

Technical Memorandum

To: Chris Byrd, PE
Benton County Engineer

From: Garrett Monson, PE
Houston Engineering, Inc.

Subject: Reestablishment of Benton County Ditch 6 Public Drainage System Records

Date: January 29, 2020

Project: 6183-0001

Introduction

The purpose of this report is to provide Benton County with the results of the investigation and analysis of the Benton County Ditch 6 (CD 6) public drainage system. CD 6 is an open channel ditch, which serves predominantly agricultural land, located in Graham Township. This report contains the necessary description of the alignment; cross-section; profile; hydraulic structure locations, materials, dimensions, and elevations; and right-of-way of the drainage system to reestablish records as requested by the Board of Commissioners. Minnesota Statute 103E.101 subd. 4a allows for the drainage authority to reestablish records if, after an investigation of drainage system records, it is found that the records establishing the alignment, cross-section, profile, or right-of-way of a drainage system are lost, destroyed or otherwise incomplete. The drainage authority may, by order, reestablish records defining the alignment; cross-section; profile; hydraulic structure locations, materials, dimensions, and elevations; and right-of-way of the drainage system which define the “As Constructed and Subsequently Improved Condition” or ACSIC. This report documents the investigation of drainage system records and physical investigation of the drainage system used by the engineer to recommend reestablished records to define the alignment, grade, and geometry as necessary to maintain the historic function of the drainage system. No other historical reviews or reviews of the as-constructed profile of this system are known to exist.

RELATIONSHIP TO DRAINAGE SYSTEM MAINTENANCE AND REPAIR

This memorandum establishes the ACSIC as the basis for future maintenance and repair of the public drainage system. A future repair report may include alternatives which adjust the elevation of the open channel and culverts consistent with the ACSIC. Additional actions such as realignment or abandonment of portions of the public system, or other similar modifications may also be considered and ultimately follow procedures in MS 103E. The range of alternatives evaluated within a repair report is based in part on discussions with landowners and other interested parties.

DEFINITIONS

This memorandum defines the condition and therefore by inference the capacity (i.e. the existing flow rate in cubic feet per second) of the public drainage systems using three definitions:

As-Designed / Established Condition: The geometry of the public drainage systems as designed in 1905 including all subsequent designs for legal repairs and alterations. A repair or alteration is considered legal if formally authorized in some legal proceedings. The details of the As-designed / Established condition are relatively unknown due to the scarcity of the original design plan and profiles that identify the dimensions, lengths and grade elevations. The As-Designed / Established Condition may or may not reflect the As-Constructed and Subsequently Improved Condition and is generally shown on construction plans and engineering drawings.

As-Constructed and Subsequently Improved Condition: The geometry of the public drainage systems as constructed in 1905 including all subsequent legal repairs and alterations as well as other actions which maintain and are consistent with the general character and efficiency of the drainage systems. Often, survey data (and only rarely as-built drawings) show that the alignment, grade and geometry (i.e., cross sectional area) of the existing public drainage system is altered from the As-Designed / Established Condition. The definition of As-Constructed and Subsequently Improved Condition (ACSIC) is intended to establish the condition to which the system can legally be repaired consistent with the definition in MS 103E.701, which states:

The term, "repair" means to restore all or a part of a drainage system, as nearly as practicable to the same hydraulic capacity as originally constructed and subsequently improved, including resloping of ditches and leveling of spoil banks if necessary to prevent further deterioration, realignment to original construction if necessary to restore the effectiveness of the drainage system, and routine operations that may be required to remove obstructions and maintain the efficiency of the drainage system. "Repair" also includes:

- (1) incidental straightening of a tile system resulting from the tile-laying technology used to replace tiles; and
- (2) replacement of tiles with the next larger size that is readily available, if the original size is not readily available.

Available records provide very limited information regarding the originally constructed alignment, grade (profile) and geometry (cross-section) of CD 6. Alterations to the public drainage system alignment, grade and geometry from the As-Designed / Established Condition likely resulted from the use of less accurate survey methods and construction techniques than currently exist, inaccurate culvert and crossing installation, and a need to "fit" the drainage system to the existing topography. Alterations to the public drainage system that were not performed per the requirements of MS 103E (i.e., ditch law) or its predecessors are typically not considered part of the ACSIC.

Repaired Condition: The condition to which the drainage authority repairs the public drainage system. If the capacity of the Repaired Condition exceeds the ACSIC, the work is considered an improvement under MS 103E and its predecessors. The County may decide for a variety of reasons to repair the public drainage system to some condition less than the As-Constructed and Subsequently Improved Condition.

Maintenance: There is no statutory distinction between the terms maintenance and repair. However, historically, drainage authorities have drawn a distinction between the two terms as a function of the scope of work performed for each. The primary difference between maintenance and repair, is that maintenance activities are generally completed at a select (more isolated) location or locations along portions of the public drainage system, rather than a drainage system-wide assessment, analysis, recommendation, or alteration that occurs in association with a repair proceeding.

Maintenance generally includes activities such as vegetation management, the removal of open channel and tile blockages (e.g., beaver dams, sediment), the replacement of tile ruptures, the installation of tile inlets and access manholes, the replacement of portions of a tile system, the stabilization and repair of slopes and spoil material, and the removal of sediment up to the repair condition. Maintenance also includes the resetting or resizing of culverts or other crossings which were inaccurately placed and result in the obstruction of the public drainage system. Maintenance activities are usually exempt from wetland permitting requirements under the Wetland Conservation Act and Section 404 of the Clean Water Act.

Location, General Description and History of the Public Drainage System

LOCATION

The Benton CD 6 public drainage system, shown in **Figure 1**, is located in Sections 25, 26, 27, and 28 (of T38N R30W) within Graham Township, Benton County. CD 6 consists of a Main Trunk and one branch. The Main Trunk generally flows from east to west, beginning at the NE quarter of the SE quarter of Section 28 and ending in the SW quarter of the NW quarter of Section 25. Branch 1 generally flows east to west, beginning where it intersects the Main Trunk at the SW quarter of the SE quarter of Section 26 and ending at State Highway 25 in the SE quarter of the SW quarter of Section 25. The drainage area that contributes to the CD 6 public drainage system is approximately 1,805 acres (**Figure 2**) and is in Sections 19 and 30 of (T38, R29W) and Sections 22, 23, 24, 25, 26, 27, 28, 35, and 36 (T38, R30W). The predominant land use in the drainage area is agricultural along with wetland, forest, and rural residential.

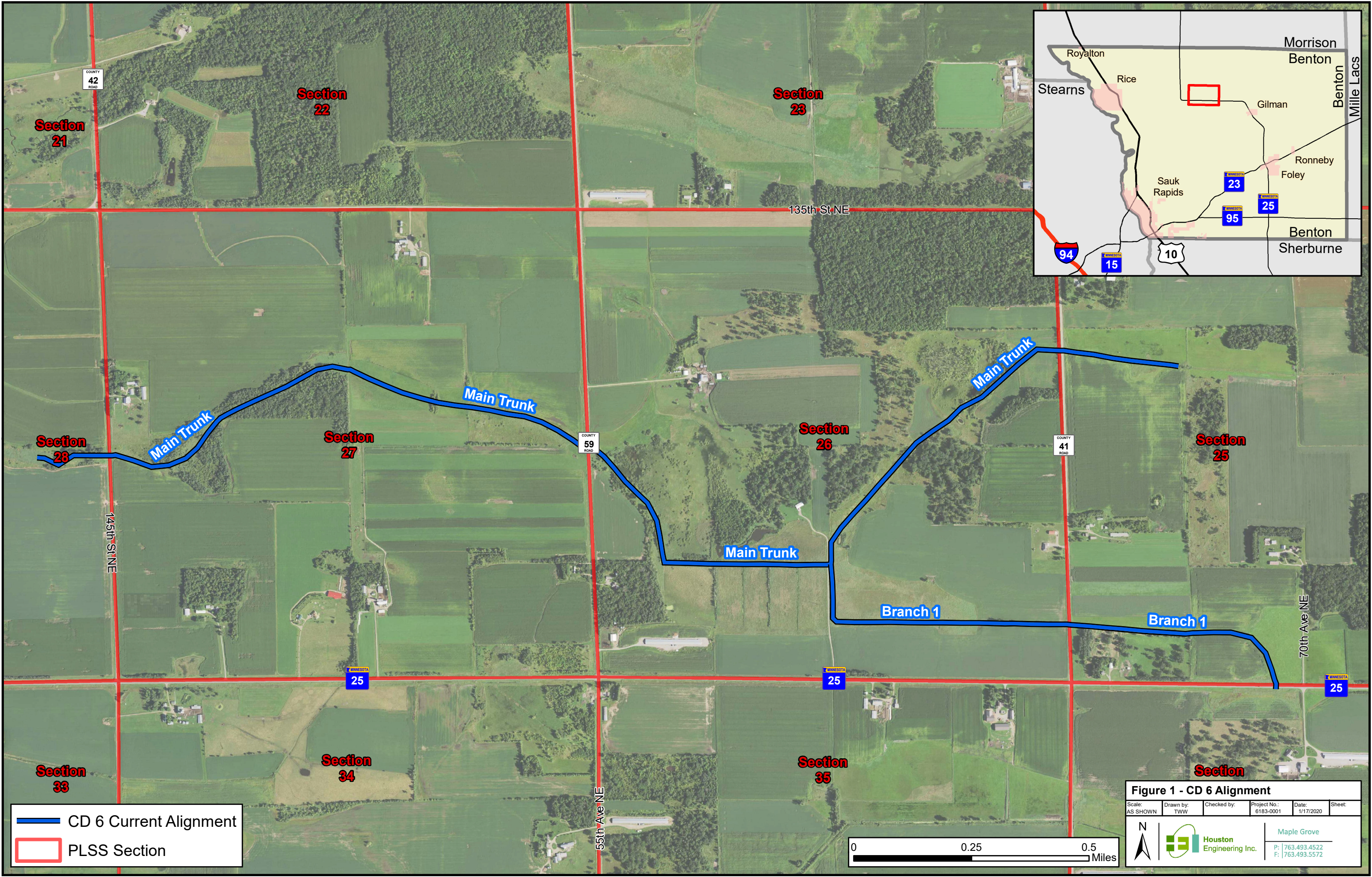



Figure 1 - CD 6 Alignment

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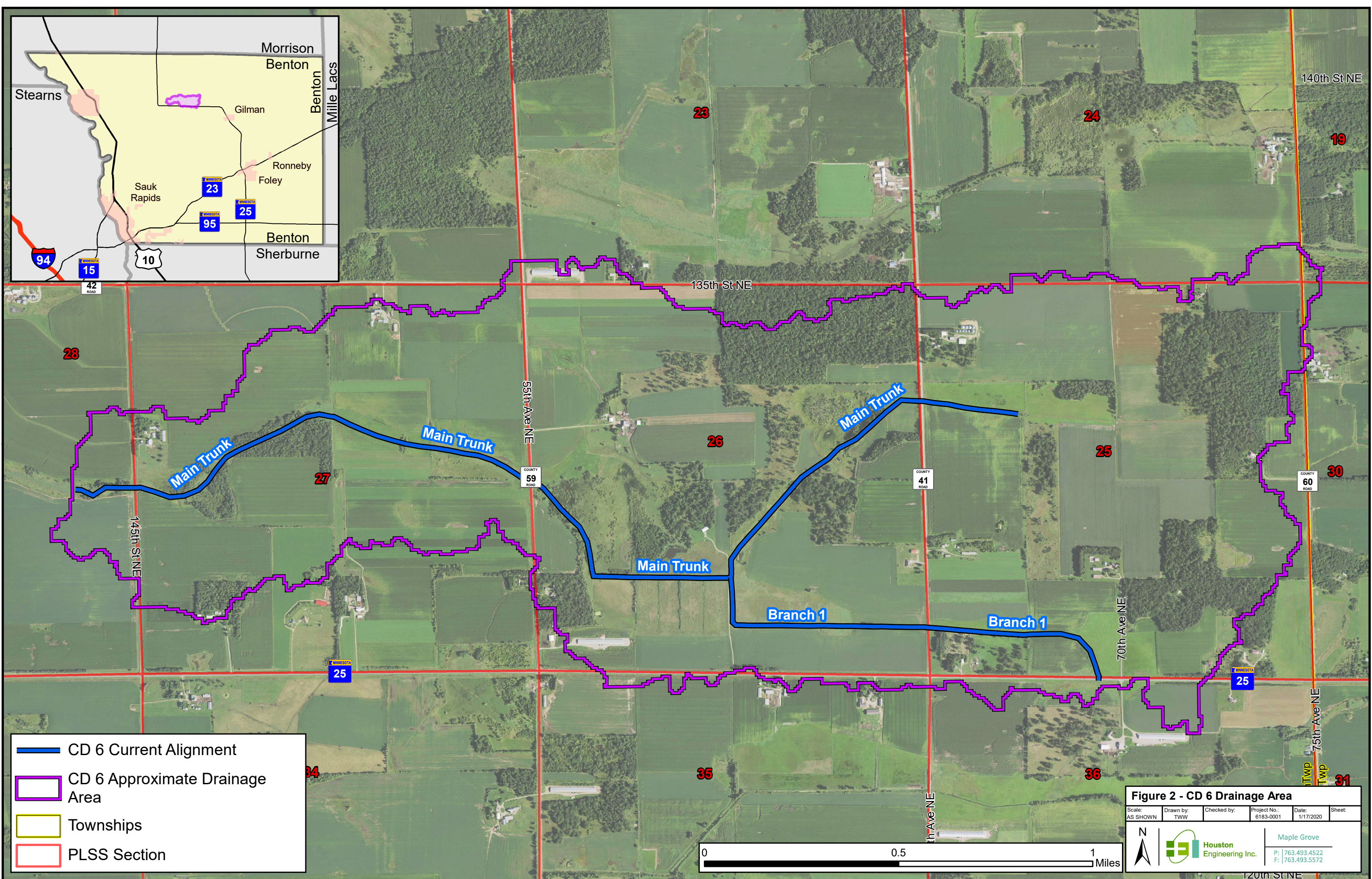
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CD 6 Current Alignment

CD 6 Approximate Drainage Area

Townships

PLSS Section

Figure 2 - CD 6 Drainage Area

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HISTORY OF THE PUBLIC DRAINAGE SYSTEM

A petition for the system was filed on September 29, 1904 and an order to establish was filed on April 25, 1905 by the Benton County Board. An Engineer's Report was filed on February 18, 1905 containing specifications, estimate of total cost, and statement of time and manner in which work must be done.

EXISTING/CURRENT ALIGNMENT

This portion of the memorandum describes the current condition of the public drainage system as observed "on-the-ground" (i.e., existing) as determined by a review of the available records, field survey, aerial imagery, and other available historical evidence. CD 6 consists entirely of an open channel ditch with several culvert crossings. The stationing used to describe the alignment proceeds from downstream to upstream. **Attachment A** shows the system's existing alignment and stationing. All references to stationing in this report refer to the stationing established in **Attachment A**.

Main Trunk:

The downstream end of the Main Trunk alignment begins in the NE quarter of the SE quarter of Section 28 (T38N R30W) at Sta. 0+00. The alignment continues east intersecting 145th St NE at Sta. 8+71 and continuing until Sta. 15+50 where the alignment turns northeast. It continues northeast until Sta. 37+47 where it turns southeast crossing 55th Ave NE at Sta. 68+06 and turning east at Sta. 84+29. The alignment proceeds east until it reaches the intersection of the Main Trunk and Branch 1 at Sta. 102+86. At this point the Main Trunk turns northeast until Sta. 140+22. The alignment then turns east crossing 65th Ave NE and ending at the SW quarter of the NW quarter of Section 25 (T38N R30W) at Sta. 153+40.

Branch 1:

The downstream end of Branch 1 begins at Sta. 0+00 in the SW quarter of the SE quarter of Section 26 where it intersects the Main Trunk at Main Trunk Sta. 102+86. The alignment proceeds south until Sta. 6+06. Then it cuts east passing under 65th Ave NE at Sta. 32+79 and diverting south at Sta. 53+33. It continues south until it terminates at Sta. 59+32. The branch ends just before State Highway 25 at the SE quarter of the SW quarter of Section 25 (T38N R30W).

SOURCE OF SURVEY DATA USED IN THIS ASSESSMENT

Survey data was collected in September 2019 to determine the existing condition of the public drainage system. All survey data collected utilizes the Benton County Coordinate System and North American Vertical Datum 1988 (NAVD'88).

KNOWN SYSTEM MODIFICATIONS OR PROCEEDINGS

If system modifications have occurred since establishment, they would likely be documented through county resolution and order records. In this case, the drainage system was constructed with a different alignment than that shown on the original Engineer's plan. Between stations 77+25 and

105+50 on the Main Trunk and between stations 0+00 and 22+50 on Branch 1, the ditch alignment as it exists today is altered from as-designed alignment in the original 1905 plans (see **Figure 3**). A letter from the Benton County Attorney dated June 8, 1987 indicates that this realignment occurred without petition by private landowners. However, the alignment of the ditch indicated in an aerial photo from 1938 is identical to its current alignment. Given that this alignment has not significantly changed in 80 years, it should be considered the ACSIC alignment. An open channel exists upstream and downstream of the Main Trunk (see Attachment A). However, those upstream and downstream portions of the channel are not considered part of the public drainage system. **Figure 1** shows the current alignment of the open channel and roadway crossings as determined by review of the available records, field survey, aerial imagery, and other available evidence.

Analysis of Current Function in Historical Context

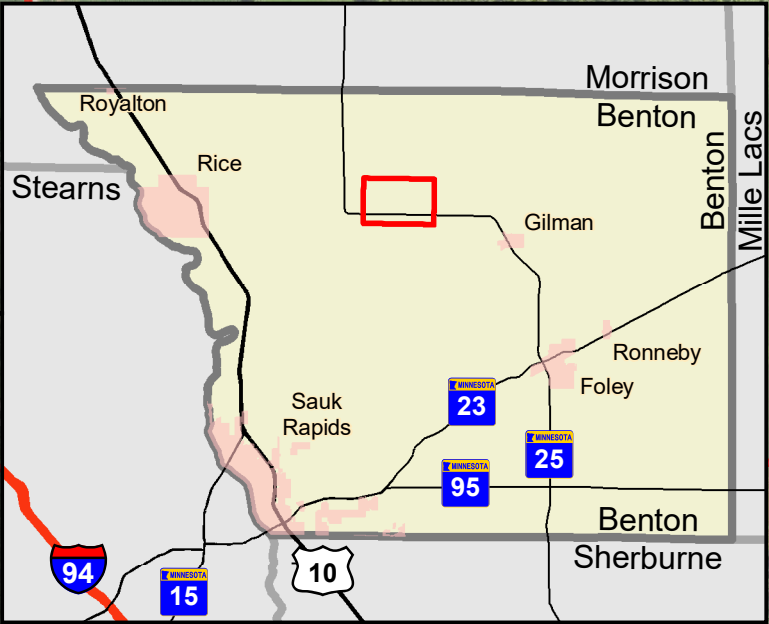
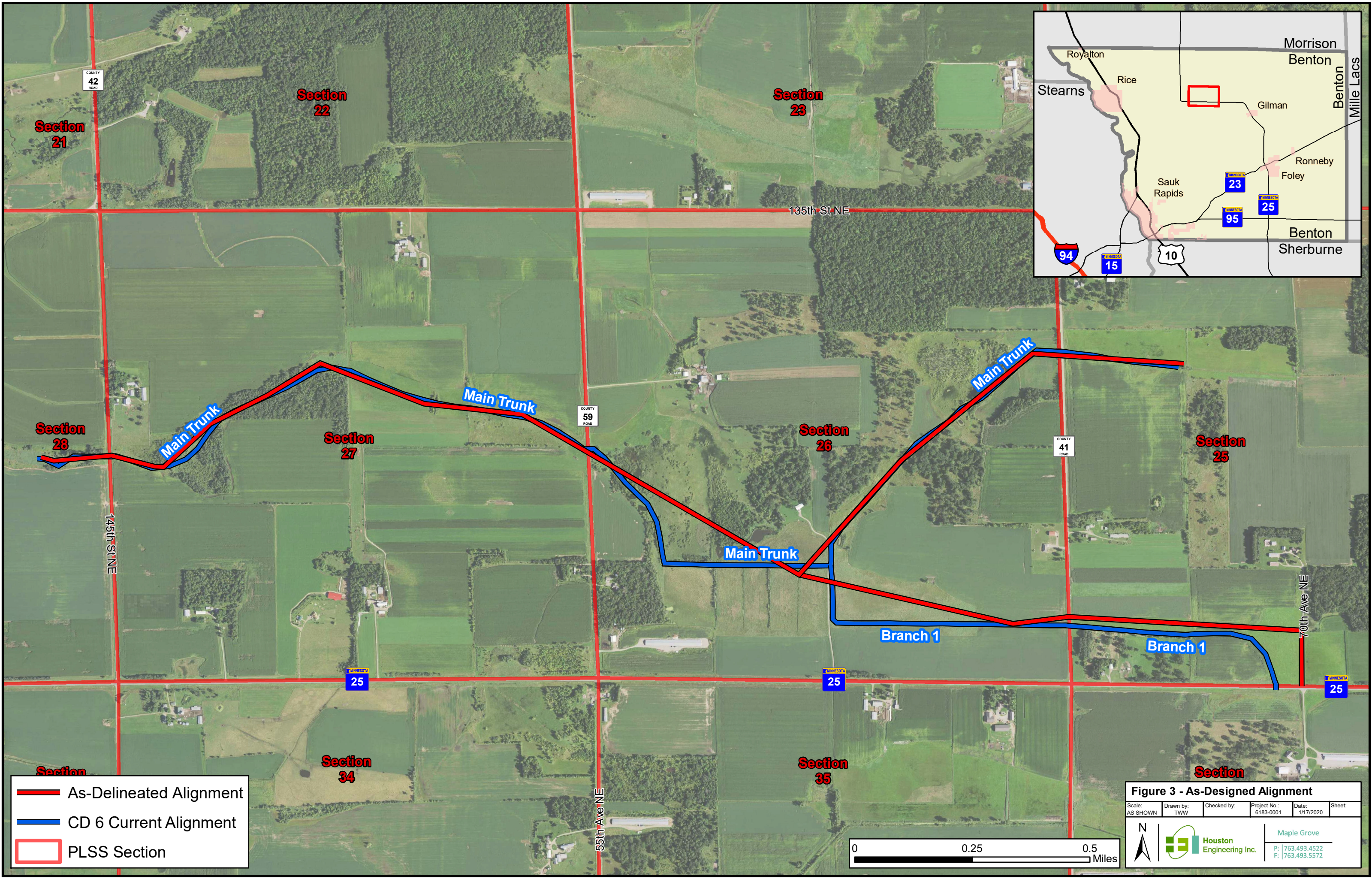
AS-CONSTRUCTED AND SUBSEQUENTLY IMPROVED GRADE AND GEOMETRY

Ideally, the grade of the ACSIC would be determined through the use of as-built drawings that identify the constructed alignment, grade and geometry. However, since as-built plans were rarely recorded for public drainage systems in the early 20th century, engineers have frequently utilized profile drawings or cut-sheets from the original designs in conjunction with test pits or soil borings to determine and corroborate the ACSIC as is the case with CD 6. Profile drawings from February 1905 and cut sheets from an engineer's report from February 8, 1905 contain the design profile for CD 6 based on a local datum. During recent survey, soil borings were taken approximately every 1000-feet along CD 6. The ACSIC profile was determined with a statistical comparison of the soil borings and design profile.

Strictly relying on the soil borings to define the ACSIC grade may not yield a practical determination of the ACSIC due to the inherent variability of soil boring data during its collection. Since the CD 6 design profile is available, while not an as-built documenting the exact constructed grades, it still provides useful information regarding the intended grades on the system. Not considering the design profiles during the record reestablishment would ignore a portion of the drainage system record.

Comparison of Design Profiles and Soil Borings

The CD 6 original 1905 design profiles were based on an assumed vertical datum referring to a benchmark no longer in existence, and as-built plans are not available. To determine the ACSIC in a modern vertical datum, soil borings collected during field survey were used to determine "as-built" excavation depths where the material transitions from accumulated sediment to native mineral soil. Soil borings were excavated along the system as shown in **Attachment A**. In total, 29 soil borings were collected during the field survey (23 along the Main Trunk and 6 along Branch 1).



As-Delineated Alignment

CD 6 Current Alignment

PLSS Section

Figure 3 - As-Designed Alignment

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A statistical comparison of the soil borings and original design profile elevations was then performed. Through the comparison process, a datum adjustment factor was calculated to convert the design profile from the local datum to NAVD88. Soil borings elevations that were not within one standard deviation from the datum adjustment calculated from the entire set of soil boring elevations were deemed to be outliers and were removed from the final datum adjustment calculation. The reaches where the channel was “realigned” were excluded from statistical comparison because the alignment varies from the design alignment and thereby, the design profile.

When the statistical analysis was completed and the outliers removed, the remaining data was not a proportionately large enough sample size to be statistically significant. Therefore, the ACSIC profile was instead determined by drawing a best fit line using the soil borings. The resulting profile, shown in **Attachment A**, provides very good correlation to the soil borings (with only one outlier) while still matching the geographic location of grade breaks denoted in the historic profile.

Crossings of the Public Drainage System

The public drainage system record does not show that any of the road crossings were constructed as part of the original ditch construction. They were likely installed after construction of CD 6 as part of field crossing construction by private landowners or as part of public road projects. Therefore, the culverts are not a component of the CD 6 public drainage system. A total of eight culvert crossings are located on the system of which five crossings are within one foot vertically of the ACSIC profile.

ACSIC Geometry

The 1905 engineer’s report indicated that the open channel was to be constructed with a 2:1 side slope. The Main Trunk was to be constructed with a bottom width of 4-feet between stations 0+00 to 109+50 and 3-feet between stations 109+50 to 153+40. The entirety of Branch 1 was to be constructed with a 3-foot bottom width. The current Main Trunk bottom width varies from 4 feet to 10 feet and is inconsistent along the alignment with some of the larger widths being in the upper half of the ditch. The current Branch 1 bottom width varies from 3 feet to 8 feet and is also inconsistent along the alignment with some of the larger widths being in the upper half of the ditch.

RIGHT-OF-WAY

Proceedings for the original establishment of the drainage system awarded damages for the areas physically occupied by the drainage system along with an easement for the area required for construction activities such as land clearing and spoil disposal. This combination of areas constitutes the right-of-way (ROW) for the drainage system and is often described as the area reasonably necessary for the drainage authority to perform its repair, maintenance, inspection obligations, along with an area of reasonable set-back to protect the drainage system. **Figure 4** shows the area estimated to have been utilized during construction.

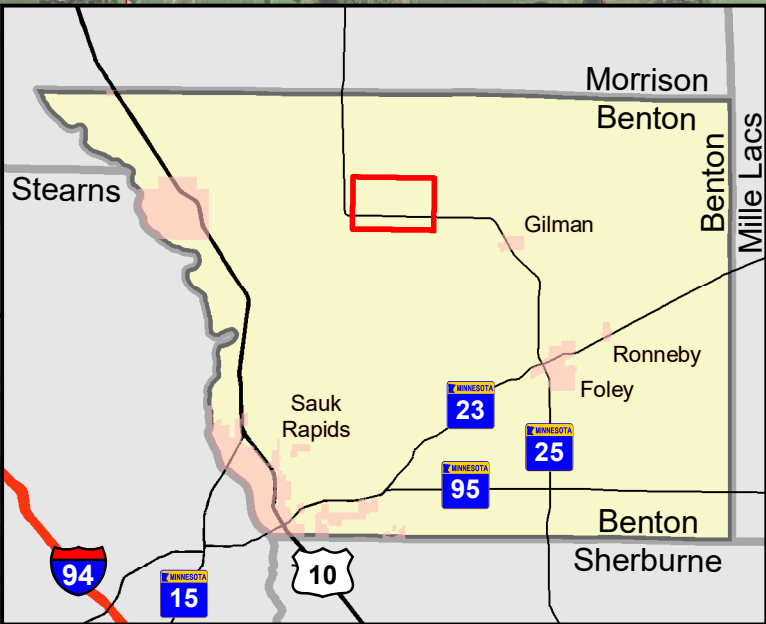
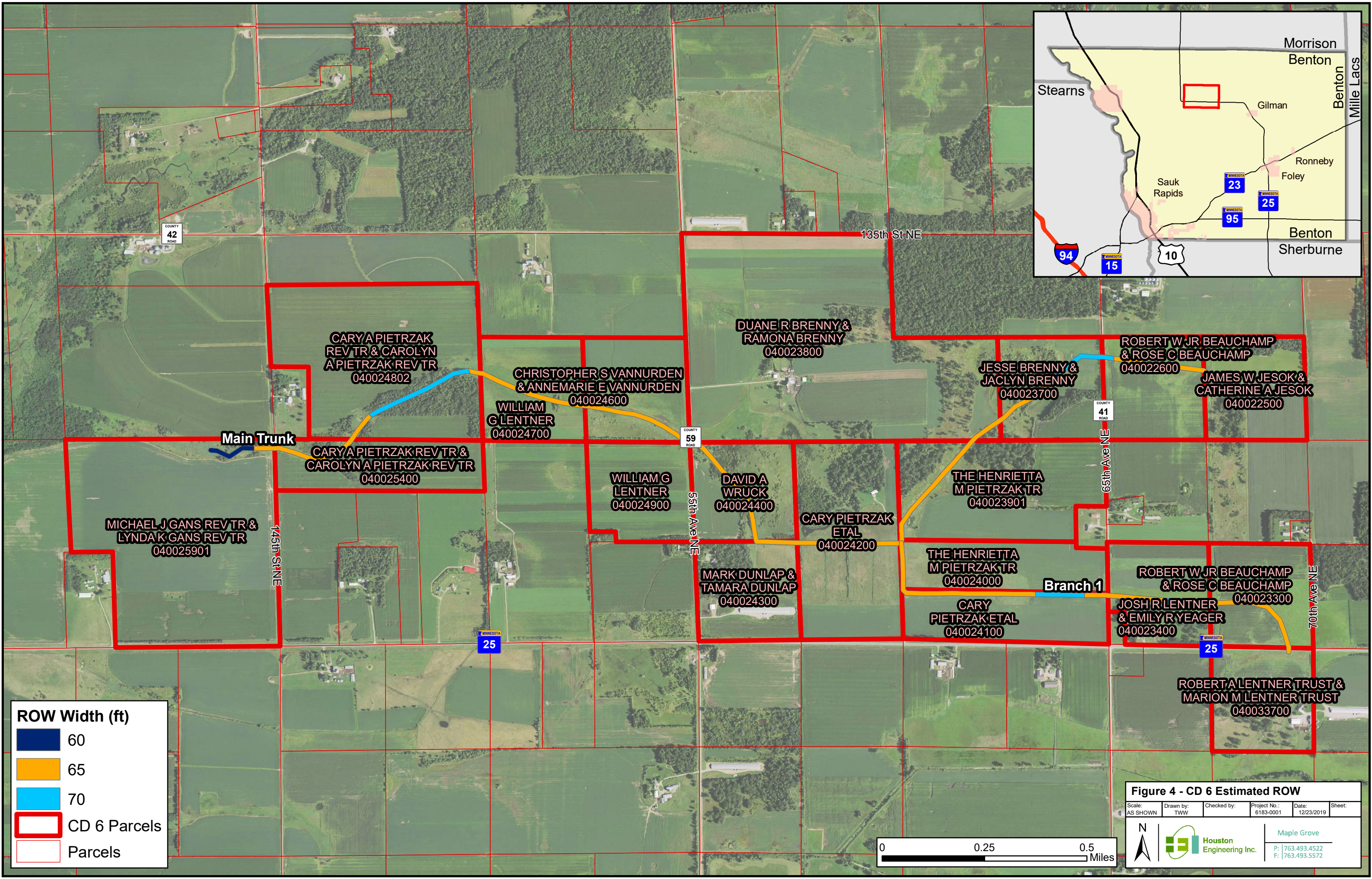
The 1905 Engineer's Report does not specify the geometry of the spoil pile but was assumed to have 3:1 in-slopes and 10:1 field slopes as was common practice of the time. This assumption was ground-truthed and confirmed to be valid along the Main Trunk from approximate STA 108+00 to 126+00 where spoil piles are visible on the landscape and occupy approximately 65-feet centered on the channel, consistent with the width calculated using the slopes assumed above.

The minimum length of spoil on each side of the ditch was set to 25 feet and total ROW width was calculated by adding together the top width of the as-designed ditch and the assumed length of spoil on either side of the ditch. The total ROW width varied along the ditch system, but sections of the ditch were grouped based on similar widths. Total ROW widths for CD 6, centered on the channel, can be found in **Table 4** and are mapped in **Figure 4**.

Table 4. ROW Widths for CD 6

	Station	ROW Width (ft)*
Main Trunk	0+00 to 6+00	60
	6+00 to 24+00	65
	24+00 to 36+00	70
	36+00 to 132+00	65
	132+00 to 142+00	70
	142+00 to 153+40	65
Branch 1	00+00 to 24+00	65
	24+00 to 27+00	70
	27+00 to 42+00	65
	42+00 to 46+00	70
	46+00 to 59+32	65

* Centered on the channel.



ROW Width (ft)

- 60
- 65
- 70

CD 6 Parcels

Parcels

Figure 4 - CD 6 Estimated ROW

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REGULATORY IMPACTS

The CD 6 public drainage system intersects wetlands identified in the U.S. Fish and Wildlife Service National Wetland Inventory (NWI) as shown in **Figure 5**. There are no listed public waters along the CD 6 public drainage system. Under most regulatory programs (i.e. Minnesota Wetland Conservation Act (WCA), Federal Clean Water Act (CWA); and Minnesota Public Waters Law), activities related to repair of a public drainage system, though potentially taking place within the confines of wetlands, are not considered to result in jurisdictional wetland loss. These activities related to public drainage system maintenance include:

- Excavation in wetlands when limited to removal of sediment or debris such as trees, logs, stumps, beaver dams, blockage of culverts, and trash, provided the removal does not result in alteration of the original cross-section of the wetland or watercourse;
- Removing those materials placed by beaver;
- Removing or moving materials blocking installed roadway culverts and related drainage structures; and
- Temporary or seasonal water level management activities done for the purpose of performing maintenance.

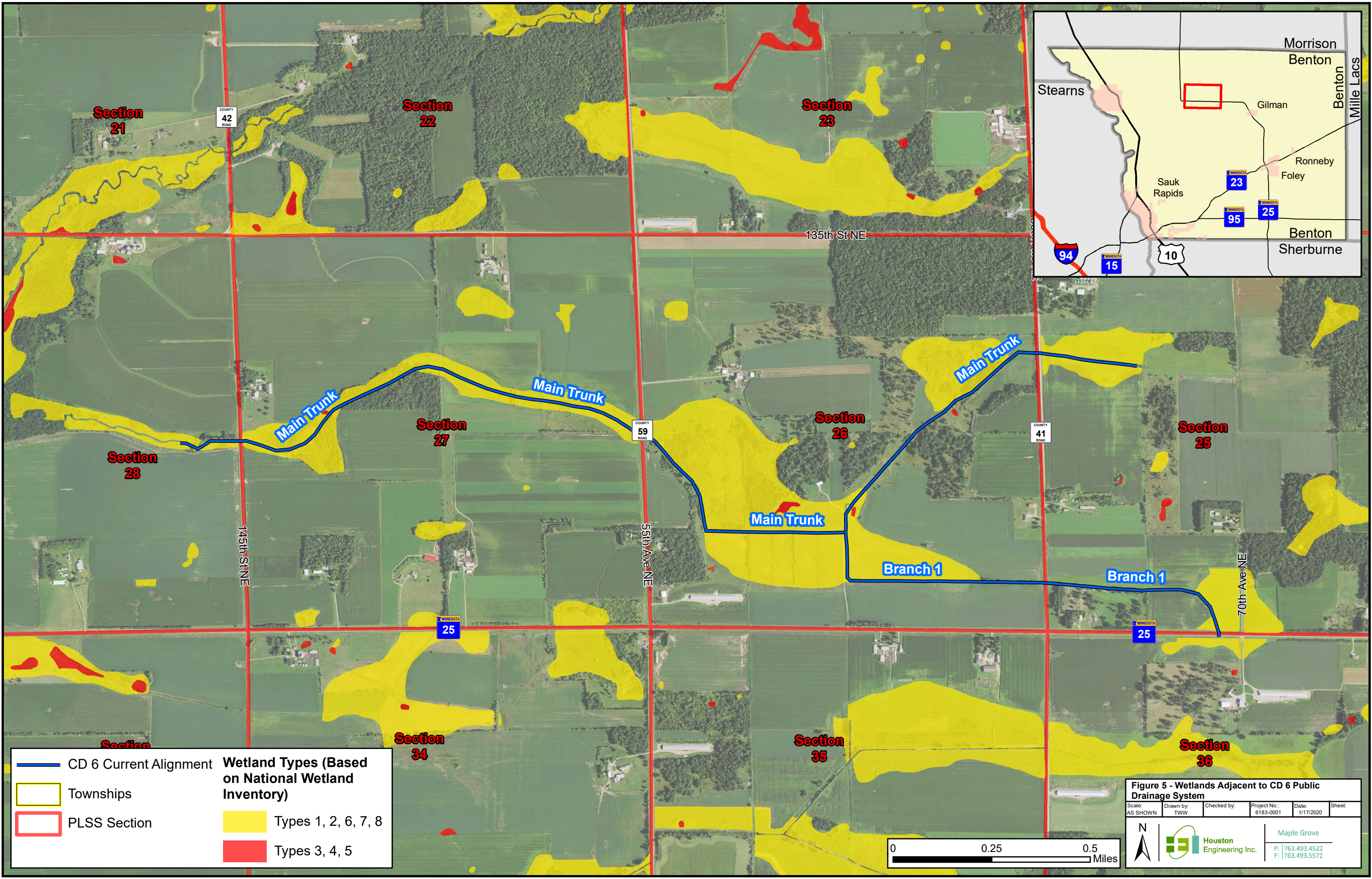
Under the CWA, all repair, regardless of wetland impacts, is exempt from regulation. Under the WCA, activities related to maintenance or repair of a public drainage system that may result in wetland impacts but are exempt from replacement, include:

- Maintenance or repair of a public drainage system which drains Type 1, 2, 6, 7, or 8 wetlands; and
- Maintenance or repair of a public drainage system which drains Type 3, 4, or 5 wetlands that have existed for 25 years or less.

Activities considered to be “no-loss” or exempt from replacement do not require wetland replacement plans under the WCA. Though not required, in these cases it may be prudent for the drainage authority to apply to the local government unit (LGU) for a no-loss or exemption decision prior to proceeding with the maintenance activity. The LGU for this location is Benton County.

Several public drainage system repair activities may result in wetland impacts that are not exempt under the WCA and require wetland replacement. These activities include, but are not limited to:

- Maintenance or repair of a public drainage system which drains Type 3, 4, or 5 wetlands that have existed for more than 25 years; and
- Maintenance or repair of a public drainage system not authorized by the drainage authority.



CD 6 Current Alignment

Townships

PLSS Section

Wetland Types (Based on National Wetland Inventory)

Types 1, 2, 6, 7, 8

Types 3, 4, 5

Figure 5 - Wetlands Adjacent to CD 6 Public Drainage System

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There appear to only be four Type 3, 4, or 5 wetlands near the public drainage system, none of which have an obvious open water connection to the ditch. Potential impacts should be assessed during a repair report.

RECOMMENDATIONS

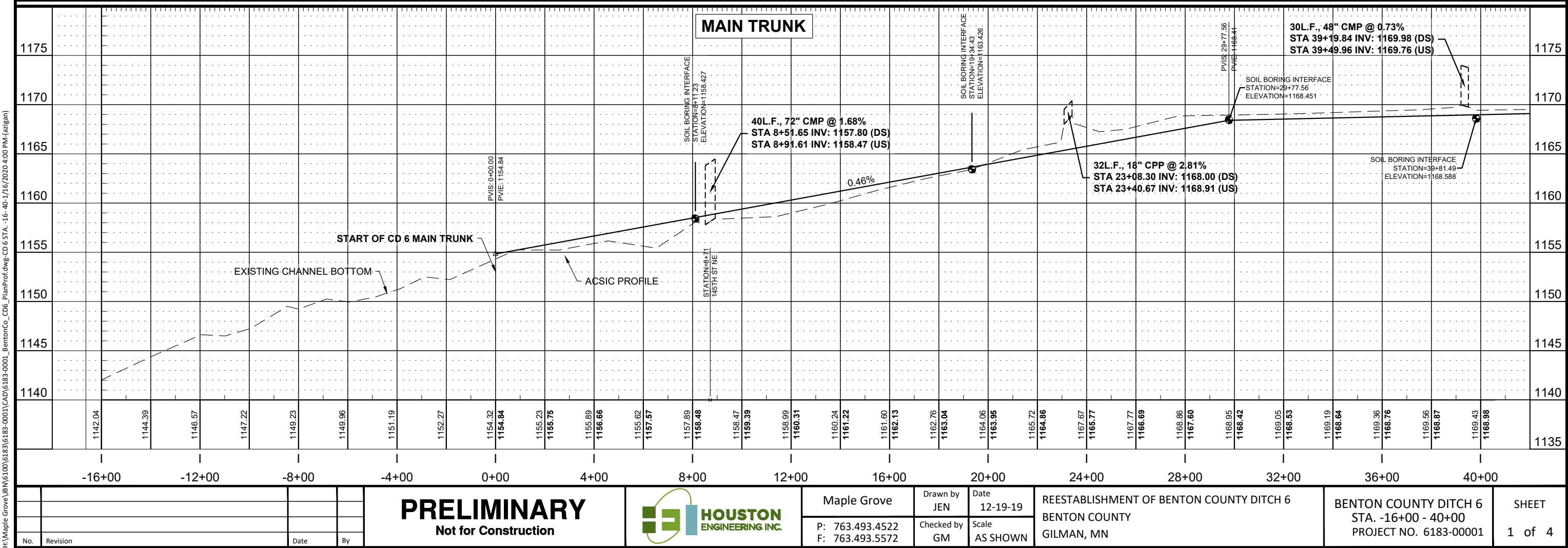
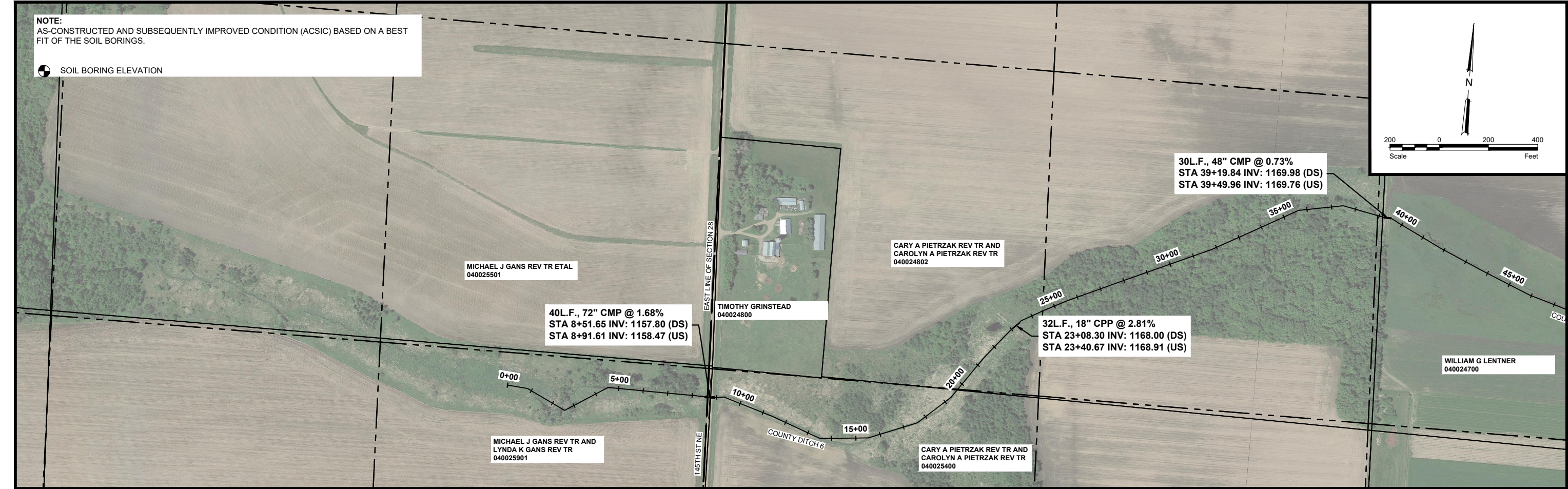
The Drainage Authority initiated proceedings to correct the drainage system record through a resolution and order by the County Board. This report having been completed and filed, the engineer recommends that the Drainage Authority schedule, notice and hold a public hearing, and consider adopting corrected records consistent with this report. The corrected drainage system records should be based on the alignment, grade, and geometry described within this historical review and in **Attachment A**. The alignment, grade, and geometry are, in the Opinion of the Engineer, necessary to reestablish the historic function of the legal drainage system to be the basis for maintenance and repair of the public drainage systems. We further recommend that the Drainage Authority submit the alignment, grade and geometry of the ACSIC to the Minnesota Department of Natural Resources and the Benton County Soil and Water Conservation District for their review and concurrence.

AVAILABLE INFORMATION/HISTORIC RECORDS

Historic records for the CD 6 public drainage system were provided by the County. The following documents have been specifically utilized or referenced for this report:

- 1904 Petition to the Benton County Board for ditch establishment of County Ditch 6 by landowners.
- 1905 Order establishing County Ditch 6 by Benton County.
- 1905 Engineer's report for County Ditch 6.
- 1938 Aerial Photos
- 1987 Letter from the Benton County Attorney regarding County Ditch 6 realignment.

ATTACHMENT A – BENTON COUNTY DITCH 6 PLAN AND PROFILES



 SOIL BORING ELEVATION

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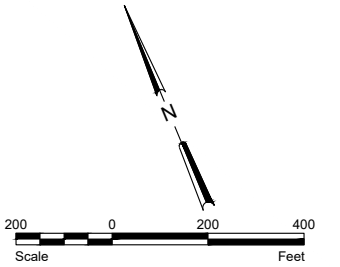
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