ensure long-term and reliable drainage function. There are several approaches to achieve the desired outcome, each with variable costs. The following sections describe the general approaches.

Alternative 1 – Compete Isolated Slope Repairs at Currently Instable Bank Locations

This approach seeks to limit repair costs by limiting slope repairs to the locations currently experiencing channel bank instability. Based on the field survey, approximately 3,000 linear feet of channel bank should be repaired, as shown on **Figure 2**. For those segments, the side slopes should be flattened from a 1.5:1 to a 2:1 slope, and vegetation should be rapidly reestablished by seeding and installing erosion control blanket or hydromulch. This work will likely require the acquisition of right-of-way for the widened channel top-width and temporary damages for spoil placement. An additional option with this approach is to install riprap to protect the toe and thereby prevent bank sloughing further up the bank slope. This protection measure is more commonly applied in more isolated bank instability locations. A downside of installing riprap is that it can create difficulty for future routine maintenance to remove accumulated sediment. The cost of riprap is not included in the preliminary opinion of probable construction cost.

Alternative 2 - Minor Resloping Along Segments with Widespread Bank Instability

This approach will reslope a greater length of channel bank to a 2:1 slope to protect against further future instability along segments where there is widespread bank instability. The segment between station 0+00 and 35+00 has the most widespread instability. This work will also require the acquisition of right-of-way for the widened channel top-width and temporary damages for spoil placement. Like Alternative 1, installing riprap at the slope toe would increase stability but also increase construction costs. The cost of riprap is not included in the preliminary opinion of probable construction cost.

Alternative 3 - Significant Resloping Along Segments with Widespread Bank Instability

This approach is similar to Alternative 2, except that the side slopes will be flattened to a 2.5 or 3:1 slope to provide a greater likelihood that long-term bank stability will be achieved. It will require the acquisition of additional right-of-way for the widened channel top-width and temporary damages for spoil placement. Riprap is not considered necessary for this alternative as the widened channel will see lesser erosive forces from the ditch flow. Alternatively, a two-stage ditch could be considered that includes a floodplain bench potentially allowing for a lesser amount of slope flattening to achieve bank stability.

Alternative 4 – Do Nothing to Stabilize Currently Instable Bank Locations

The “do-nothing” alternative is not seen as viable as the current open channel will certainly continue to degrade affecting its drainage function and being a source of sediment into the channel bottom and downstream.

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Beyond in-channel measures described in the above alternatives, other opportunities exist to manage upstream runoff to reduce peak flows and runoff volumes seen in the open channel to lessen the potential for continued channel bank instability. These opportunities include practices to capture and store runoff or in-field management practices to reduce runoff volumes and may beincluded in additional analysis to measure their feasibility and effectiveness.

REGULATORY CONSIDERATIONS

Based on an offsite review of the CD 60 public drainage system and adjacent lands, it does not appear that the area contains any wetland resources that would be regulated under state or federal laws. Below is a general discussion of regulatory considerations for drainage projects containing wetlands and state Public Water resources.

Wetlands

Discharges of dredge or fill material into federally regulated wetlands for the purpose of maintenance of drainage ditches is exempt from CWA Section 404 permitting requirements. USACE Regulatory Guidance Letter No. 07-02, dated July 4, 2007, defines “maintenance of drainage ditches” to include excavating accumulated sediments back to the original contours and culvert replacement, where the original function and capacity is not increased (consistent with the definition of repair in MS 103E.701). As long as a drainage system project does not include improvements to the system (above and beyond the ACSIC then the drainage system project is exempt from federal CWA permitting requirements.

Under the state Wetland Conservation Act, repairs to public drainage systems, as defined by MS 103E.701, carry exemptions for impacts resulting from the maintenance or repair of existing public drainage systems, if conducted by the authorized Drainage Authority under MN Statues 103E. An exception to this exemption is impact to a Type 3, 4, and 5 wetland (including shallow marshes, deep marshes, and open water communities) that has existed for more than 25 years before the proposed impact. Consequently, mitigation obligations for drainage system repair projects (that are maintenance or repair, not improvements) are only for any impacts to Type 3, 4, or 5 wetlands.

Other cultivated wetlands may be present within the proximity of the drainage system channel. While these wetlands are potentially present, these (Type 1) wetlands would not be subject to replacement plan or mitigation requirements of the state WCA or federal CWA. However, HEI encourages the County to direct individual landowners to coordinate with NRCS staff regarding the drainage system repair, Swampbuster and their Farm Program eligibility.

Public Waters

The drainage system channel is identified as a state Public Watercourse (#M-055-076-015) by the Public Waters Inventory (PWI). The watercourse is categorized as a Public Ditch / Altered Natural Watercourse by the MnDNR which, for a drainage system repair or maintenance project, are generally exempt from the Public Water Permitting requirements.

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PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST

Preliminary Opinion of Probable Construction Costs (POPCC) were developed for the repair alternatives and are shown in **Table 3**. Repair alternative costs includes open channel excavation, replacement of culverts, bank sloughing repairs, tile outlet replacement, and bank erosion repairs.

Table 3: County Ditch 60 Culverts

	Cost Estimate
Alternative 1	$263,110
Alternative 2	$287,010
Alternative 3	$317,510

*includes a 20% contingency, right-of-way acquisition and temporary damages.

A detailed cost table included in **Appendix D** for Alternative 3. The cost estimates provided above assume culvert replacements will be completed by the ditch authority as a single project, using open cut methods. The costs for these crossings then could be billed back to the roadway authority. Alternatively, the roadway authorities (Faribault County and the township) could elect to complete the culvert replacements themselves.

RECOMMENDATION

To restore the function of the CD 60 public drainage system to the condition as it was originally constructed, we recommend the County complete a full repair of the open channel portions of the system to the ACSIC profile as depicted in **Attachment C,** including culvert replacement, tile outlet repairs, bank erosion repairs and sloughing repairs as described in Alternative 3. Alternative 3, while more costly than Alternative 1 and 2, is recommended as it provides a much greater likelihood of long-term stability and thereby sustaining drainage function with limited maintenance. We conclude that the proposed repairs are necessary to meet the current and future drainage needs, and that the repairs are in the best interest of the property owners.

Detailed construction plans, bid documents, and specifications will need to be prepared subsequent to the County establishing and ordering a repair project. The County retains the decision whether to accept, reject or modify the Engineer's Recommendation.

CERTIFICATION

I hereby certify that the attached plan, specification, or report was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer under the laws of the State of Minnesota.

DRAFT

Joseph Lewis
MN Reg, No 46215

LIST OF ATTACHMENTS

Attachment A: Field Survey Photographs
Attachment B: Drone Flight Photographs
Attachment C: Preliminary Construction Plans
Attachment D: Detailed Preliminary Opinion of Probable Construction Cost

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ATTACHMENT A – FIELD SURVEY PHOTOGRAPHS

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Field Survey Photograph 1: Eroded Bank at Station 6+00

Field Survey Photograph 2: Eroded Bank and Fill at Station 10+50

Field Survey Photograph 3: Eroded Bank at Station 18+00

Field Survey Photograph 4: Eroded Bank at Station 30+00

Field Survey Photograph 5: Erosion and Side Inlet at Station 45+50

Field Survey Photograph 6: Broken 42” RCP at Station 69+00

Field Survey Photograph 7: 12” RCP Draintile Outlet and Eroded Bank at Station 100+00

ATTACHMENT B – DRONE SURVEY PHOTOGRAPHS

Drone Survey Photograph 1: Eroded Bank and Fill at Station 10+50

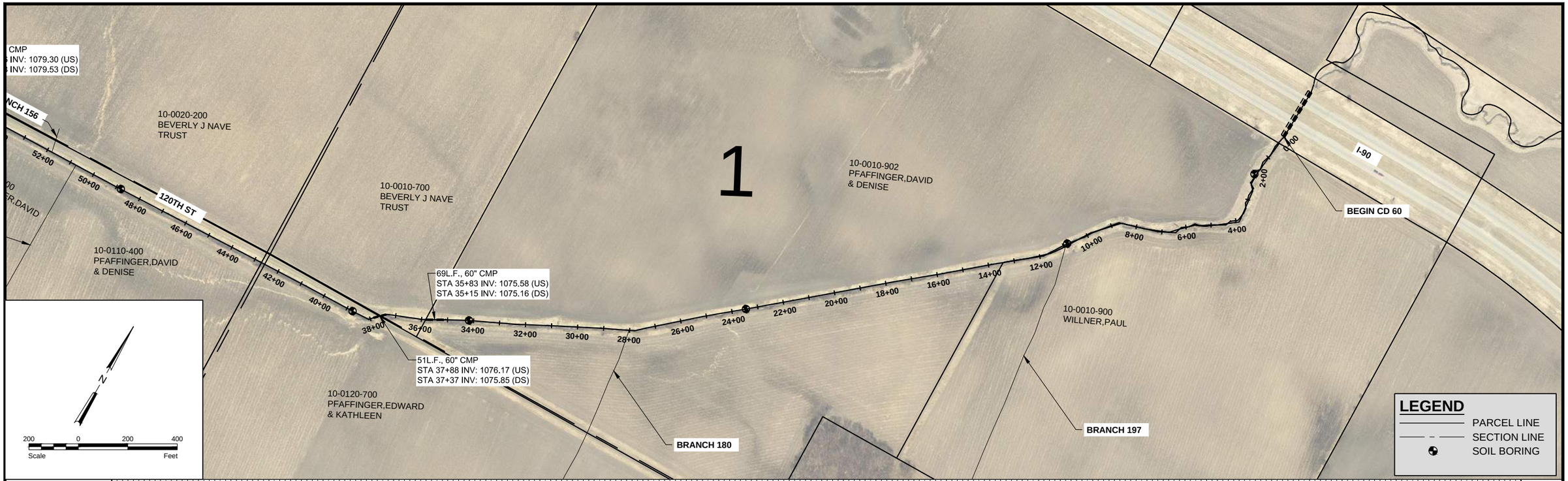
Drone Survey Photograph 2: Sloughed Bank at Station 14+00

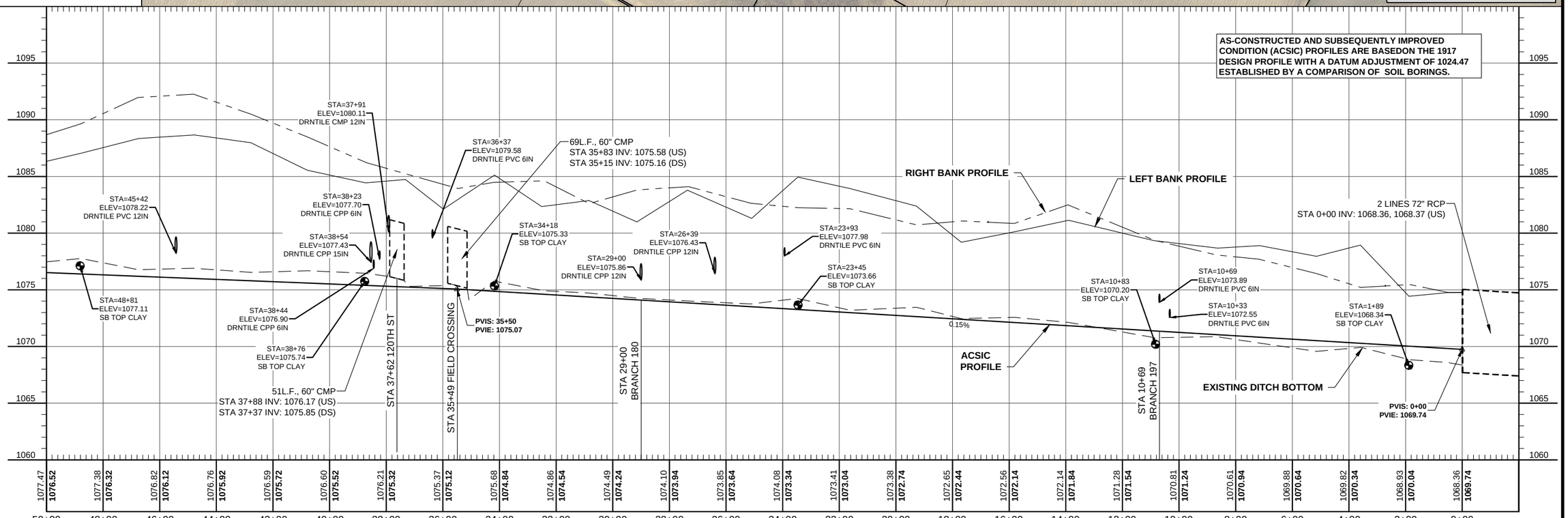
Drone Survey Photograph 3: Sloughed Bank at Station 46+00

Drone Survey Photograph 4: Removed Field Crossing and Culvert Obstruction at Station 109+00

ATTACHMENT C – PLAN-PROFILE DRAWINGS

Drone Survey Photograph 5: Tree Obstruction at Station 121+00





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FARIBAULT COUNTY DITCH 60
JO DAVIESS TOWNSHIP SECTIONS 1,10,11, AND 12
FARIBAULT COUNTY

PLAN AND PROFILE
PROJECT NO. 6255-0011

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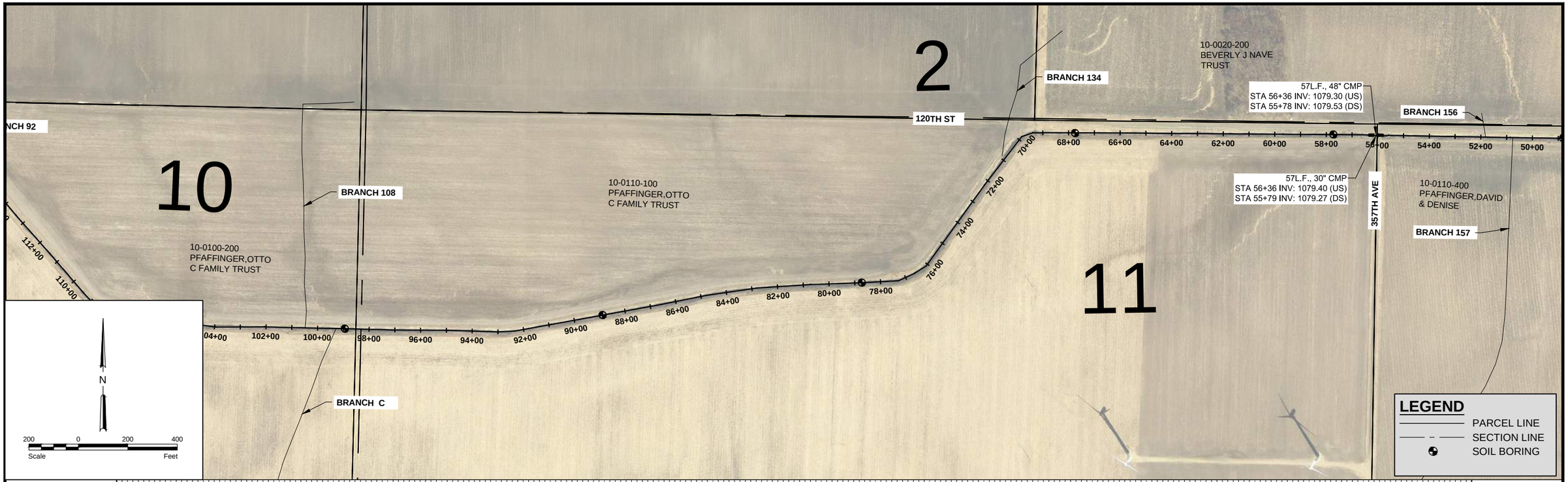

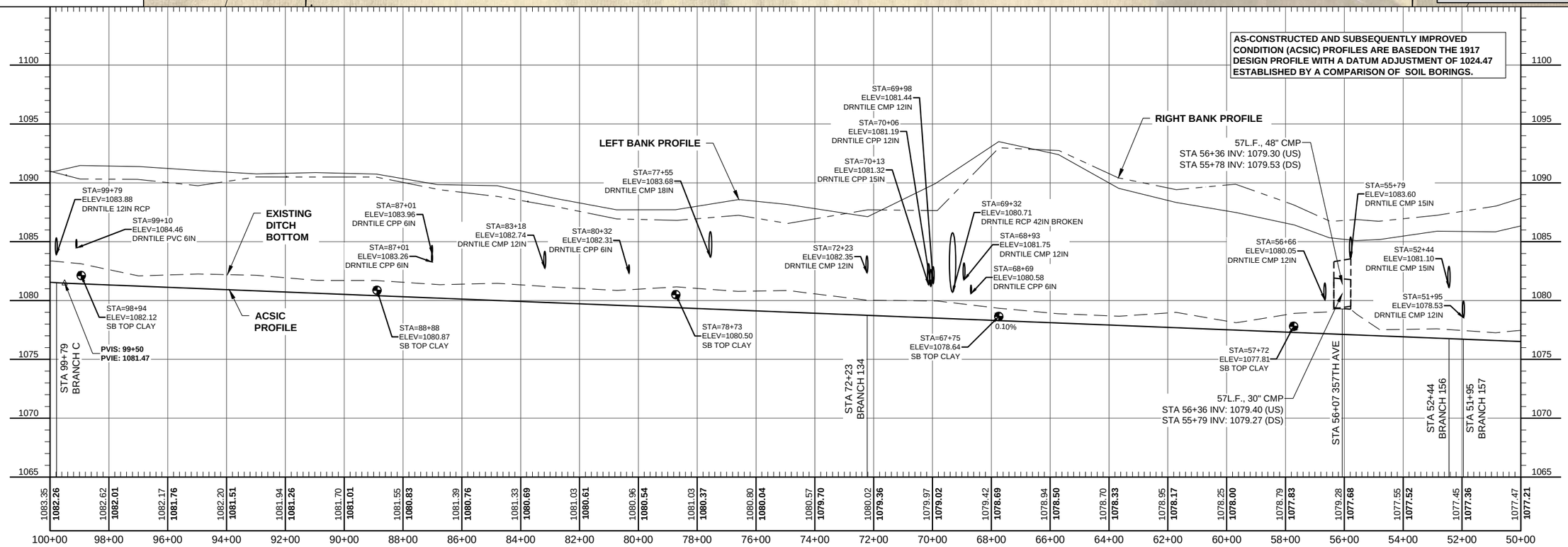

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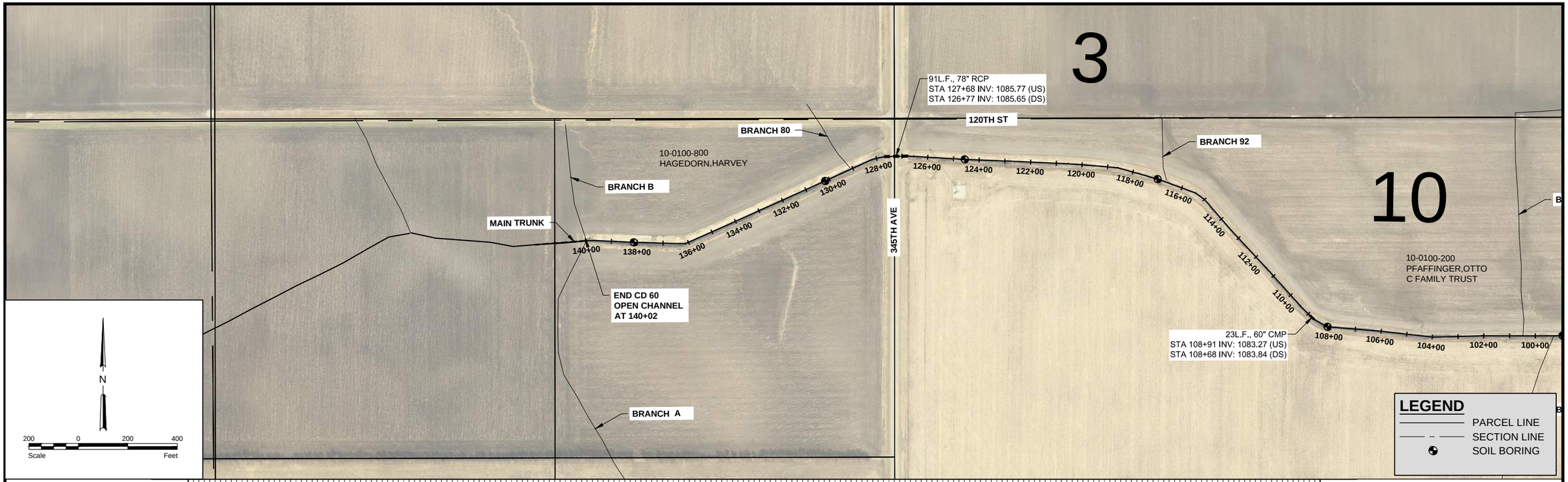

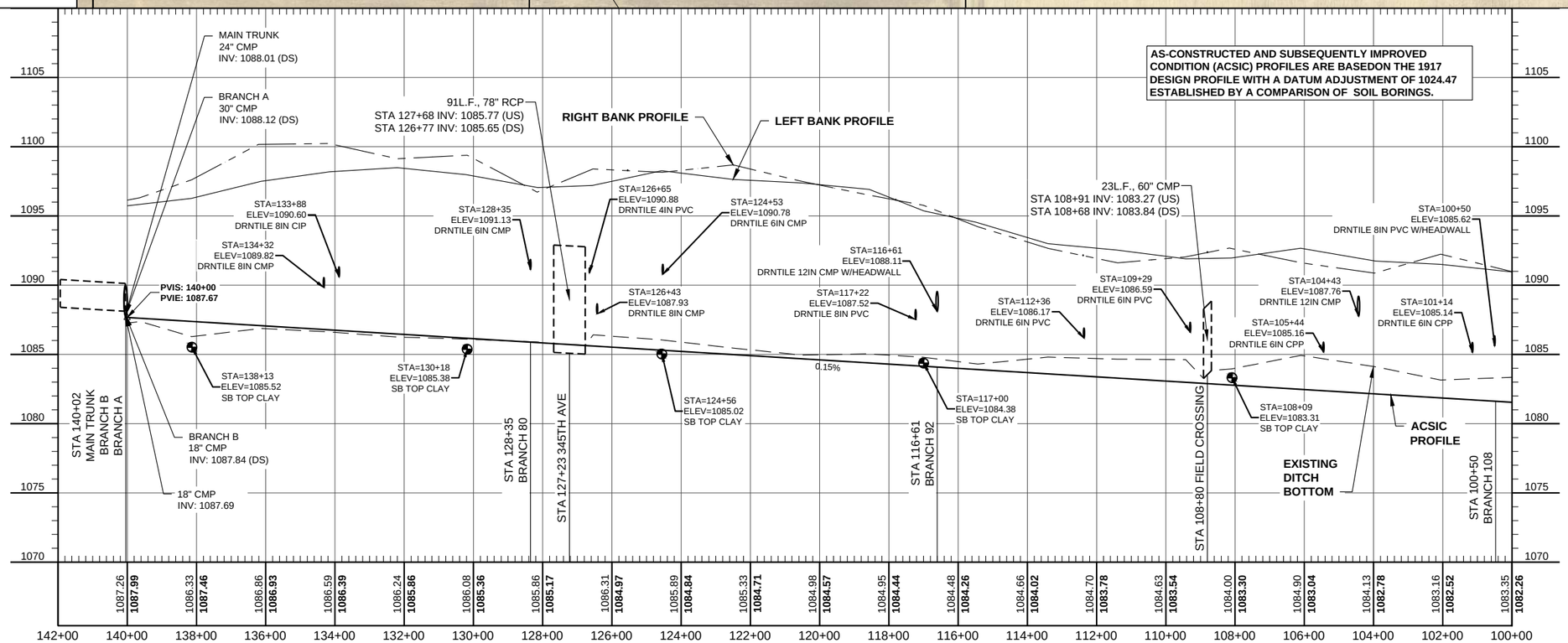

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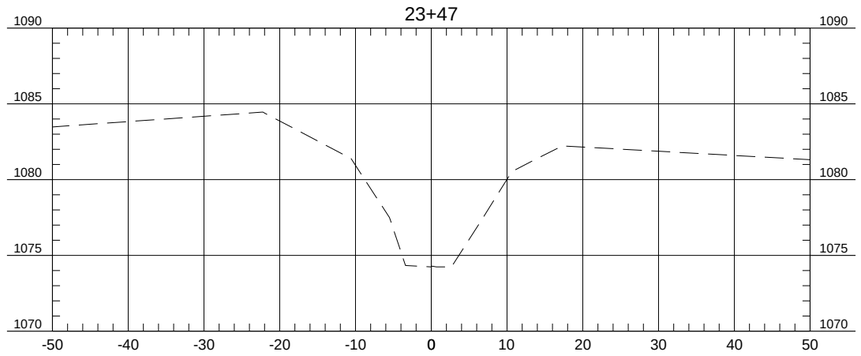

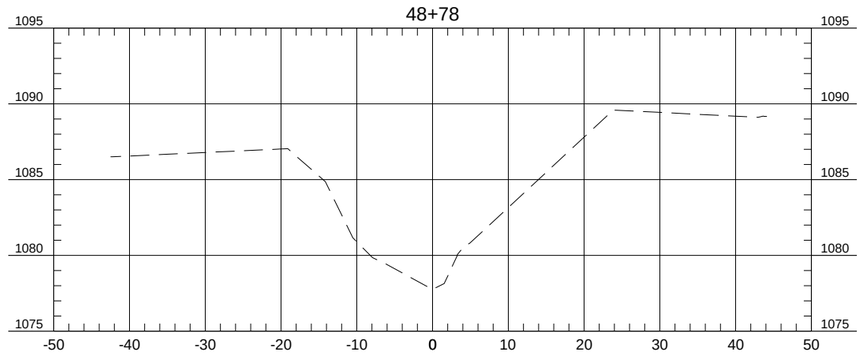

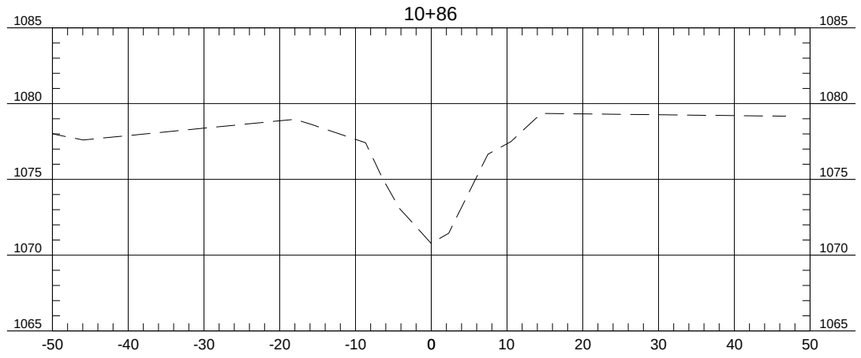

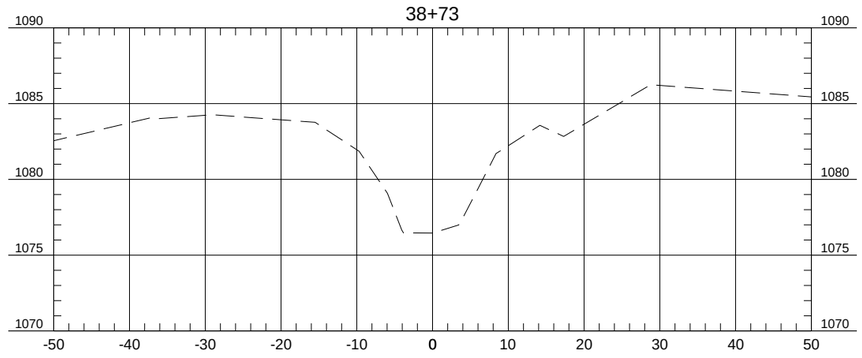

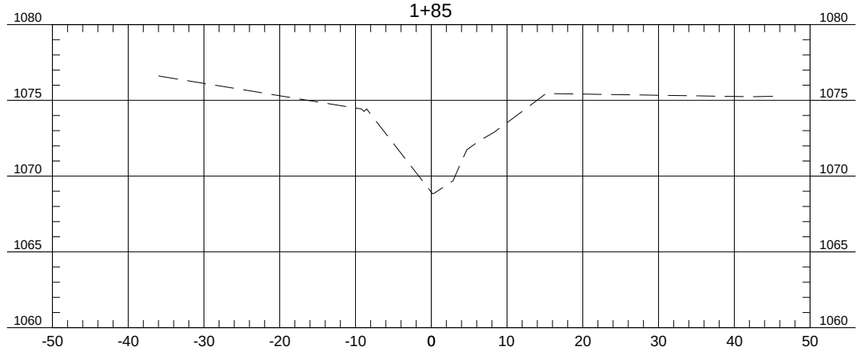

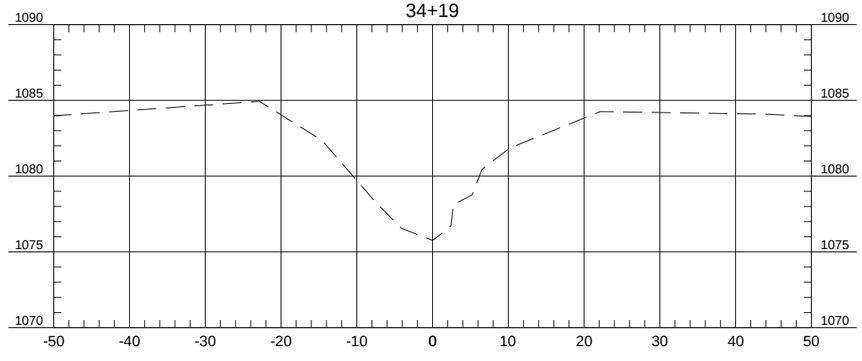

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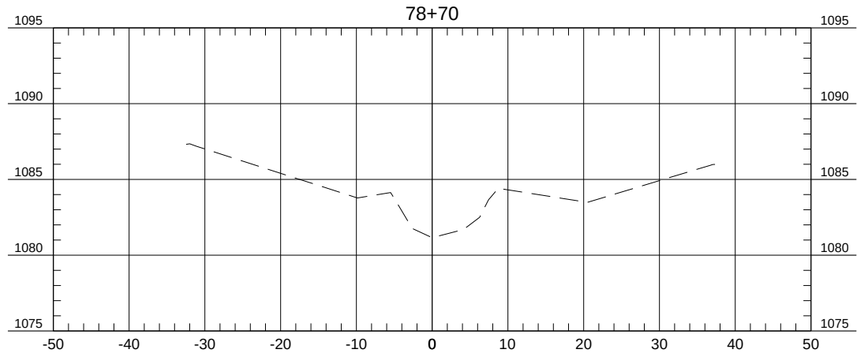

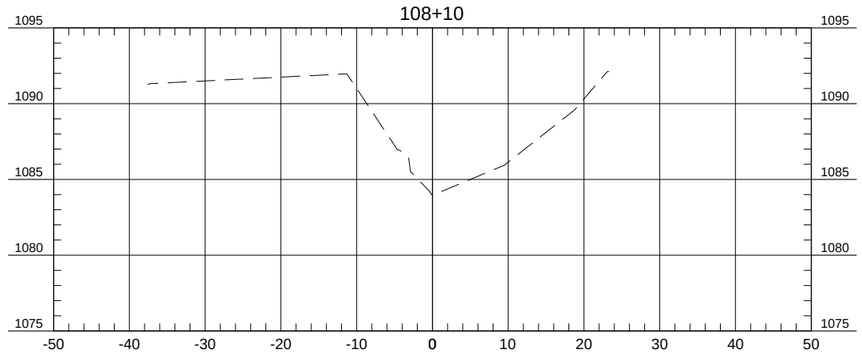

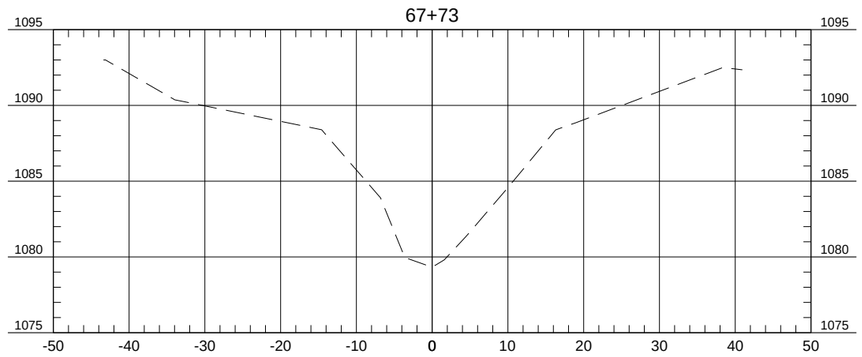

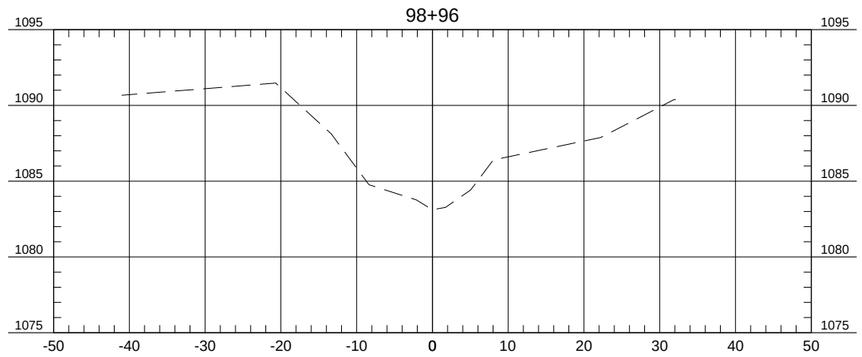

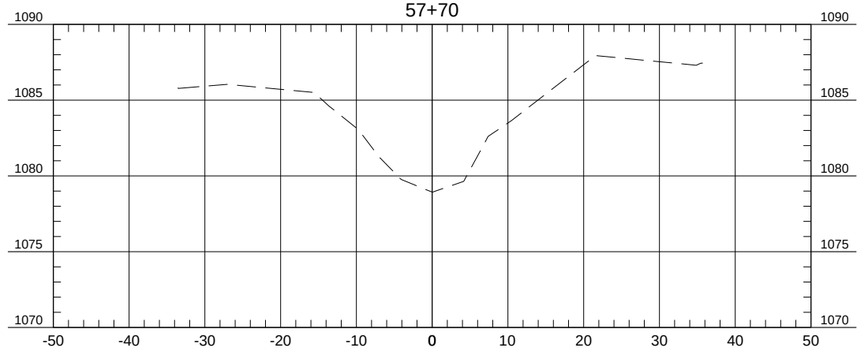

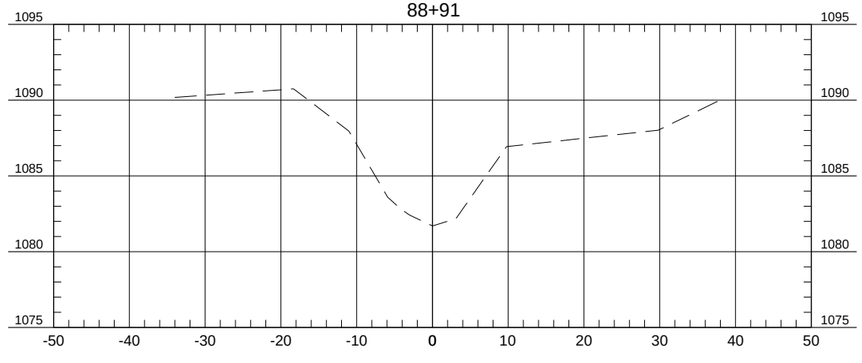

No.	Revision	Date	By

PRELIMINARY
Not for Construction

HOUSTON ENGINEERING INC.

Maple Grove
P: 763.493.4522
F: 763.493.5572

Drawn by	Date
DWS	7-11-2019
Checked by	Scale
JAL	AS SHOWN

FARIBAULT COUNTY DITCH 60
JO DAVIESS TOWNSHIP SECTIONS 1,10,11, AND 12
FARIBAULT COUNTY

CROSS SECTIONS

PROJECT NO. 6255-0011

SHEET 2 of 3

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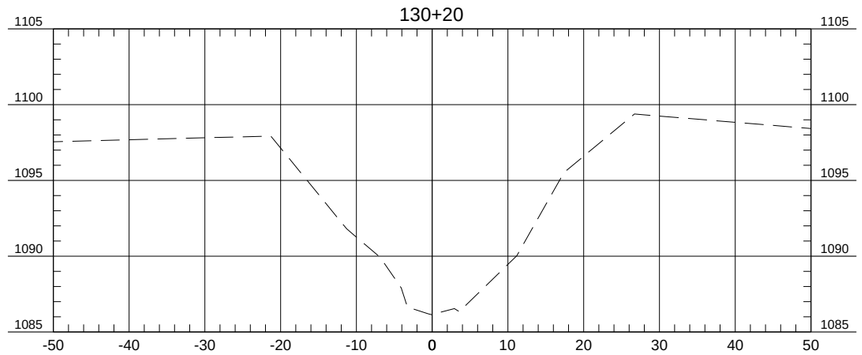

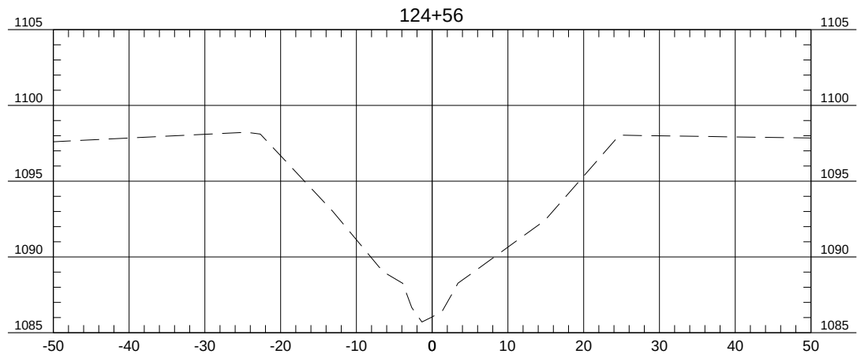

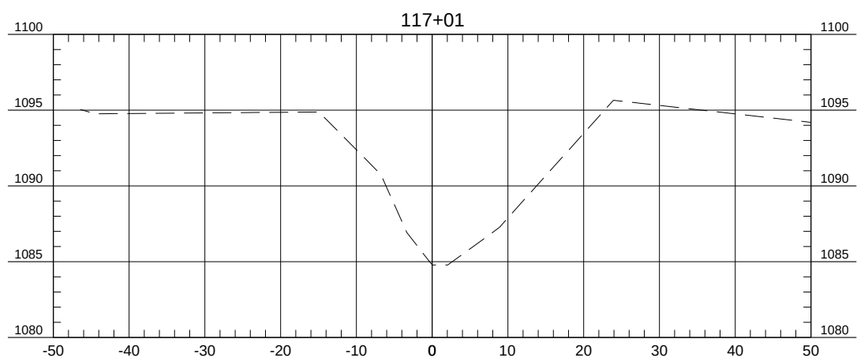

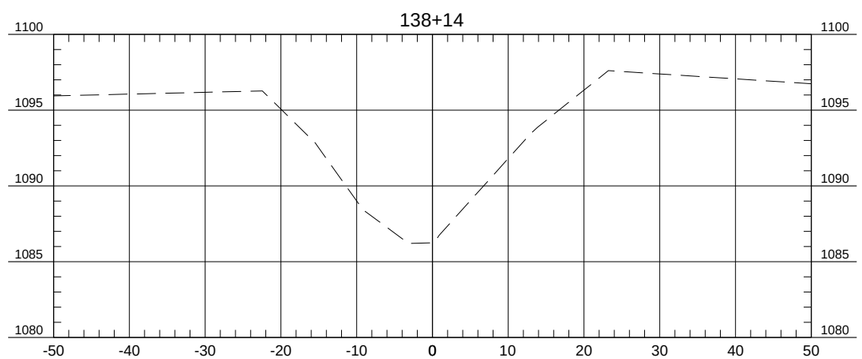

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JO DAVIESS TOWNSHIP SECTIONS 1,10,11, AND 12
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SHEET
3 of 3

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ATTACHMENT D – DETAILED PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST

OPINION OF PROBABLE COST:
FARIBAULT COUNTY DITCH 60 REPAIR
FARIBAULT COUNTY

SECTION 1,10,11,12
JO DAVIES TOWNSHIP, FARIBAULT COUNTY, MINNESOTA July 12, 2019

Item Description	Unit	Quantity	Unit Price	Total Price
Mobilization	Lump Sum	1	$ 10,000.00	$ 10,000.00
Traffic Control	Lump Sum	1	$ 2,000.00	$ 2,000.00
Clearing	Acre	1	$ 4,000.00	$ 4,000.00
Remove and Dispose of Inplace Culvert	Lin. Ft.	20	$ 25.00	$ 500.00
Open Channel Excavation	Lin. Ft.	10,500	$ 3.00	$ 31,500.00
60-inch CPP	Lin. Ft.	210	$ 140.00	$ 29,400.00
Gravel Roadway Patch	Each	2	$ 1,200.00	$ 2,400.00
Water Quality Drop Inlet - Diameter Varies	Each	9	$ 1,800.00	$ 16,200.00
Stabilize Tile Outlet - Riprap	Each	43	$ 1,000.00	$ 43,000.00
Replace Tile Outlet Pipe - Diameter Varies between 6-15 inches	Each	27	$ 750.00	$ 20,250.00
Replace Tile Outlet Pipe - Diameter Varies between 18-30 inches	Each	3	$ 1,250.00	$ 3,750.00
Remove and Dispose of Headwall	Each	3	$ 1,000.00	$ 3,000.00
Re-install 42-inch RCP	Each	1	$ 500.00	$ 500.00
Silt Fence	Lin. Ft.	100	$ 5.00	$ 500.00
Excavator/Dozer Hours	Hours	8	$ 225.00	$ 1,800.00
Seeding and Mulch - Spoil Area	Acre	20	$ 1,000.00	$ 20,000.00
Open Channel Resloping	Lin. Ft.	3500	$ 8.00	$ 28,000.00
Hydromulch and Seeding Resloped Channel Banks	Acre	4	$ 6,000.00	$ 24,000.00
Erosion Control Blanket	Sq. Yds	3000	$ 2.50	$ 7,500.00
Construction Sub-total				**$ 248,300.00**
20% Construction Contingency				$ 49,660.00
Right-of-way Acquisition				$ 18,750.00
Temporary Damages				$ 800.00
TOTAL OPINION OF PROBABLE CONSTRUCTION COST				**$317,510.00**