

Van-Cass Intercounty Drain Engineering Report



Prepared for:
**Van-Cass Intercounty Drain
Drainage Board**

June 24, 2020

TABLE OF CONTENTS

Description	Page(s)
Introduction	
Purpose of Study	1
Watershed Description	2
Route and Course	2
Drain History	3
Drainage District Delineation	4
Field Reconnaissance	
Bankson Lake	5
Van-Cass Intercounty Drain	6-7
Preliminary Ecological Assessment	7-8
Hydrologic and Hydraulic Analysis	9-10
Evaluation of Alternatives	
Alternative 1 – Do Nothing	11
Alternative 2 – 18-Inch Gravity Outlet	11-12
Alternative 3 – 24-Inch Gravity Gravity Outlet	12
Recommendation & Implementation	13

Figures

- Figure 1 – Bankson Lake Flooding
- Figure 2 – Alternative 2
- Exhibit 3 – Alternative 3

Exhibits

- Exhibit B-1 – Lands Added / Removed Map
- Exhibit B-2 – Drainage District Map

Appendices

- Appendix 1 – Preliminary Estimates of Project Cost
- Appendix 2 – Hydrologic & Hydraulic Calculations

Survey Drawings

- CS – Cover Sheet
- C1 – Plan & Profile Van-Cass Intercounty Drain (Sta. 0+00 – 27+50)
- C2 – Plan & Profile Van-Cass Intercounty Drain (Sta. 27+50 – 48+50)
- C3 – Plan & Profile Van-Cass Extension (Sta. 0+00 – 27+50)
- C4 – Plan & Profile Van-Cass Extension (Sta. 27+50 – 54+50)
- C5 – Plan & Profile Van-Cass Extension (Sta. 54+50 – 68+50)



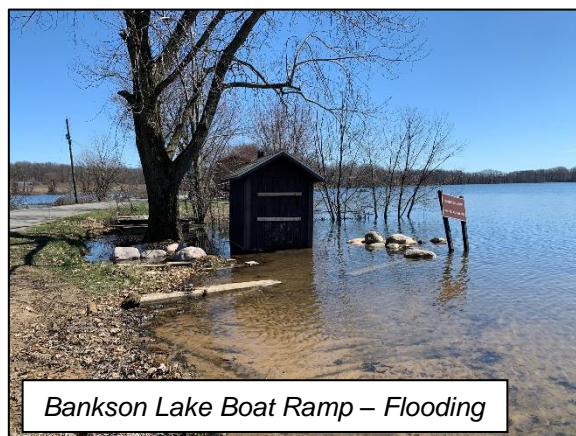
INTRODUCTION

Purpose of Study

A petition for maintenance and improvements to the Van-Cass Intercounty Drain (Drain) under Chapter 8 of the Michigan Drain Code (Act No. 40, Public Acts of 1956, as amended) was filed by 69 freeholders of land within Van Buren County. The petition was determined practicable by the Van-Cass Intercounty Drain Drainage Board (Board) on August 23, 2019.

A majority of the petitioners live on Bankson Lake in Porter Township, Van Buren County. Bankson Lake has no surface drainage outlet and is currently located outside (north) of the Van-Cass Intercounty Drain Drainage District (District), but still located within the larger Rocky River watershed. The water surface elevation of Bankson Lake has fluctuated throughout history but appears to be near an all-time high.

Land & Resource Engineering (LRE) was retained by the Board on September 25, 2019 to conduct an engineering study in preparation for the Hearing of Necessity. The purpose of the study is to assess flooding issues around Bankson Lake, identify impairments/deficiencies in the current drainage system and evaluate feasible alternatives to provide a surface drainage outlet from Bankson Lake to the Drain. The findings and recommendations of our engineering study are presented in this report.



Bankson Lake Boat Ramp – Flooding



*Kolbe Property (81847
Laguna Beach) – Flooding*



Co. Road 652 (Lyttles Landing) – Flooding

Watershed Description

The historic Van-Cass Intercounty Drain Drainage District (Drainage District) encompasses approximately 3,201 acres in Sections 22-23, 26-27, and 34-35 of Porter Township, Van Buren County and Sections 1-3 and 11-12 of Marcellus Township, Cass County as shown in [Exhibit B-1](#). The watershed includes Mud Lake, which the Drain flows through and got its original name from.

The larger Rocky River watershed includes Bankson Lake as well as Little Bankson Lake. Bankson Lake encompasses approximately 217 acres with depths up to 42 feet. Bankson Lake is spring-fed and has no surface outlet. Instead, the water surface elevation fluctuates with groundwater. Bankson Lake is home to two large camps including the Miracle Camp and Retreat Center and Girl Scout camp.

Land use consists of dense residential cottages around Bankson Lake, with the remaining area consisting of agricultural lands, large residential tracts, and forested / wetland areas. Soils consist of sand, loam and muck with varying infiltration rates (hydrologic soil group ratings of A to C). The topography of the watershed is comprised of rolling hills and depressions with wetland complexes (including lakes) in the north near Bankson Lake. The historic Drainage District consists of flatter agricultural tracts bordering the Drain along with gently rolling hills.

Route and Course

The Van-Cass Intercounty Drain, also known as the Mud Lake Drain, forms the headwaters of Sheldon Creek within the Rocky River watershed. The Drain extends more than 4 miles (1320 Rods) from the downstream terminus at the former Grand Trunk Western Railroad (now CN Railroad) in Section 12 of Marcellus Township, Cass County to the upstream terminus near the center of the Northeast $\frac{1}{4}$ of Section 27 in Porter Township, Van Buren County. The Drain flows through Mud Lake in Section 35 of Porter Township, Van Buren County.

The *Survey Notes of Mud Lake Drain*, dated June 1920 by W.H. Goss, indicate that the historic bottom width varies from 4-feet in the upper portions of the Drain to 8-feet wide throughout most of Cass County. Channel banks were graded at a 1.5:1 (H:V) slope. Subsequent petition projects, including the most recent from 1969/70, maintained the original channel bottom widths and side slopes.

The historic channel slope of the Drain varied by reach and generally increased slightly in a downstream direction with an average slope of approximately 0.1%. The channel was deepened over time as part of historic petition projects.

Release of Rights-of-Way were obtained in 1920 along the Drain. The total drainage easement width is 120-feet (60-feet each side of the Drain centerline).

Drain History

The Van-Cass Intercounty Drain has a long history, the accounts of which are summarized below. In addition, the law firm of Fahey, Schultz, Burzych and Rhodes prepared a legal opinion for the Drain dated April 30, 2019.

The Drain was originally established as a Van Buren County intra-county drain in 1902. Proceedings to establish the Mud Lake Drain began as far back as 1908. However, the current intercounty drain was not established until 1920, when it was designated as the Mud Lake Drain. The length and general dimensions of the Drain have not changed since the original 1920 petition project.

Subsequent petition improvement projects to remove sediment, improve the hydraulic capacity (channel gradient) and replace crossings were undertaken in 1939, 1961 and 1969. The Drain name was formally changed from the Mud Lake Drain to the Van-Cass Intercounty Drain as part of the 1961 petition.

Bankson Lake recorded historic lows in the 1940s. It was during this time that many cottages were built and then later flooded as water levels rose. The flooding was so bad in the 1950s that a petition, similar to the current one, was brought forth in 1952 to extend the Drain to Bankson Lake. The purpose of the 1952 petition was *“to provide an outlet for the excess waters in Bankson Lake and to provide a means of controlling the level of said Lake and*



Bankson Lake Flooding – 1950s

to run off such excess waters without damage or injury to the existing Drain and the adjacent farm lands”. Initial actions to establish a legal lake level for Bankson Lake were also undertaken but never materialized.

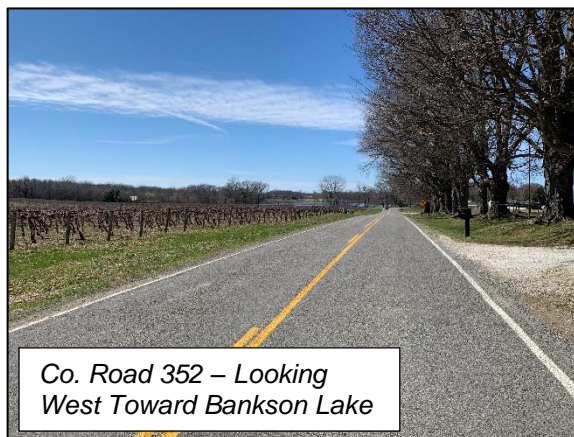
Since the last petition improvement project was completed in 1970, regular maintenance of the Drain has continued to ensure the Drain continues to function at its optimum capacity. Some of the more recent maintenance work includes:

- Beaver Dam / Obstruction Removal.
- Mowing / Brushing of Channel Banks
- More than 1-mile of Bottom Dip-Out in 2014
- Replacement of the 90th Avenue Culvert in 2014.

Drainage District Delineation

Historic Drainage District: The historic Drainage District consists of 3,201.04 acres of land in Sections 22-23, 26-27, and 34-35 of Porter Township, Van Buren County and Sections 1-3 and 11-12 of Marcellus Township, Cass County Michigan. Approximately 111 parcels are located within the historic Drainage District (roughly 40 in Cass County and 71 in Van Buren County). The Historic District, as shown in [Exhibit B-1 – Lands Added/Removed Map](#), is based on the “Mud Lake Drainage District” map prepared by T.A. Smith, dated June 1939.

Revised Drainage District: LRE prepared a revised Drainage District boundary to account for the proposed Drain extension to Bankson Lake. The revised boundary is based on GIS contours provided by Van Buren and Cass Counties, which were field verified to accurately reflect the contributing drainage area. Micro-topography and depression storage areas that may provide for some infiltration within the larger boundary are included in the revised Drainage District.



The revised Drainage District has been expanded to 5,520.52 acres to accurately reflect the contributing drainage area. The revised Drainage District includes Bankson Lake and Little Bankson Lake, which have approximately 200 properties surrounding them. 439 parcels are located within the revised Drainage District (98 in Cass County and 341 in Van Buren County). The revised Drainage District includes 1,409.31 acres (25.5%) in Marcellus Township, Cass County and 4,111.21 acres (74.5%) in Porter Township, Van Buren County, as shown in [Exhibit B-2 – Drainage District Map](#). A total of 2,461.09 acres are recommended to be added to the Drainage District and 141.61 acres are recommended to be removed from the Drainage District as shown in [Exhibit B-1 – Lands Added/Removed Map](#).



FIELD RECONNAISSANCE

LRE conducted a field reconnaissance with Streamside Ecological Services (SES) on April 2, 2020. In Addition, LRE conducted a topographic survey of the Drain and Bankson Lake in March 2020. [Survey Drawings](#) of the Drain and land between 90th Avenue and Bankson Lake are enclosed.

BANKSON LAKE

Bankson Lake encompasses approximately 217 acres with depths up to 42 feet. Bankson Lake is spring-fed and has no natural surface outlet. Instead, water surface elevations in the lake fluctuate with the groundwater table and the delicate balance between precipitation and surface runoff versus infiltration and evaporation.

Bankson Lake does not have a legal lake level. USGS topographic maps from the late 1970s label the normal water surface elevation as 898 feet, which correlates with testimony from locals (including Miracle Camp and Retreat Center staff) who state the lake is up roughly 3.5 feet. The water surface elevation was at 901.7 feet NAVD 88 during the time of our survey.

Today, water surface elevations have risen to historic highs, similar to those in the 1950s. LRE and SES staff observed numerous flooded homes, garages, yards, septic fields, driveways and roads. In some areas, vehicular access (including emergency vehicles) is not possible and residents must wade through floodwaters in order to get to their homes. Other residents are dependent on make-shift levees and continuous running pumps in an attempt to keep their homes from flooding. The severe extent of flooding poses a threat to the public health, safety and welfare. A map depicting finish flood elevations of a few of the flood-prone structures around Bankson Lake is provided in [Figure 1](#).



VAN-CASS INTERCOUNTY DRAIN

LRE conducted a topographic survey of the Drain from 90th Avenue to the current upstream terminus as well as the lands between the established Drain and Bankson Lake. In addition, a visual inspection of the established Drain was performed from 90th Avenue to the downstream terminus at the CN Railroad (formerly Grand Trunk Western Railroad).

The results of our topographic survey confirm that there is sufficient fall throughout the Drain to provide an adequate outlet for Bankson Lake and the contributing sub-watershed. The culvert invert at 90th Avenue culvert, which is roughly 1.5 miles downstream (south) of Bankson Lake, is approximately 10-feet below the normal water surface elevation of the lake (898 feet). The ground rises nearly 10-feet above Bankson Lake south of County Road 352 before tapering back down into a large wetland complex with elevation closer to 898 feet near the south line of the northeast quarter of Section 22, Porter Township. The ditch network that feeds the Drain begins near the north line of Section 27, Porter Township. The elevation of the ditch varies from 896 feet at the upstream end to 888 feet at 90th Avenue.

There is a large wetland complex near the center of Section 22, Porter Township. The proposed Drain extension route and course from the failed 1952 petition, crossed through this wetland complex. While this alignment is ideal from a topographic standpoint, it is likely no longer feasible. Aside from significant permitting issues that would be faced in attempting to dredge the wetland complex, parcel 80-16-022-010-00 is now owned by the Michigan Nature Association and likely includes a conservation easement that would not allow for any open channel excavation. Therefore, the Drain extension alignment will have to be located either east or west (most likely east) of the Michigan Nature Association property.

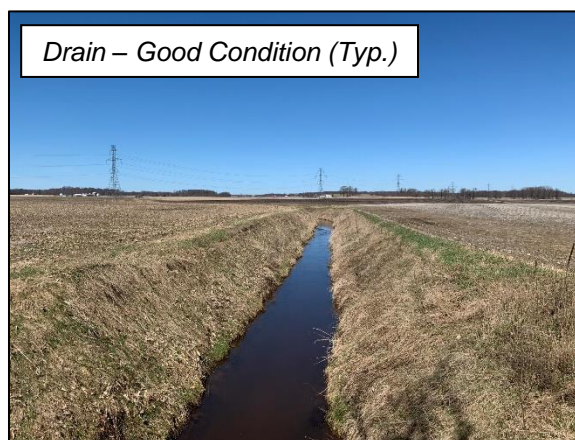


Co. Rd. 352 – Looking North toward Bankson Lake



Drain at 90th Ave. – Looking South

In general, the Drain is well maintained and in good condition downstream of 90th Avenue. Banks are well vegetated and crossings do not exhibit any signs of excessive scour or downcutting to indicate an undersized culvert. Property owners continue to complain about flooding near the downstream end of the Drain at the CN Railroad (formerly Grand Trunk Western Railroad). Historic Drain records document flooding issues caused by the undersized railroad culvert going back to at-least 1967. LRE recommends notifying CN Railroad that their current culvert is undersized (and likely does not meet their hydraulic standards) and let them coordinate the necessary crossing improvements.



PRELIMINARY ECOLOGICAL ASSESSMENT

LRE contracted Streamside Ecological Services, Inc. (SES) to perform a preliminary ecological assessment using existing information to determine what data is available and what data must be collected to justify proposed improvements to the Drain or Bankson Lake.

SES obtained data and/or reports from Michigan Department of Natural Resources – Fisheries Division; Michigan Department of Environment, Great Lakes and Energy; Michigan Clean Water Corp (MiCorps) and Bankson Lake residents. Based upon the data found to date, the aquatic community (fish and macrophytes) of Bankson Lake appears to be typical of an inland southern Michigan lake, with a few exceptions discussed below. Results of water quality monitoring are sparse, but show no indication that levels of total phosphorus or chlorophyll-a are excessive.

Regarding the possibility of reducing flooding of Bankson Lake by transferring water into the Van-Cass Intercounty Drain, the following issues must be considered:

- The Drain is surrounded, in large part, by agricultural lands. Visual inspection of the Drain suggests that water quality is poor, and many sources of pollution were observed. Water within the Drain was turbid on the date of inspection, and suspended solids were clearly visible. Sheep were observed grazing in a pasture sloping directly to the channel; uncovered manure piles were noted at the same location. Adjacent cropland slopes directly to the channel, with fields tilled to the top of bank and leaving no natural buffer. Significant gully and rill erosion was observed on these same fields, with erosion and sediment transport leading into the stream channel. The sediment is undoubtedly carrying nutrients and other

pollutants from the cropland. Runoff from the gravel road at 90th Avenue, including a sinkhole within the road, was noted. Tree canopy is sparse and the water likely gets very warm during summer months.

- Total phosphorus concentration within Bankson Lake is comparable to surface waters within the 25th percentile of EPA ecoregion sites (<0.031 mg/L). Chlorophyll-a concentrations are low. Based upon this limited information, it is unlikely that project alternatives would have a negative impact on the water quality of the Drain.
- The water temperature and dissolved oxygen profile of Bankson Lake indicate that stratification does occur, but dissolved oxygen concentrations are not conducive to supporting coldwater fish. Any proposed project alternatives should maintain stratification of the lake.
- Eurasian milfoil, fanwort and purple loosestrife are invasive species known to occur in Bankson Lake. Cattails are also listed in the plant inventory, but not identified to species. Narrow-leaf cattail is known to be highly invasive. If these species are not present in the Drain, it is unlikely that an EGLE permit will be issued without assurance that the project alternatives will prevent the spread of these species. The Drain should be inspected for these species in late spring/early summer of 2020.
- Bankson Lake is stocked and used as a brood stock lake by the DNR, for northern-strain muskellunge since it is not connected to the Great Lakes. Transfer of the species to downstream waters must be prevented.
- Redear sunfish have also been documented in Bankson Lake, apparently as a result of unauthorized stocking. Transfer of the species to downstream waters must be prevented.

In addition, wetland data must be collected, specific to project alternatives. The alternatives must not have negative impacts to the size or quality of wetlands, unless compensatory mitigation is possible.



HYDROLOGIC AND HYDRAULIC ANALYSIS

A hydrologic and hydraulic analysis was performed to evaluate proposed conveyance improvement alternatives to better manage drainage within the Bankson Lake sub-watershed. Data from our hydrologic and hydraulic analysis are provided in [Appendix 2](#).

The study area was broken down into several sub-catchments for hydrologic analysis purposes. Peak discharges at critical design locations for a range of 24-hour rainfall events including the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year storm (100%, 50%, 20%, 10%, 4%, 2% and 1% return frequencies) were provided by the Michigan Department of Environment Great Lakes and Energy (EGLE) Hydrologic Studies and Dam Safety Unit. It should be noted that EGLE appears to have overestimated the contributing drainage areas; therefore, actual peak discharges are most likely less than the values presented in [Table 1](#).

Table 1. Peak Discharges along the Van-Cass Intercounty Drain

Location	Drainage Area (Miles ²)	Peak Discharge Rate (cfs)					
		Return Period and 24-Hour Precipitation Depth					
		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
		2.37 inches	3.00 inches	3.52 inches	4.45 inches	5.27 inches	6.15 inches
90 th Avenue	5.9	80	140	200	330	460	650
CN RR	11.6	100	160	230	370	500	700

cfs-cubic feet per second

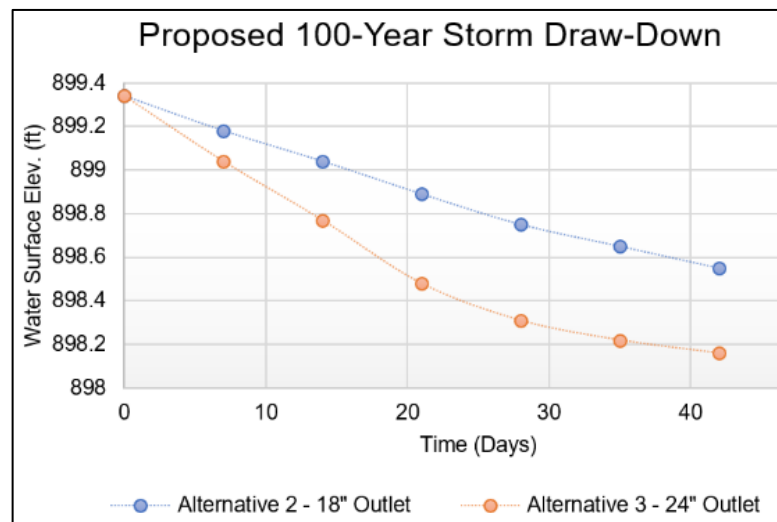
In order to better analyze flow dynamics, LRE developed a hydrologic model of the Bankson Lake watershed using HydroCAD computer software. The pond and flood-routing capabilities of the software allowed us to more accurately account for storage volume in the lake and more accurately predict estimated peak flows for various rainfall frequency events. In addition, the hydrologic model allows us to evaluate the effectiveness of various improvement alternatives in terms of regulating the water surface elevation of Bankson Lake and determining the drawdown time of the lake for various storm events.

Existing Conditions: Under normal conditions, when the water surface elevation is approximately 898 feet, Bankson Lake can handle the runoff associated with a 100-year (1% return frequency) storm (395 acre-feet) and raise water levels by only 1.5-feet (to 899.5 feet), which is approximately 9-inches below the lowest surveyed finished floor elevation of flood-prone homes. However, during periods of excessive precipitation and resulting high groundwater (such as occurred during the 1950's and is happening again today), the lack of a gravity surface outlet results in flooding around the lake. The annual total rainfall from 2016 to 2019 ranged from 37.03 to 41.1 inches, while the annual total rainfall from 2012 to 2015 ranged from 24.5 to 31.25 inches (*based on Michigan State University weather station in Lawton, MI*).

Proposed Conditions: LRE utilized the HydroCAD model to evaluate potential gravity outlet configurations for Bankson Lake. Given that under normal conditions Bankson Lake has sufficient storage capacity to handle rainfalls greater than the 100-year (1% return frequency) event, the presence of a gravity outlet is more important than the diameter or hydraulic capacity of the storm sewer. Furthermore, it is imperative that the Bankson Lake outlet does not significantly increase peak discharges downstream so as to adversely impact properties and push the flooding problem further downstream.

An 18-inch diameter storm sewer outlet was proposed for Bankson Lake back in the 1950s, as part of the failed petition project. LRE analyzed both an 18-inch diameter storm sewer outlet, transitioning to an open channel approximately 1,500 linear feet downstream (south) of Bankson Lake, and a 24-inch diameter storm sewer along the entirety of the proposed extension to the confluence with the Van-Cass Intercounty Drain. We envision that some form of adjustable weir will be installed upstream of the storm sewer to regulate flow from Bankson Lake. For modeling purposes, the weir was set at an elevation of 898 feet.

Neither outlet alternative does much to reduce peak water surface elevations of Bankson Lake during storm events; however, both provide a draw-down period to ensure the lake returns to its normal water surface elevation. Below is a graph showing draw-down time (water surface elevation over time) for each alternative during a 100-year (1% frequency) storm event. In summary, an 18-inch outlet can draw-down water levels from the 100-year peak (899.34 feet) to within 6-inches of the normal water surface elevation (898 feet) in approximately 6 weeks; while a



24-inch outlet can draw-down water levels from the 100-year peak (899.34 feet) to within 6-inches of the normal water surface elevation (898 feet) in approximately 3 weeks.

In addition, neither outlet alternative should adversely increase downstream peak discharges. The estimated 100-year peak discharge for an 18-inch outlet is 4.2 CFS and for a 24-inch outlet is 7.4 CFS. EGGLE estimates the 100-year peak discharge for the Van-Cass Intercounty Drain at 90th Avenue to be 650 CFS. Therefore, the 18-inch outlet alternative would increase downstream discharges by less than 1% and the 24-inch outlet alternative would increase downstream discharges by slightly more than 1%. In either case, these flow increases should not adversely impact downstream properties or infrastructure (roads, culverts, etc.).

EVALUATION OF ALTERNATIVES

Numerous alternatives were evaluated to provide an adequate outlet for Bankson Lake and achieve a 100-year level of flood protection for surrounding homes without adversely impacting (increasing flooding along) downstream properties. Following are three of the alternatives that we evaluated in detail.

Alternative 1 – Do Nothing

Bankson Lake currently has no surface water outlet. Water surface elevations are governed by the delicate balance of precipitation and stormwater runoff versus infiltration and evaporation. The established Van-Cass Intercounty Drain currently stops more than 1 mile south of Bankson Lake. The “do nothing” alternative may be acceptable if property owners within the Drainage District determine that the current water surface fluctuations are acceptable, or the proposed improvements are too costly.

Alternative 2 – 18-Inch Gravity Outlet

Alternative 2 consists of extending the Van-Cass Intercounty Drain approximately 6,350 linear feet to Bankson Lake. [Figure 2](#) provides a conceptual schematic of the proposed alignment and improvements associated with Alternative 2. Below is a list of major elements included in Alternative 2.

Drain Extension: The Drain would be legally extended from the current upstream terminus at the center of the Northeast $\frac{1}{4}$ of Section 27 in Porter Township to the south end of Bankson Lake near the northern end of the shared line between Sections 22 and 23 in Porter Township. The Drain extension alignment will have to be shifted east of the proposed 1952 route and course to avoid wetland impacts and property owned by the Michigan Nature Association (which presumably has a conservation easement over it). The Drain extension would require approximately 10 permanent easements and a resolution from the Van Buren County Road Commission to locate the Drain within road right-of-way.

Control Structure: An adjustable weir will be installed upstream of the proposed storm sewer to regulate flow from the Bankson Lake sub-watershed. The elevation of the outlet control structure will be set based on historical data (approximately 898-feet), yet flexible enough to allow for adjustments to the water surface elevation.

Storm Sewer Outlet: An 18-inch diameter storm sewer pipe would serve as the lake outlet and run approximately 1,500 linear feet south / southwest from Bankson Lake until it daylights to an open channel on the east side of the large wetland complex near the center of Section 22. The pipe invert elevation will be set somewhere between 896.5 and 898 feet and have a slope of approximately 0.1%.

Open Channel Excavation: Approximately 4,200 linear feet of open channel excavation is proposed from the pipe outlet to the confluence with the current Drain in Section 27 of Porter Township. Up to 650 linear feet of open channel excavation (dredging) along the south end of Bankson Lake may be required to ensure an adequate hydraulic connection from the lake to the outlet control structure. Efforts should be made to minimize impacts to existing wetlands as much as possible. Additional dip-out of the Drain may be required downstream to 90th Avenue to provide sufficient grade for the extension (Bankson Lake outlet). Properties bisected by the proposed open channel will be provided with appropriately sized crossing for access.

Estimated Project Cost: The preliminary estimate of probable cost to implement the improvements associated with Alternative 2 is approximately \$750,000. Please note that this estimated cost does not include administrative, land/easement acquisition or financing costs. A detailed project cost breakdown is provided in [Appendix 1](#).

Alternative 3 – 24-Inch Gravity Outlet

Alternative 3 is similar to Alternative 2 except that the storm sewer diameter is increased to 24-inches and extended south from the lake outlet through Section 22 of Porter Township. [Figure 3](#) provides a conceptual schematic of the proposed alignment and improvements associated with Alternative 3. The intent of Alternative 3 is to speed-up the draw-down time for Bankson Lake and reduce the impact to downstream wetland areas. Major differences from Alternative 2 include the following.

Storm Sewer Outlet: A 24-inch diameter storm sewer pipe would serve as the lake outlet and run approximately 5,700 linear feet south / southwest from Bankson Lake to the confluence with the current Drain in Section 27 of Porter Township. The pipe invert elevation will be set somewhere between 896 and 898 feet and have a slope of approximately 0.1%.

Open Channel Excavation: Up to 650 linear feet of open channel excavation (dredging) along the south end of Bankson Lake may be required to ensure an adequate hydraulic connection from the lake to the outlet control structure. Additional dip-out of the Drain may be required downstream to 90th Avenue to provide sufficient grade for the extension (Bankson Lake outlet).

Estimated Project Cost: The preliminary estimate of probable cost to implement the improvements associated with Alternative 3 is approximately \$1,080,000. Please note that this estimated cost does not include administrative, land/easement acquisition or financing costs. A detailed project cost breakdown is provided in [Appendix 1](#).

RECOMMENDATIONS & IMPLEMENTATION

LRE will work with the Board to develop a final project scope, if the petition is found necessary. We tentatively recommend proceeding with Alternative 2 as the most cost-effective way to provide an adequate outlet for the Bankson Lake sub-watershed. Implementation of the recommended scope of improvements to the Drain, as presented in this report, requires consideration of the following:

Easement Acquisition: Approximately 10 new drainage easements will be required along the proposed Drain extension to access and complete the work.

Permitting: The proposed Drain extension will require an Environment Great Lakes and Energy permit pursuant to Part 301, Inland Lakes and Streams and Part 303, wetlands protection of the Natural Resources and Environmental Protection Act, PA 451 of 1994 (NREPA). Portions of the proposed Drain extension may impact wetlands; therefore, coordination with and permits from the Michigan Department of Environment, Great Lakes and Energy (EGLE) will be critical. It is likely that EGLE will require a functional lift to improve the stream system and/or wetlands as part of any Drain extension project. In addition, considerations for impacts to aquatic life, fisheries, water quantity and water quality will also need to be considered.

Drainage District Revisions: If the petition is found necessary by the Board, the Drainage District should be revised as shown in [Exhibits B-1 and B-2](#) to accurately reflect the contributing drainage area.

Final Design and Construction: If the petition is found necessary, LRE will work with the Board to define the project scope and schedule, complete the final design and prepare contract documents for bidding and construction.

Figures

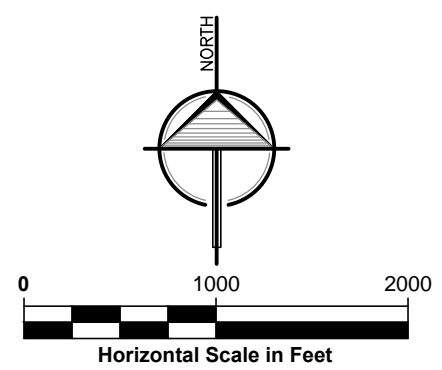
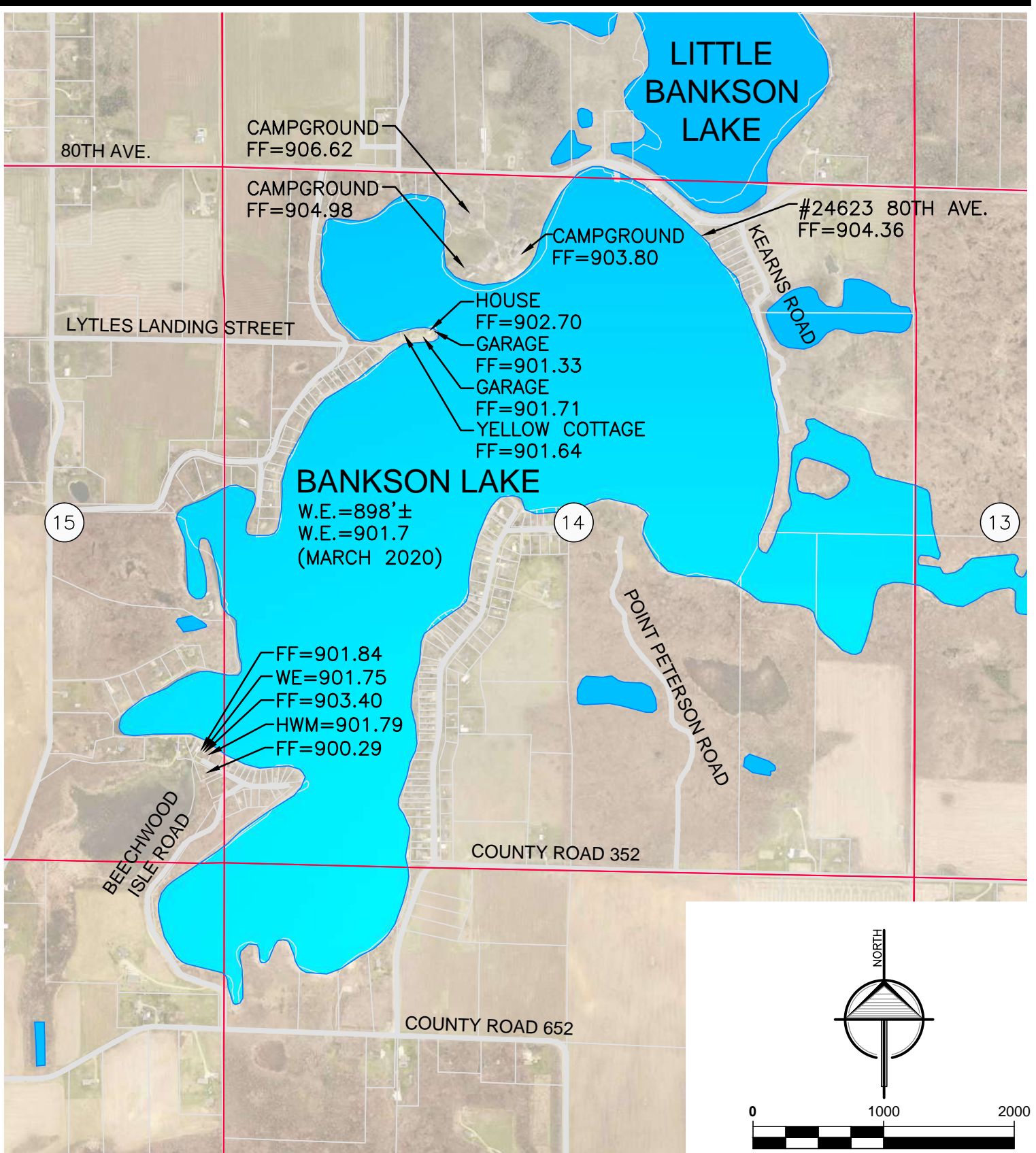


2121 3 Mile Rd.

Walker, Michigan 49544

Phone: 616.301.7888

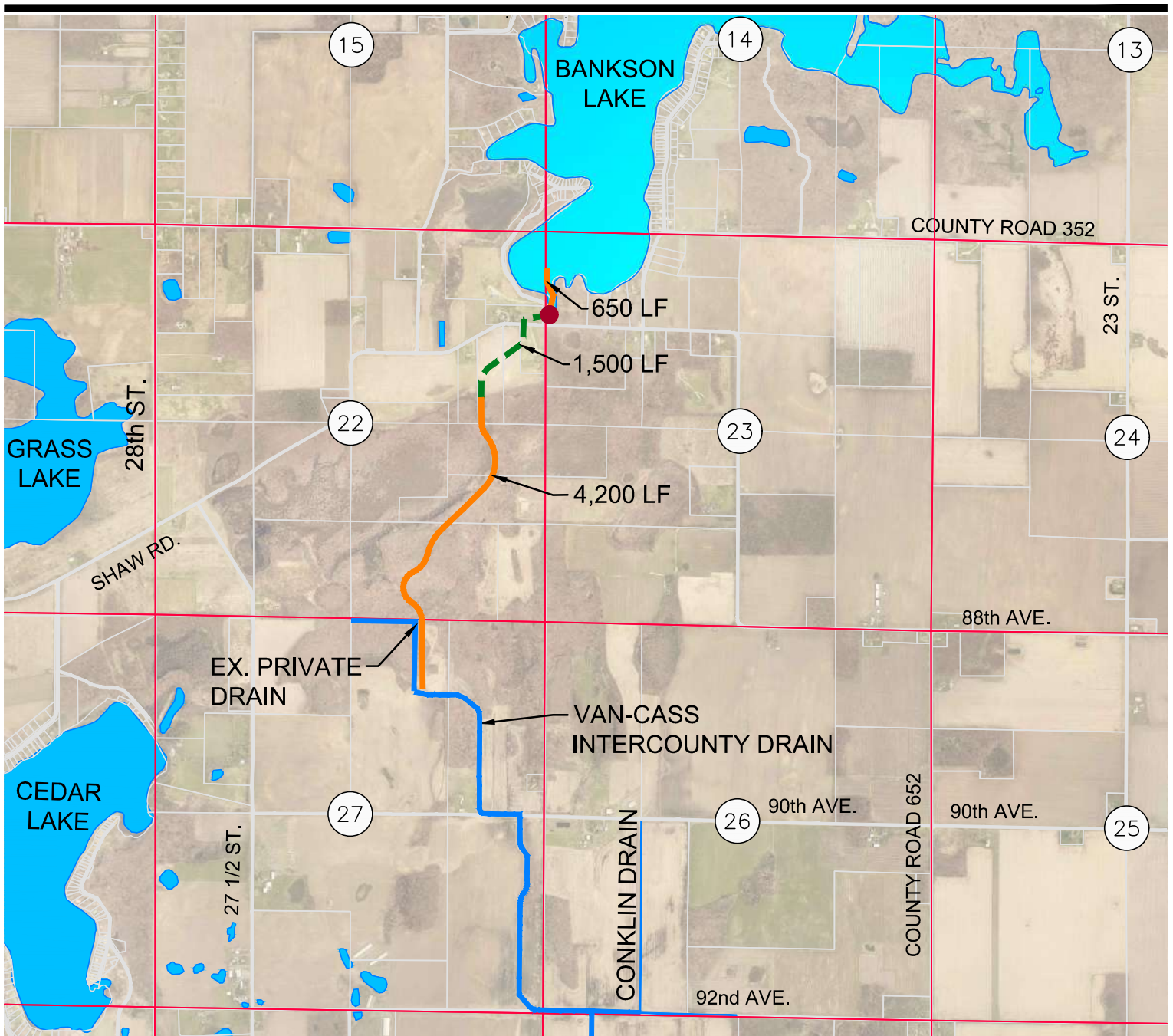
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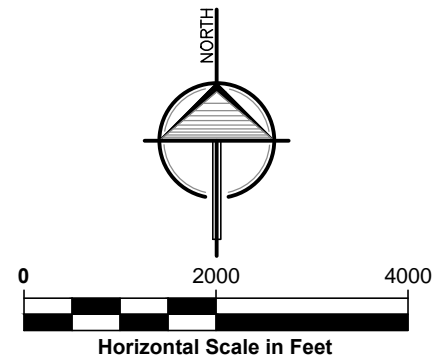
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Walker, MI 49544
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www.LREMI.com

BANKSON LAKE FLOODING	
PROJECT NUMBER: 19-109	DATE: 2020/06/04
DESIGNED BY: KJV	FIGURE 1
DRAFTED BY: NDJ	



LEGEND

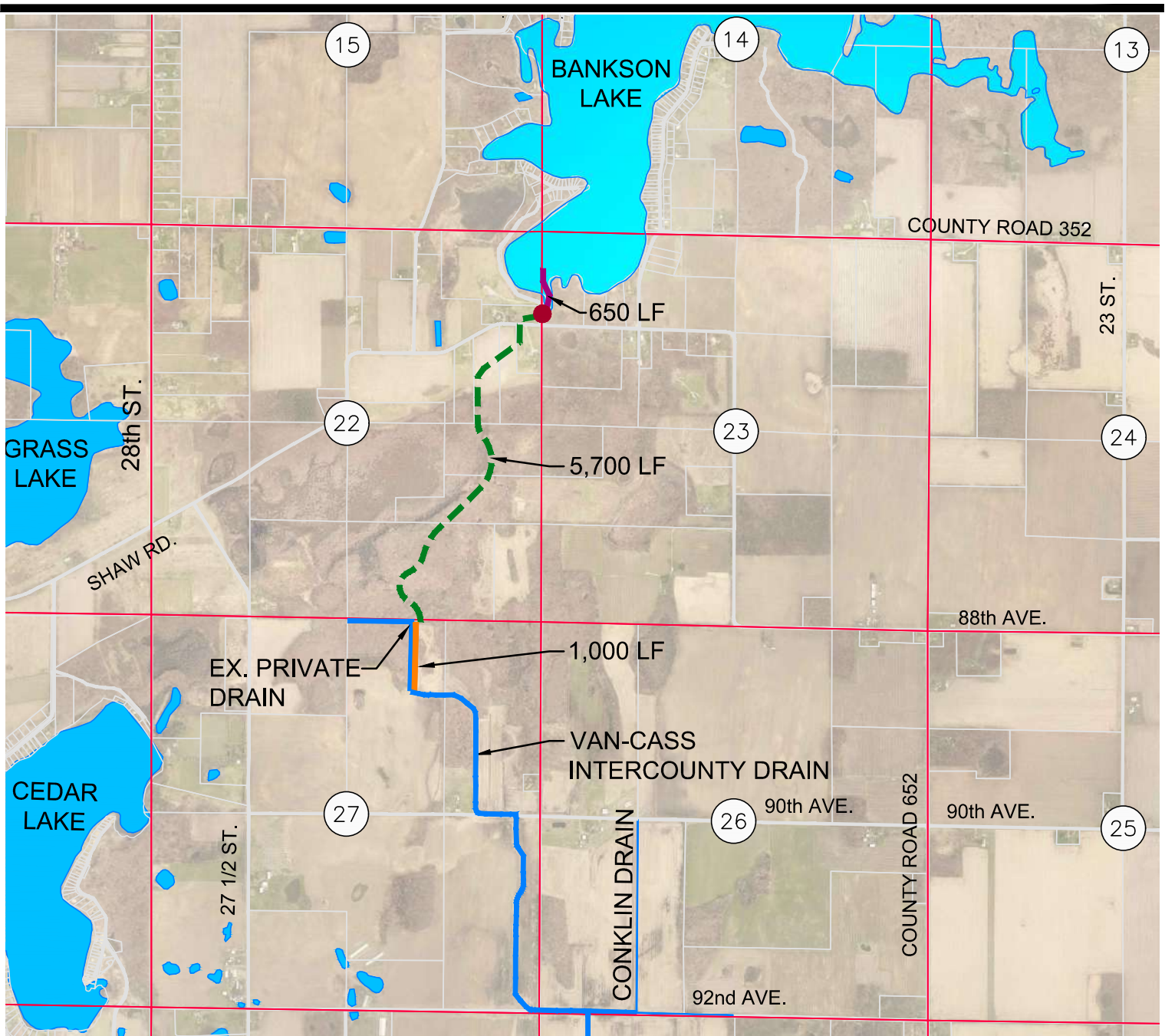
- - - - PROPOSED DRAIN EXTENSION 18" STORM SEWER
- - PROPOSED DRAIN EXTENSION OPEN CHANNEL
- - VAN CASS ICD OPEN CHANNEL OPEN CHANNEL
- - PROPOSED OUTLET CONTROL STRUCTURE





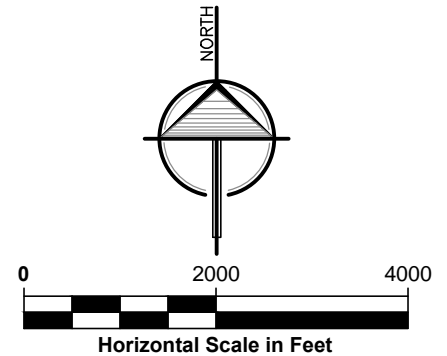
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ALTERNATIVE 2	
PROJECT NUMBER: 19-109	DATE: 2020/06/04
DESIGNED BY: KJV	FIGURE 2
DRAFTED BY: NDJ	



LEGEND

- - PROPOSED DRAIN EXTENSION OPEN CHANNEL
- - - - PROPOSED DRAIN EXTENSION 24" STORM SEWER
- - PROPOSED OPEN CHANNEL EXCAVATION
- - EXISTING VAN CASS ICD OPEN CHANNEL DRAIN
- - PROPOSED OUTLET CONTROL STRUCTURE





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Walker, MI 49544
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ALTERNATIVE 3	
PROJECT NUMBER: 19-109	DATE: 2020/06/04
DESIGNED BY: KJV	FIGURE 3
DRAFTED BY: NDJ	

Exhibits



2121 3 Mile Rd.

Walker, Michigan 49544

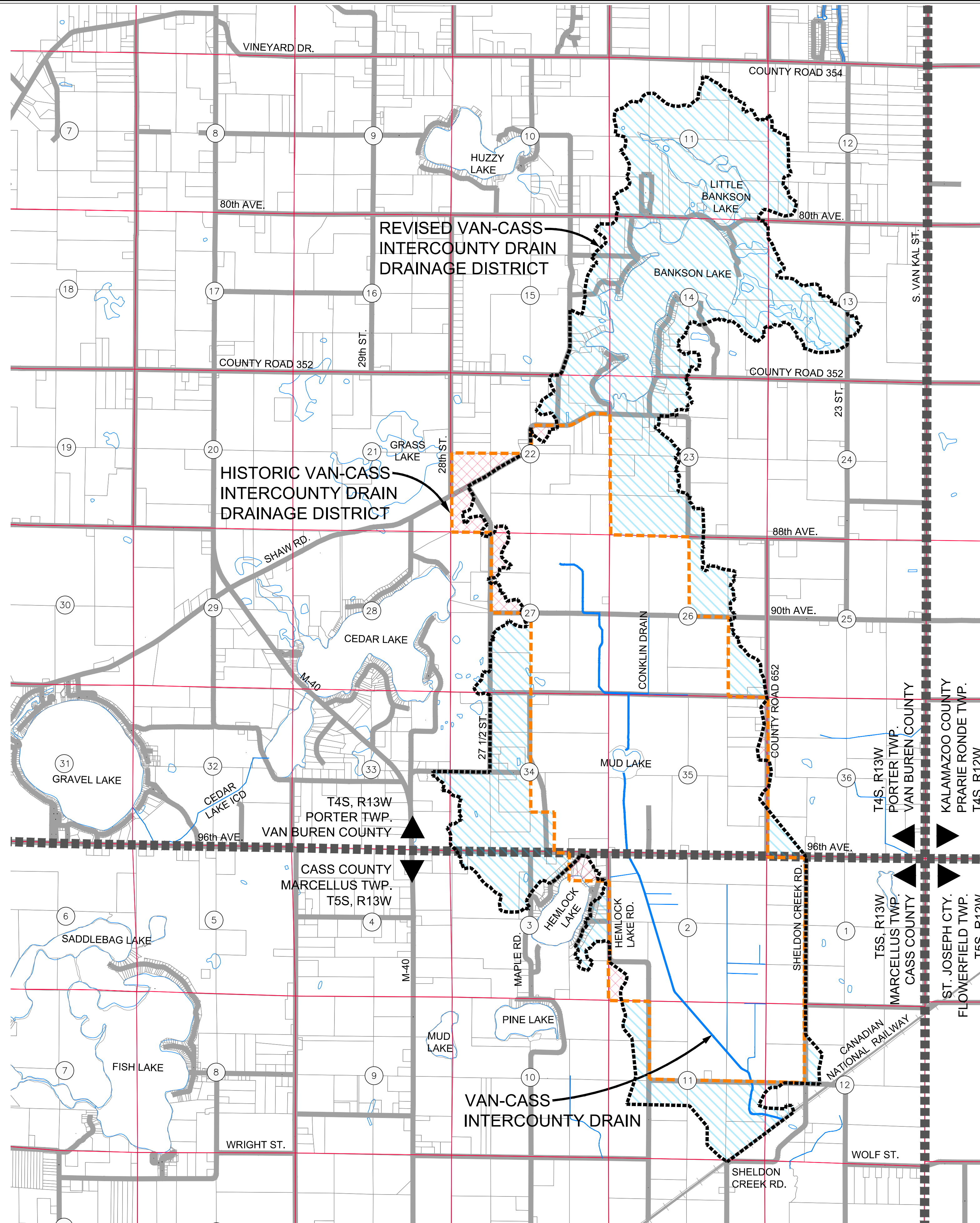
Phone: 616.301.7888

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VAN-CASS INTERCOUNTY DRAIN

DRAINAGE DISTRICT

SECTIONS 11-15, 22-23, 26-27 & 33-36
 T4S R13W
 PORTER TOWNSHIP, VAN BUREN COUNTY
 &
 SECTION 1-3 & 11-12
 T5S R13W
 MARCELLUS TOWNSHIP, CASS COUNTY



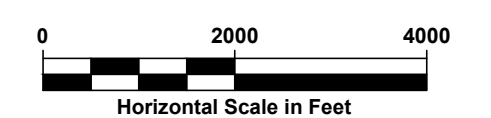
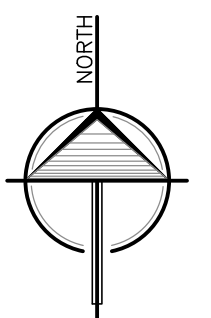
DRAINAGE DISTRICT INFORMATION:

HISTORIC DISTRICT:	3,201.04 ACRES
REVISED DISTRICT:	5,520.52 ACRES
LANDS ADDED:	2,461.09 ACRES
LANDS REMOVED:	141.61 ACRES

DRAIN LENGTH	
VAN-CASS INTERCOUNTY DRAIN	4.30 MILES

LEGEND

- LANDS REMOVED
- LANDS ADDED
- DRAIN ALIGNMENT (OPEN CHANNEL)
- DRAIN ALIGNMENT (ENCLOSED)
- HISTORIC DRAINAGE DISTRICT BOUNDARY
- REVISED DRAINAGE DISTRICT BOUNDARY
- CITY/VILLAGE LIMITS
- PARCEL LINES
- ROADS
- SECTION LINES
- TOWNSHIP LINE
- COUNTY LINE
- SECTION NUMBERS



LANDS ADDED/REMOVED MAP EXHIBIT B-1

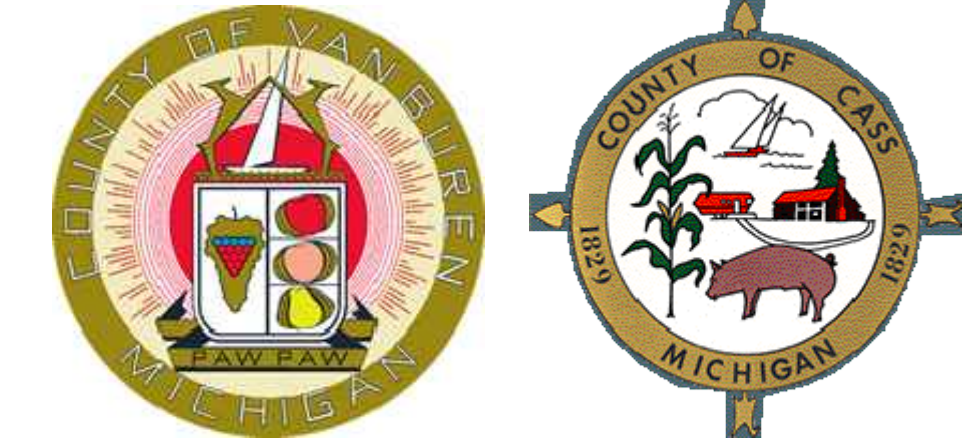
LRE ENGINEERS & SURVEYORS	2121 3 Mile Rd. NW Walker, MI 49544 Ph: 616-301-7888 www.LREMI.com	PROJECT#: 19-109
		DRAWN BY: KJB
		DATE: 05/28/2020
		QA/QC: NDJ

Map 28, 2020 - 2.25km x 1.125km Van-Cass Intercounty Drain Drainage District

VAN-CASS INTERCOUNTY DRAIN

DRAINAGE DISTRICT

SECTIONS 11-15, 22-23, 26-27 & 33-36
 T4S R13W
 PORTER TOWNSHIP, VAN BUREN COUNTY
 &
 SECTION 1-3 & 11-12
 T5S R13W
 MARCELLUS TOWNSHIP, CASS COUNTY



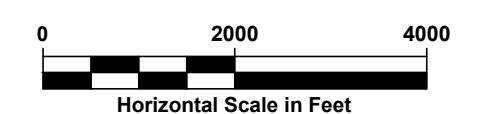
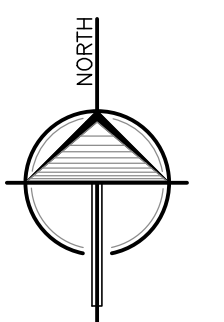
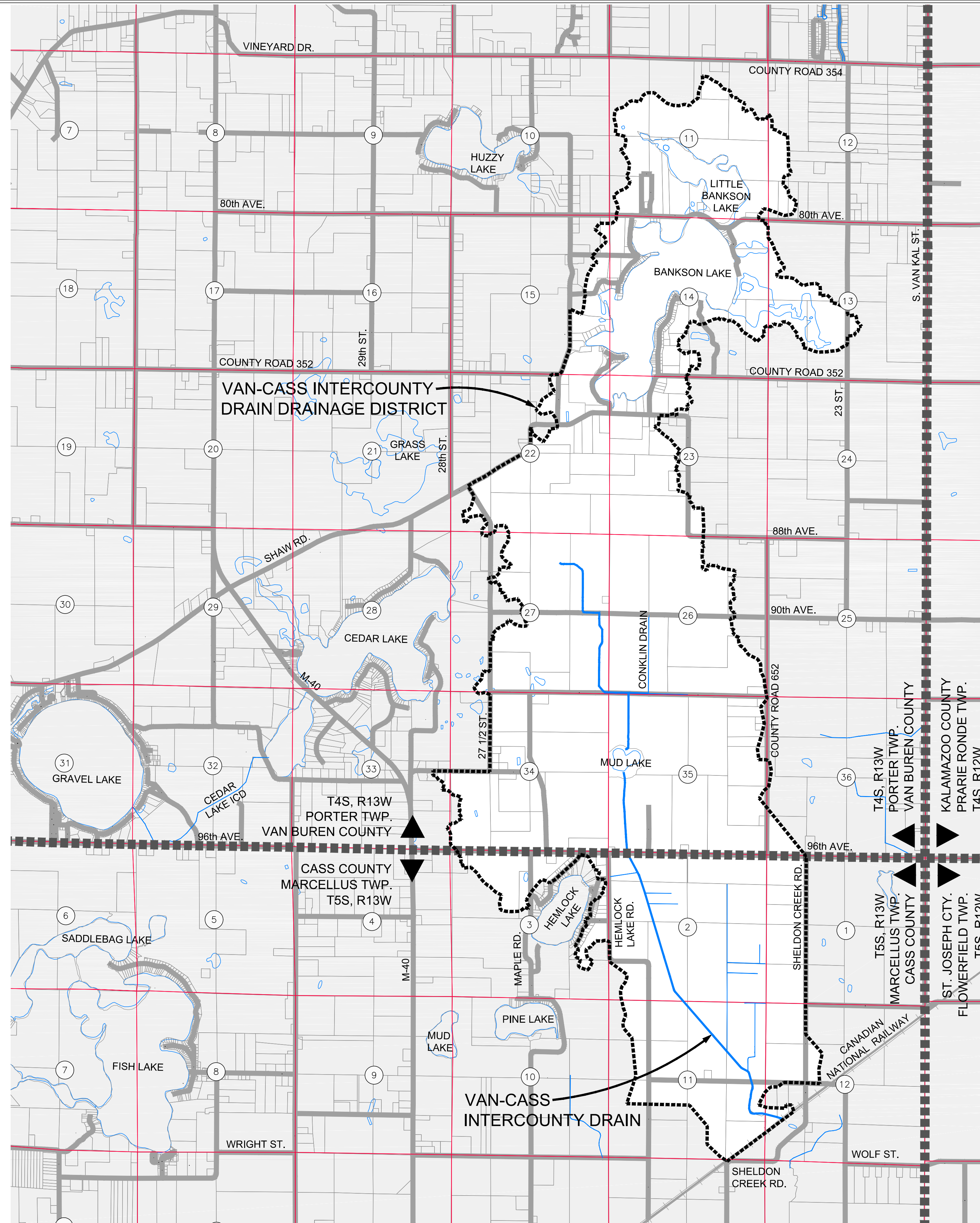
DRAINAGE DISTRICT INFORMATION:

DRAINAGE DISTRICT AREA:
 VAN BUREN COUNTY: 4,111.21 ACRES (74.47%)
 CASS COUNTY: 1,409.31 ACRES (25.53%)
 TOTALS 5,520.52 ACRES

DRAIN LENGTH:
 VAN BUREN COUNTY: 2.21 MILES
 CASS COUNTY: 2.09 MILES
 TOTALS: 4.30 MILES

LEGEND

- DRAIN ALIGNMENT (OPEN CHANNEL)
- DRAIN ALIGNMENT (ENCLOSED)
- DRAINAGE DISTRICT BOUNDARY
- CITY/VILLAGE LIMITS
- PARCEL LINES
- ROADS
- SECTION LINES
- TOWNSHIP LINE
- COUNTY LINE
- SECTION NUMBERS



DRAINAGE DISTRICT MAP EXHIBIT B-2

	2121 3 Mile Rd. NW Walker, MI 49544 Ph: 616-301-7888 www.LREMI.com	PROJECT#: 19-109
		DRAWN BY: KJB
		DATE: 05/28/2020
		QA/QC: NDJ

May 28, 2020 - 2:20pm - Van-Cass Intercounty Drain Drainage District Map - Exhibit B-2 - LRE

Appendix 1

Preliminary Estimates of Project Cost



**VAN-CASS INTERCOUNTY DRAIN
ALTERNATIVE 2 - PRELIMINARY ESTIMATE OF PROJECT COST**

By Land & Resource Engineering, June 2020



Alternative 2: 18-inch Outlet & Open Channel Drain Extension

No.	Item Description	Quantity		Unit Cost	Total Cost
1	Mobilization	1	LS	\$ 25,000.00	\$ 25,000.00
2	Maintenance along Existing Drain	1	LS	\$ 25,000.00	\$ 25,000.00
3	Traffic Control	1	LS	\$ 5,000.00	\$ 5,000.00
4	Woody Debris Management	4,850	LF	\$ 4.00	\$ 19,400.00
5	Open Channel Excavation	4,850	LF	\$ 12.00	\$ 58,200.00
6	Spoil Hauling	650	LF	\$ 15.00	\$ 9,750.00
7	Dewatering	1	LS	\$ 50,000.00	\$ 50,000.00
8	Culvert, 36-inch (3 locations)	90	LF	\$ 100.00	\$ 9,000.00
9	Storm Sewer, 18-inch PE	1,500	LF	\$ 75.00	\$ 112,500.00
10	Manhole, 48-inch Diameter	6	EA	\$ 3,500.00	\$ 21,000.00
11	Riprap End Treatment	80	SY	\$ 75.00	\$ 6,000.00
12	Private Crossing Restoration	3	EA	\$ 2,500.00	\$ 7,500.00
13	Paved Road Restoration	2	EA	\$ 7,500.00	\$ 15,000.00
14	Lawn Restoration	1,500	LF	\$ 5.00	\$ 7,500.00
15	Open Channel Seeding	4,850	LF	\$ 2.00	\$ 9,700.00
16	Mulch Blanket	13,000	SY	\$ 2.00	\$ 26,000.00
17	Outlet Control Structure	1	EA	\$ 45,000.00	\$ 45,000.00

Estimated Total Construction Cost \$ 451,550.00

Estimated Total Construction Cost	\$ 451,550.00
Estimated Engineering (Study though Construction)	\$ 125,000.00
Estimated Legal	\$ 50,000.00
Estimated Permits	\$ 30,000.00
Contingency (~15%)	\$ 93,887.50
* Preliminary Estimate of Project Cost	\$ 750,000.00

* Does not include Administrative, Wetland Mitigation, Floodplain Mitigation, Environmental Remediation, Land Acquisition, Easement Acquisition or Financing Costs.

**VAN-CASS INTERCOUNTY DRAIN
ALTERNATIVE 3 - PRELIMINARY ESTIMATE OF PROJECT COST**

By Land & Resource Engineering, June 2020



Alternative 3: 24-inch Pipe along Entire Drain Extension

No.	Item Description	Quantity		Unit Cost	Total Cost
1	Mobilization	1	LS	\$ 25,000.00	\$ 25,000.00
2	Maintenance along Existing Drain	1	LS	\$ 25,000.00	\$ 25,000.00
3	Traffic Control	1	LS	\$ 5,000.00	\$ 5,000.00
4	Woody Debris Management	650	LF	\$ 4.00	\$ 2,600.00
5	Open Channel Excavation	650	LF	\$ 12.00	\$ 7,800.00
6	Spoil Hauling	650	LF	\$ 15.00	\$ 9,750.00
7	Dewatering	1	LS	\$ 50,000.00	\$ 50,000.00
8	Storm Sewer, 24-inch PE	5,700	LF	\$ 75.00	\$ 427,500.00
9	Manhole, 48-inch Diameter	20	EA	\$ 3,500.00	\$ 70,000.00
10	Riprap End Treatment	20	SY	\$ 75.00	\$ 1,500.00
11	Paved Road Restoration	2	EA	\$ 7,500.00	\$ 15,000.00
12	Lawn Restoration	1,500	LF	\$ 5.00	\$ 7,500.00
13	Seeding	4,850	LF	\$ 2.00	\$ 9,700.00
14	Mulch Blanket	5,000	SY	\$ 2.00	\$ 10,000.00
15	Outlet Control Structure	1	EA	\$ 45,000.00	\$ 45,000.00

Estimated Total Construction Cost \$ 711,350.00

Estimated Total Construction Cost	\$	711,350.00
Estimated Engineering (Study though Construction)	\$	150,000.00
Estimated Legal	\$	50,000.00
Estimated Permits	\$	30,000.00
Contingency (~15%)	\$	138,650.00
* Preliminary Estimate of Project Cost	\$	1,080,000.00

* Does not include Administrative, Wetland Mitigation, Floodplain Mitigation, Environmental Remediation, Land Acquisition, Easement Acquisition or Financing Costs.

Appendix 2

Hydrologic & Hydraulic Calculations



Taylor Mantey

From: EGLE-wrd-qreq <EGLE-wrd-qreq@michigan.gov>
Sent: Tuesday, December 3, 2019 7:04 PM
To: Taylor Mantey
Subject: RE: flood or low flow discharge request (ContentID - 168812)

Follow Up Flag: Follow up
Flag Status: Flagged

We have estimated the flood frequency discharges requested in your email of November 22, 2019 (Process No. 20190717), as follows:

Tributary to Sheldon Creek at Bankson Lake outlet, Section 23, T4S, R13W, Porter Township, Van Buren County, has a total drainage area of 5.8 square miles and a contributing drainage area of 3.6 square miles. The 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance peak flows are estimated to be 80 cubic feet per second (cfs), 140 cfs, 200 cfs, 330 cfs, 460 cfs, 650 cfs, 800 cfs, and 1100 cfs, respectively. (Watershed Basin No. 34 St. Joseph).

Sheldon Creek at 90th Avenue, Section 27, T4S, R13W, Porter Township, Van Buren County, has a total drainage area of 9.8 square miles and a contributing drainage area of 5.9 square miles. The 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance peak flows are estimated to be 80 cubic feet per second (cfs), 140 cfs, 200 cfs, 330 cfs, 460 cfs, 650 cfs, 800 cfs, and 1100 cfs, respectively. (Watershed Basin No. 34 St. Joseph).

Sheldon Creek at 92nd Avenue, Section 26, T4S, R13W, Porter Township, Van Buren County, has a total drainage area of 10.6 square miles and a contributing drainage area of 6.8 square miles. The 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance peak flows are estimated to be 80 cubic feet per second (cfs), 140 cfs, 200 cfs, 330 cfs, 460 cfs, 650 cfs, 800 cfs, and 1100 cfs, respectively. (Watershed Basin No. 34 St. Joseph).

Sheldon Creek at 96th Avenue, Section 35, T4S, R13W, Porter Township, Van Buren County, has a total drainage area of 12.4 square miles and a contributing drainage area of 8.4 square miles. The 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance peak flows are estimated to be 90 cubic feet per second (cfs), 150 cfs, 210 cfs, 340 cfs, 470 cfs, 650 cfs, 800 cfs, and 1100 cfs, respectively. (Watershed Basin No. 34 St. Joseph).

Sheldon Creek at Knight Road, Section 11, T5S, R13W, Marcellus Township, Cass County, has a total drainage area of 15 square miles and a contributing drainage area of 11 square miles. The 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance peak flows are estimated to be 90 cubic feet per second (cfs), 160 cfs, 220 cfs, 360 cfs, 500 cfs, 700 cfs, 850 cfs, and 1100 cfs, respectively. (Watershed Basin No. 34 St. Joseph).

Sheldon Creek at CN North American Railroad, Section 12, T5S, R13W, Marcellus Township, Cass County, has a total drainage area of 15.5 square miles and a contributing drainage area of 11.6 square miles. The 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance peak flows are estimated to be 100 cubic feet per second (cfs), 160 cfs, 230 cfs, 370 cfs, 500 cfs, 700 cfs, 850 cfs, and 1100 cfs, respectively. (Watershed Basin No. 34 St. Joseph).

Please include a copy of this letter with your application for permit and indicate whether or not the project is funded under Act 51. These estimates should be confirmed by our office if an application is not submitted within one year. If you have any questions concerning the discharge estimates, please contact Ms. Susan Greiner, Hydrologic Studies and Dam Safety Unit, at 517-284-5579 or by email to GreinerS@michigan.gov. Any questions concerning hydraulic and/or environmental permit issues should be directed to Mr. Jim Watling, Water Resources Division, Transportation Review Unit, at 517-284-5504 or by email to WatlingJ@michigan.gov.

-----Original Message-----

From: DoNotReply@michigan.gov <DoNotReply@michigan.gov>

Sent: Friday, November 22, 2019 11:27 AM

To: EGLE-wrd-qreq <EGLE-wrd-qreq@michigan.gov>

Cc: mantey@lremi.com

Subject: flood or low flow discharge request (ContentID - 168812)

Requestor: Taylor Mantey

Company: LRE

Address: 2121 3-Mile Rd. NW

City: Walker, MI

Zip: 49544

Phone: 6163017888

Date: 2019-11-22

F50percent: Yes

F20percent: Yes

F10percent: Yes

F4percent: Yes

F2percent: Yes

F1percent: Yes

F0.5percent: Yes

F0.2percent: Yes

ContactAgency: None Selected

ContactPerson:

Watercourse: Sheldon Creek

LocalName: Van-Cass Intercounty Drain

CountyLocation: Van Buren

CityorTownship: Porter Township

Section: 23, 27, 26, 35

Town: 4S

Range: 13W

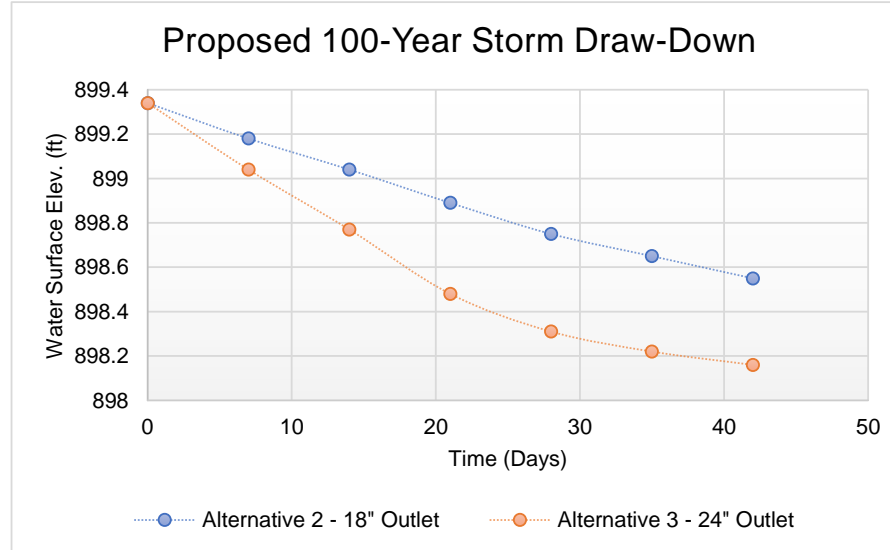
Location: #1 - 1,090 feet South of NW corner of Section 23; 90 feet East of Beechwood Isle Dr. #2 - 90th Avenue #3 - 92nd Avenue #4 - 96th Avenue

FFR1: County drain project

Bankson Lake Water Surface Elevation Summary

HydroCAD Model Results - Proposed Conditions

Duration in Weeks (Days)	Water Surface Elevation											
	Return Period and 24-Hour Precipitation Depth											
	2-Year		5-Year		10-Year		25-Year		50-Year		100-Year	
	2.37- Inches		3.00- Inches		3.52- Inches		4.45- Inches		5.27- Inches		6.15- Inches	
	Alt 2	Alt3	Alt 2	Alt3	Alt 2	Alt3	Alt 2	Alt3	Alt 2	Alt3	Alt 2	Alt3
0	898.28	898.28	898.46	898.46	898.6	898.6	898.87	898.87	899.1	899.1	899.34	899.34
1 (7)	898.22	898.19	898.37	898.3	898.5	898.38	898.74	898.55	898.95	898.79	899.18	899.04
2 (14)	898.17	898.15	898.31	898.22	898.42	898.26	898.63	898.37	898.82	898.52	899.04	898.77
3 (21)	898.12	898.11	898.24	898.15	898.33	898.18	898.52	898.25	898.69	898.33	898.89	898.48
4 (28)	898.09	898.08	898.18	898.11	898.26	898.13	898.43	898.17	898.58	898.22	898.75	898.31
5 (35)	898.08	898.07	898.14	898.09	898.21	898.11	898.36	898.13	898.49	898.17	898.65	898.22
6 (42)	898.06	898.06	898.11	898.07	898.16	898.08	898.29	898.1	898.41	898.13	898.55	898.16



ALT 2

100-1/2

~~100-1/2~~

Van-Cass ICD Drain Time 2020-06-01

Type II 24-hr Drain Time Rainfall=0.04"

Prepared by {enter your company name here}

Printed 6/2/2020

HydroCAD® 10.00-22 s/n 09958 © 2018 HydroCAD Software Solutions LLC

6.15" KI 24 hrs

Pond 2P: Bankson Lake

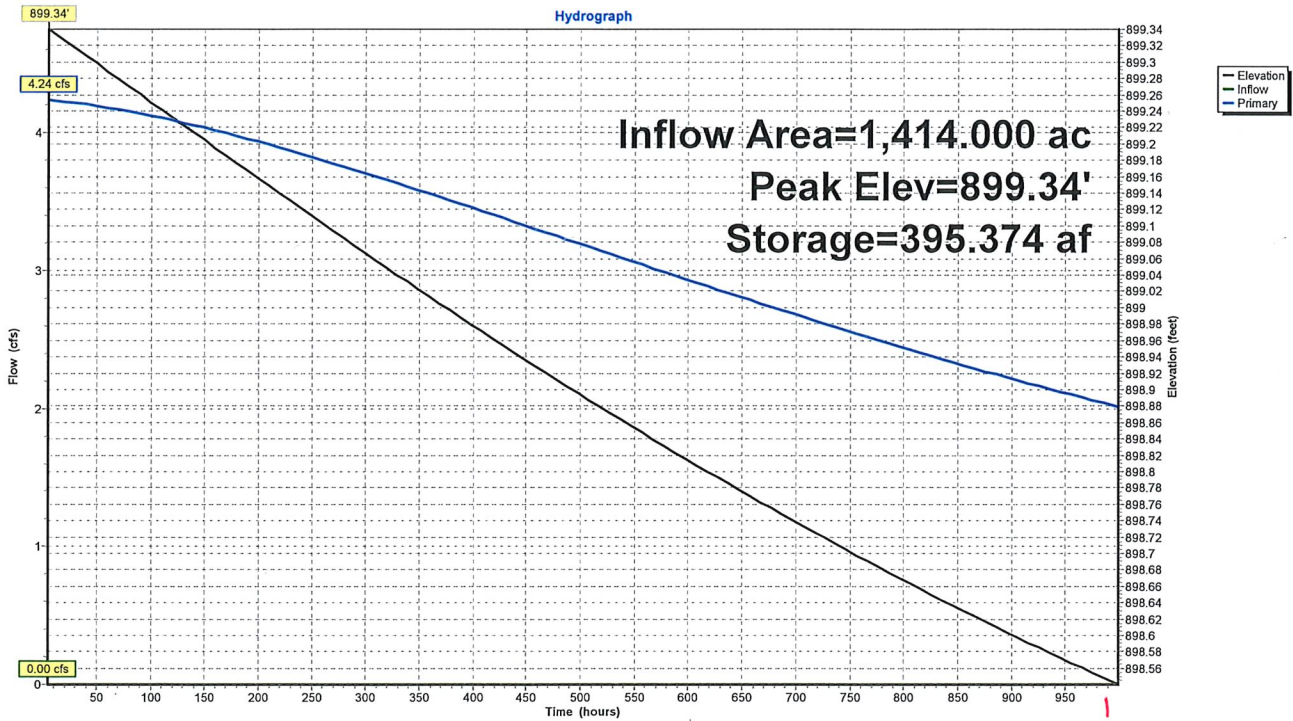
18"



1,500 LF

0.00%

897.50 - 896.0



1
20 DAYS
898.91

1
40 DAYS
898.55

h

Van-Cass ICD Drain Time 2020-06-01*Type II 24-hr Drain Time Rainfall=0.04"*

Prepared by {enter your company name here}

Printed 6/2/2020

HydroCAD® 10.00-22 s/n 09958 © 2018 HydroCAD Software Solutions LLC

Hydrograph for Pond 2P: Bankson Lake

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	395.374	899.34	4.24
30.00	0.00	386.633	899.32	4.22
55.00	0.00	377.947	899.29	4.19
80.00	0.00	369.326	899.27	4.16
105.00	0.00	360.780	899.25	4.12
130.00	0.00	352.318	899.22	4.07
155.00	0.00	343.948	899.20	4.03
180.00	0.00	335.677	899.18	3.98
205.00	0.00	327.512	899.15	3.93
230.00	0.00	319.456	899.13	3.87
255.00	0.00	311.517	899.11	3.81
280.00	0.00	303.697	899.08	3.76
305.00	0.00	296.000	899.06	3.69
330.00	0.00	288.430	899.04	3.63
355.00	0.00	280.988	899.02	3.57
380.00	0.00	273.677	899.00	3.51
405.00	0.00	266.500	898.97	3.44
430.00	0.00	259.456	898.95	3.38
455.00	0.00	252.546	898.93	3.31
480.00	0.00	245.772	898.91	3.25
505.00	0.00	239.134	898.89	3.18
530.00	0.00	232.631	898.87	3.11
555.00	0.00	226.263	898.85	3.05
580.00	0.00	220.030	898.83	2.98
605.00	0.00	213.931	898.81	2.92
630.00	0.00	207.964	898.79	2.86
655.00	0.00	202.128	898.77	2.79
680.00	0.00	196.423	898.75	2.73
705.00	0.00	190.846	898.73	2.67
730.00	0.00	185.396	898.72	2.61
755.00	0.00	180.072	898.70	2.55
780.00	0.00	174.870	898.68	2.49
805.00	0.00	169.790	898.66	2.43
830.00	0.00	164.829	898.65	2.37
855.00	0.00	159.985	898.63	2.32
880.00	0.00	155.256	898.61	2.26
905.00	0.00	150.640	898.60	2.21
930.00	0.00	146.134	898.58	2.15
955.00	0.00	141.737	898.57	2.10
980.00	0.00	137.446	898.55	2.05

ALT 3

Van-Cass ICD Drain Time 2020-06-01

Type II 24-hr Drain Time Rainfall=~~0.04"~~ ^{100-yr}

Prepared by {enter your company name here}

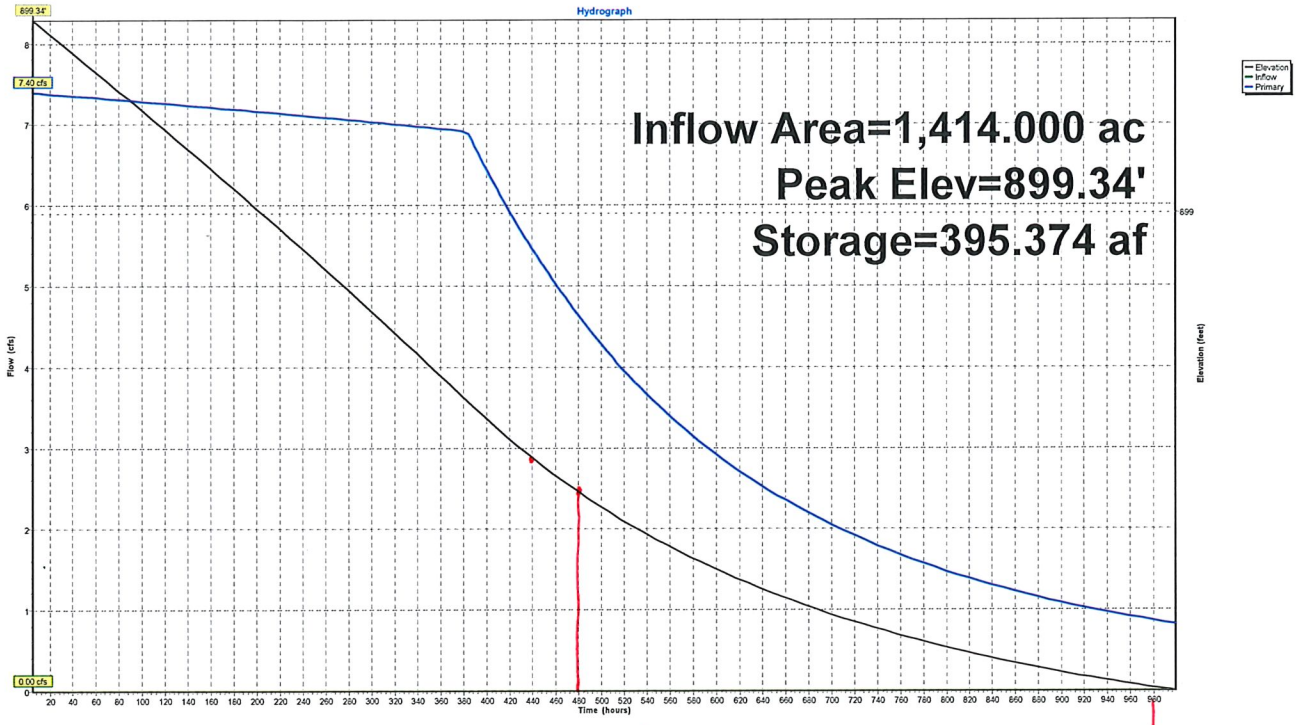
Printed 6/2/2020

HydroCAD® 10.00-22 s/n 09958 © 2018 HydroCAD Software Solutions LLC

~~6.15" 1st 24 hrs~~

Pond 2P: Bankson Lake

24" 5,700 LF 0.07% 896.00 TO 892.00



20 DAYS
898.5

40 DAYS
898.16

Van-Cass ICD Drain Time 2020-06-01*Type II 24-hr Drain Time Rainfall=0.04"*

Prepared by {enter your company name here}

Printed 6/2/2020

HydroCAD® 10.00-22 s/n 09958 © 2018 HydroCAD Software Solutions LLC

Hydrograph for Pond 2P: Bankson Lake

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	395.374	899.34	7.40
30.00	0.00	380.120	899.30	7.37
55.00	0.00	364.925	899.26	7.34
80.00	0.00	349.791	899.22	7.31
105.00	0.00	334.718	899.17	7.28
130.00	0.00	319.706	899.13	7.25
155.00	0.00	304.758	899.09	7.22
180.00	0.00	289.873	899.04	7.19
205.00	0.00	275.052	899.00	7.16
230.00	0.00	260.297	898.95	7.13
255.00	0.00	245.609	898.91	7.09
280.00	0.00	230.989	898.86	7.06
305.00	0.00	216.437	898.82	7.03
330.00	0.00	201.955	898.77	6.99
355.00	0.00	187.545	898.72	6.96
380.00	0.00	173.207	898.68	6.92
405.00	0.00	159.460	898.63	6.32
430.00	0.00	147.069	898.59	5.69
455.00	0.00	135.896	898.55	5.14
480.00	0.00	125.806	898.51	4.64
505.00	0.00	116.678	898.48	4.20
530.00	0.00	108.408	898.45	3.81
555.00	0.00	100.901	898.42	3.46
580.00	0.00	94.077	898.39	3.15
605.00	0.00	87.862	898.37	2.87
630.00	0.00	82.191	898.35	2.62
655.00	0.00	77.009	898.33	2.40
680.00	0.00	72.266	898.31	2.20
705.00	0.00	67.916	898.29	2.02
730.00	0.00	63.920	898.27	1.85
755.00	0.00	60.244	898.26	1.71
780.00	0.00	56.856	898.25	1.57
805.00	0.00	53.730	898.23	1.45
830.00	0.00	50.840	898.22	1.35
855.00	0.00	48.164	898.21	1.25
880.00	0.00	45.683	898.20	1.16
905.00	0.00	43.379	898.19	1.07
930.00	0.00	41.237	898.18	1.00
955.00	0.00	39.243	898.17	0.93
980.00	0.00	37.384	898.16	0.87

Survey Drawings



2121 3 Mile Rd.

Walker, Michigan 49544

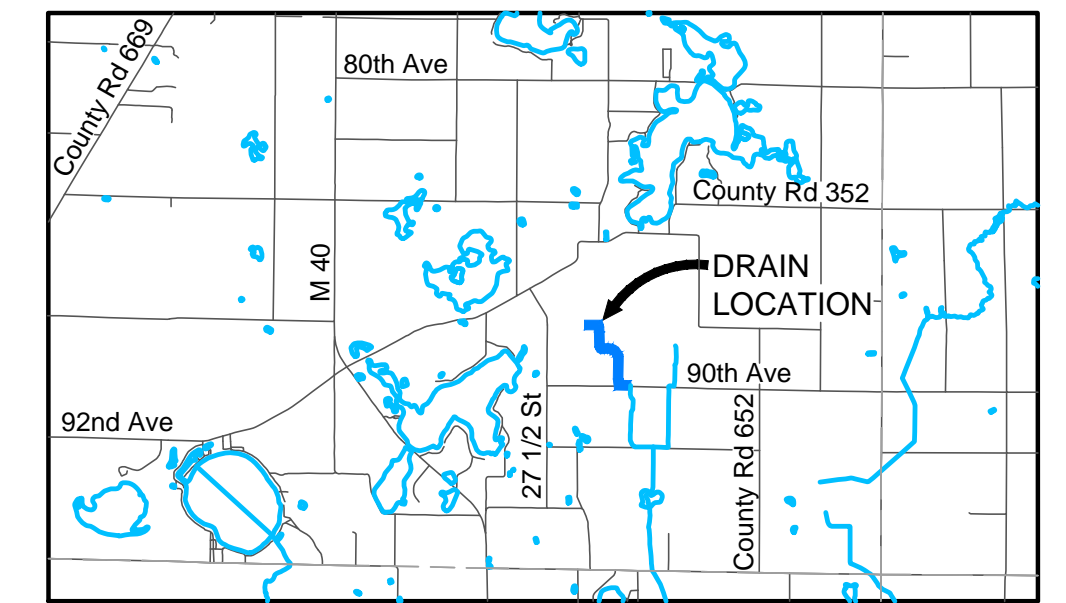
Phone: 616.301.7888

www.LREMI.com

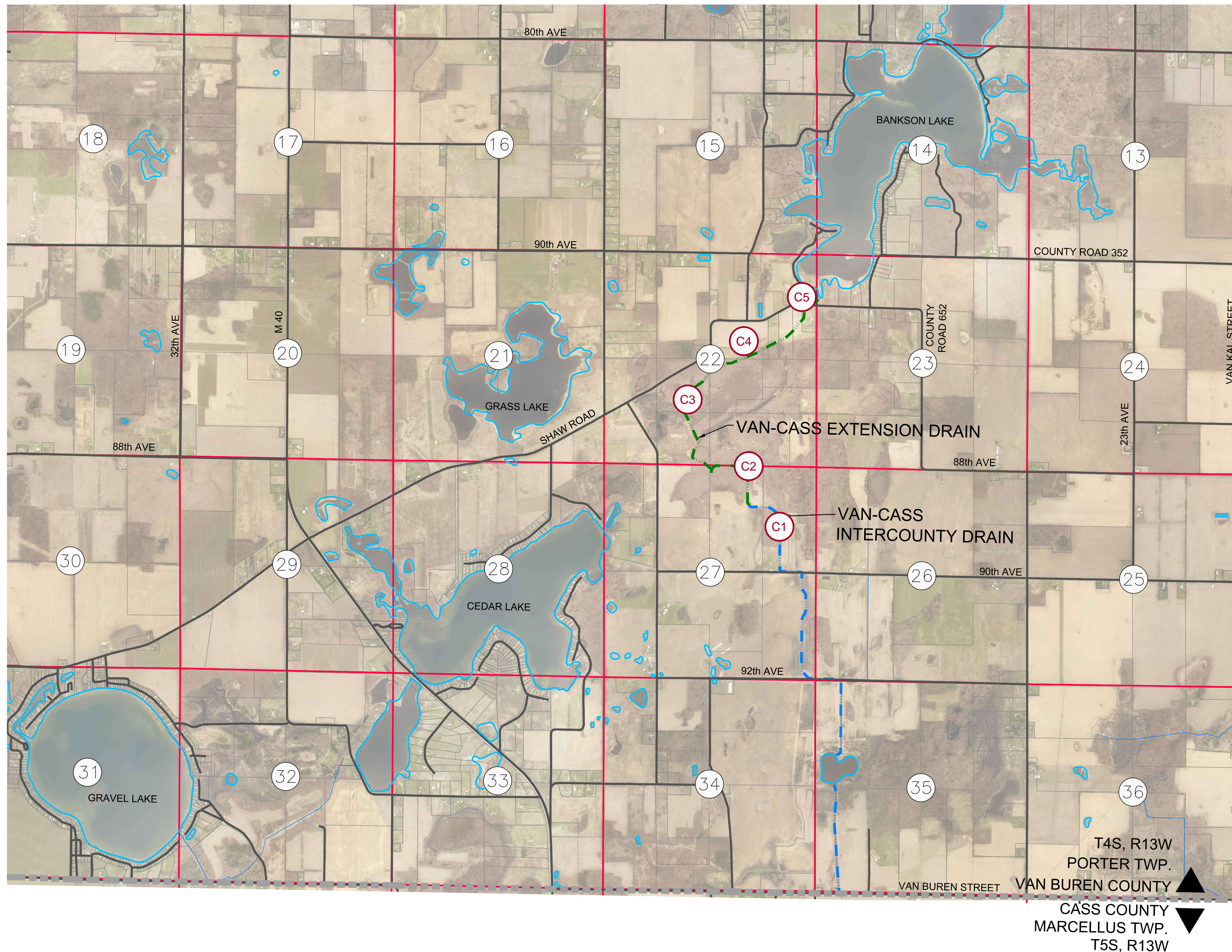


Van-Cass Intercounty Drain

Sections 11-15, 22-23, 26-27 & 33-36
 T4S R13W
 Porter Township, Van Buren County
 &
 Section 1-3 & 11-12
 T5S R13W
 Marcellus Township, Cass County



VICINITY MAP
NOT TO SCALE



INDEX OF SHEETS

CS - COVER SHEET

C1 - PLAN & PROFILE

VAN-CASS INTERCOUNTY DRAIN
 (STA. 00+00 - 27+50)

C2 - PLAN & PROFILE

VAN-CASS INTERCOUNTY DRAIN
 (STA. 27+50 - 48+50)

C3 - PLAN & PROFILE

VAN-CASS EXTENSION DRAIN
 (STA. 00+00 - 27+50)

C4 - PLAN & PROFILE

VAN-CASS EXTENSION DRAIN
 (STA. 27+50 - 54+50)

C5 - PLAN & PROFILE

VAN-CASS EXTENSION DRAIN
 (STA. 54+50 - 68+50)

LEGEND

- ENCLOSED CHANNEL DRAIN
- OPEN CHANNEL DRAIN
- SECTION LINE
- TOWNSHIP LINE
- ROADS
- PROPERTY LINES
- SECTION NUMBERS
- SHEET NUMBERS

3 WORKING DAYS
BEFORE YOU DIG
 CALL MISS DIG
 1-800-482-7171

ALL UTILITIES AS SHOWN ARE APPROXIMATE LOCATIONS DERIVED FROM ACTUAL MEASUREMENTS AND AVAILABLE RECORDS. THEY SHOULD NOT BE INTERPRETED TO BE EXACT LOCATION NOR SHOULD IT BE ASSUMED THAT THEY ARE THE ONLY UTILITIES IN THE AREA.

2121 3 Mile Rd. NW
 Walker, MI 49544
 Ph: 616-301-7886
 www.LREMI.com

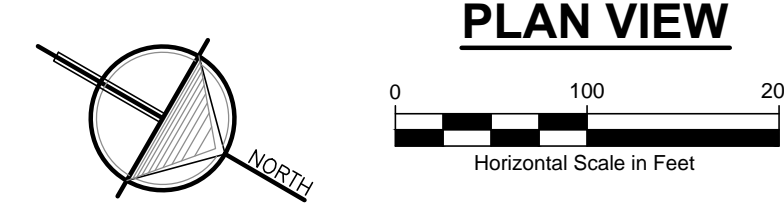


REVISIONS:	NO.	ISSUED FOR	DATE
	1.	ENGINEERING REPORT	6/10/2020

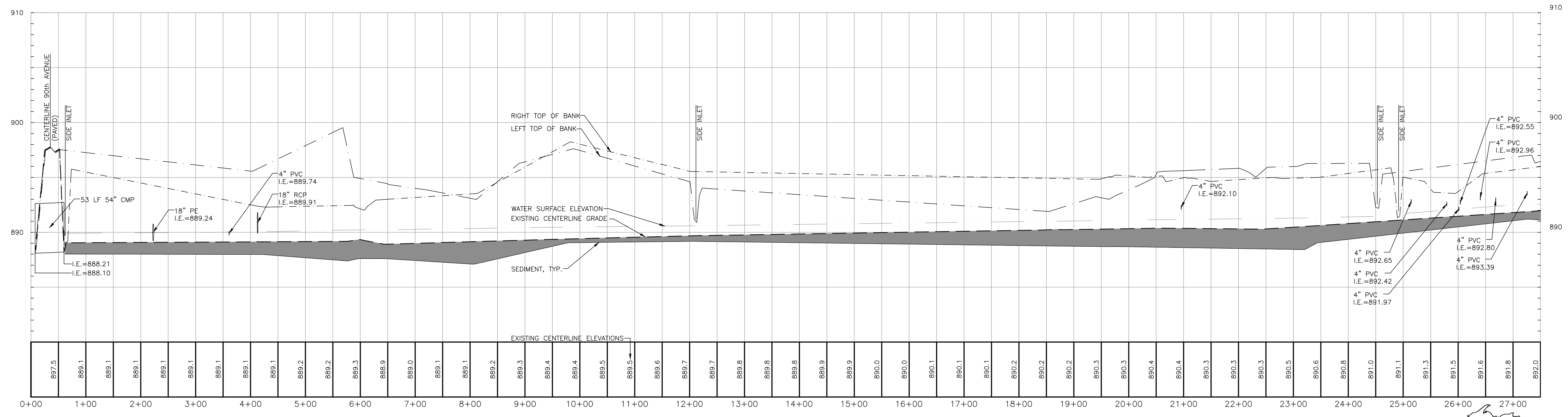
CLIENT: VAN-CASS INTERCOUNTY DRAIN DRAINAGE BOARD
 PROJECT: VAN-CASS INTERCOUNTY DRAIN
 VAN BUREN AND CASS COUNTIES

PROJECT NUMBER:	DATE
19-108	03/2020
SURVEYED BY: RLB	04/2020
DESIGNED BY: DVF	04/2020
DRAFTED BY: KJB	04/2020
QA/QC: NDJ	04/2020

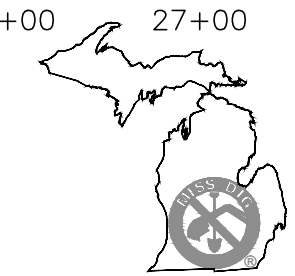
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 SHEET NUMBER: CS



PLAN VIEW



CENTERLINE PROFILE
 SCALE: HORIZONTAL: 1" = 100'
 VERTICAL: 1" = 5'



ALL UTILITIES AS SHOWN ARE APPROXIMATE LOCATIONS DERIVED FROM ACTUAL MEASUREMENTS AND AVAILABLE RECORDS. THEY SHOULD NOT BE INTERPRETED TO BE EXACT LOCATION NOR SHOULD IT BE ASSUMED THAT THEY ARE THE ONLY UTILITIES IN THE AREA.

21213 Mile Rd. NW
 Walker, MI 49544
 Ph: 616-301-7886
 www.LREMI.com



REVISIONS:	NO.	ISSUED FOR	DATE
	1.	ENGINEERING REPORT	6/10/2020

CLIENT: VAN-CASS INTERCOUNTY DRAIN DRAINAGE BOARD
 PROJECT: VAN-CASS INTERCOUNTY DRAIN
 VAN BUREN AND CASS COUNTIES

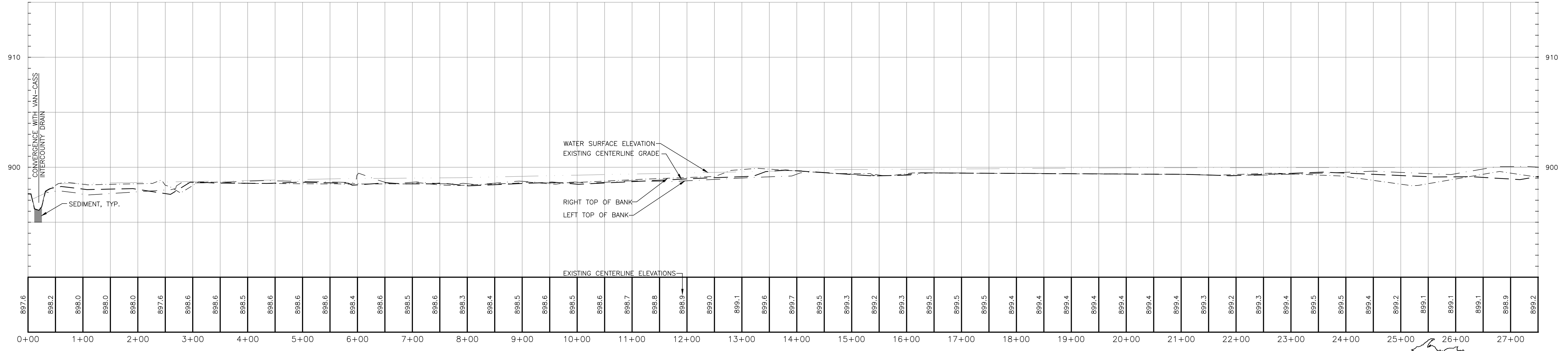
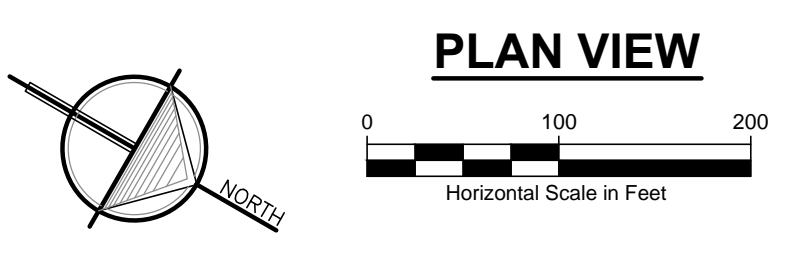
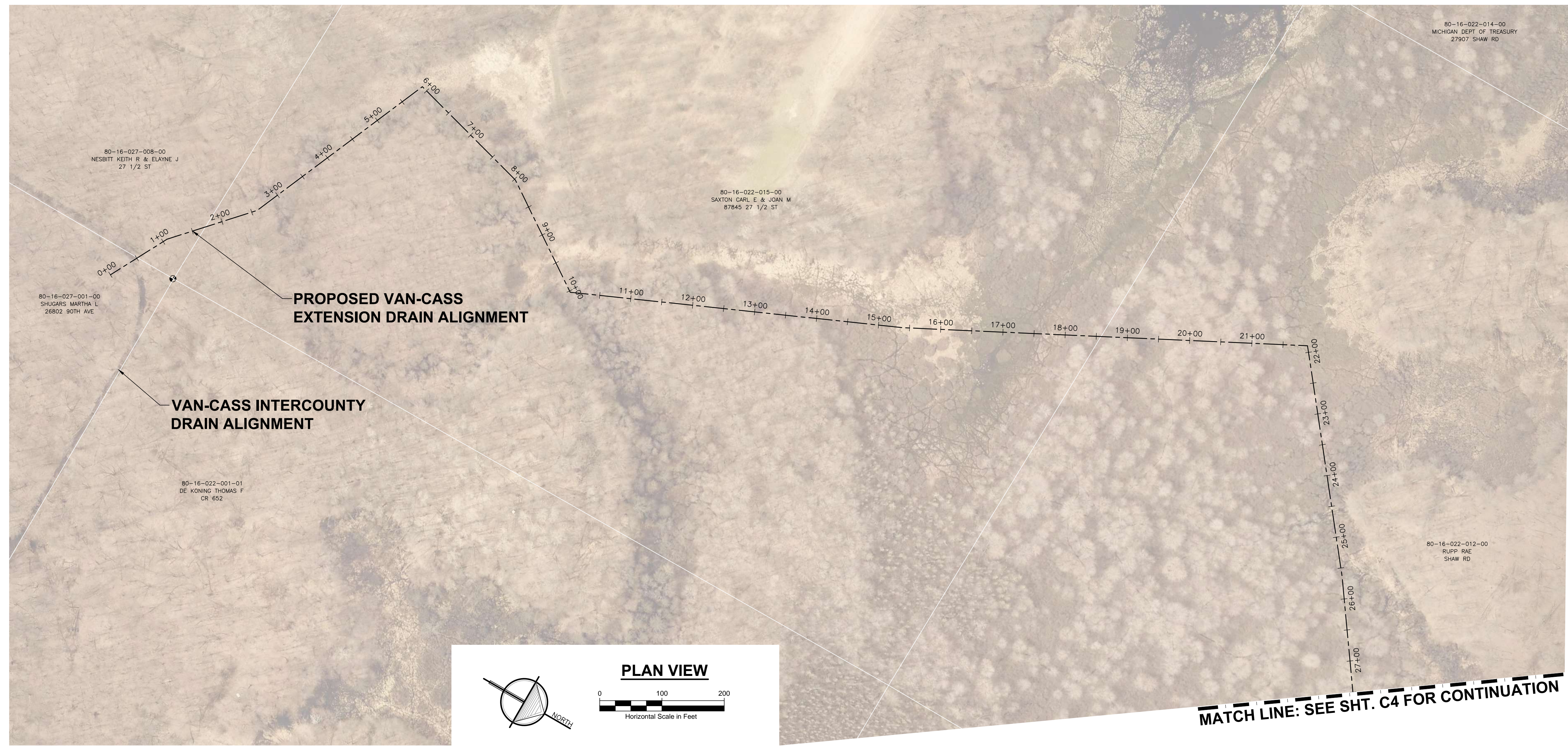
PROJECT NUMBER:	DATE
19-108	03/2020
SURVEYED BY: RLB	04/2020
DESIGNED BY: DVF	04/2020
DRAFTED BY: KJB	04/2020
QA/QC: NDJ	

PLAN & PROFILE
 STA: 00+00 - 27+50

SHEET NUMBER

C1

6/10/2020 10:43:28 AM C:\Users\jrb\OneDrive\Documents\19-108\19-108.dwg (P) [D] [S] [M]



CENTERLINE PROFILE
 SCALE: HORIZONTAL: 1" = 100'
 VERTICAL: 1" = 5'

3 WORKING DAYS
BEFORE YOU DIG
 CALL MISS DIG
 1-800-482-7171

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2121 3 Mile Rd. NW
 Walker, MI 49544
 Ph: 616-301-7886
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REVISIONS:	NO.	ISSUED FOR	DATE
	1.	ENGINEERING REPORT	6/10/2020

CLIENT: VAN-CASS INTERCOUNTY DRAIN DRAINAGE BOARD
 PROJECT: VAN-CASS INTERCOUNTY DRAIN
 VAN BUREN AND CASS COUNTIES

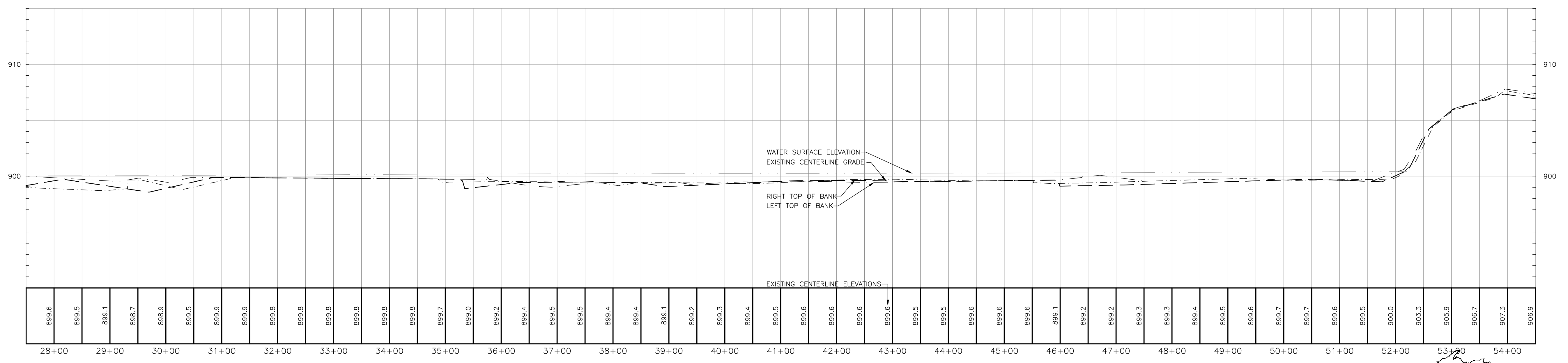
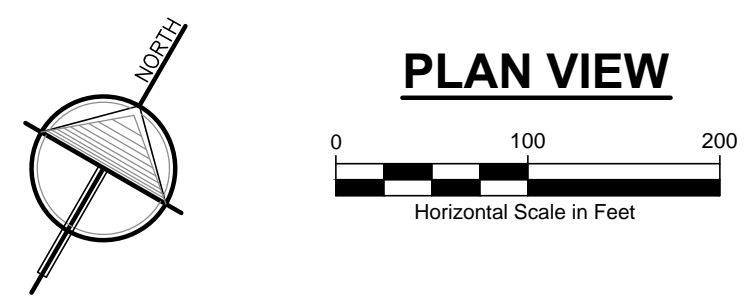
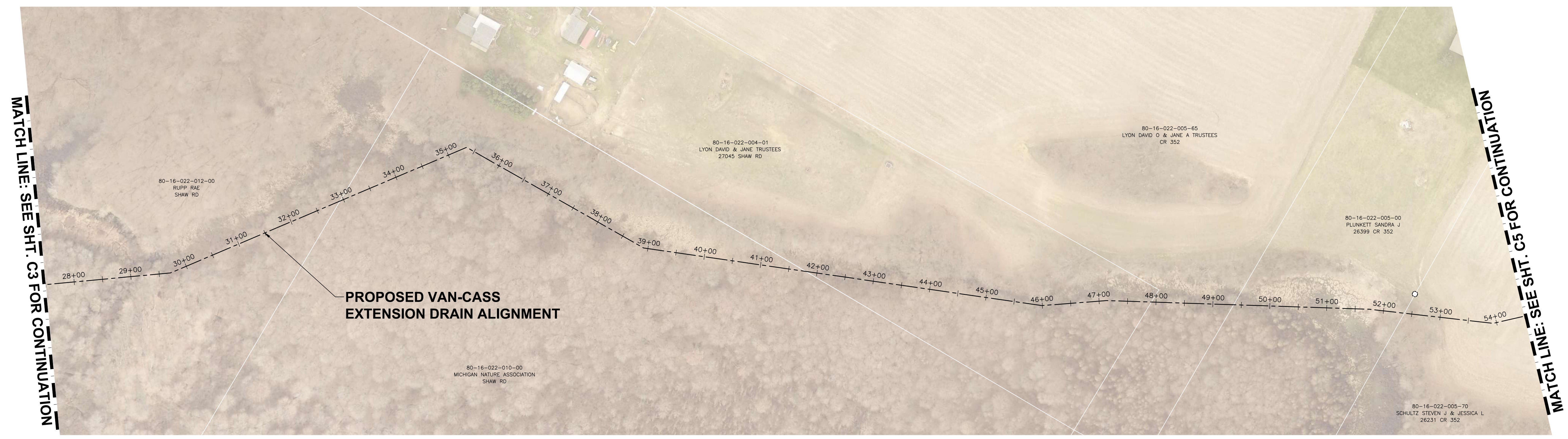
PROJECT NUMBER:	DATE
19-109	03/2020
SURVEYED BY: RLB	04/2020
DESIGNED BY: DVF	04/2020
DRAFTED BY: KJB	04/2020
QA/QC: NDJ	

PLAN & PROFILE
 STA: 00+00 - 27+50

SHEET NUMBER

C3

As of 2020 - 4/20/20 in Project 19-109 Van-Cass Intercounty Drain and Profile, LRE, Inc. (LRE) (LRE) (LRE)



CENTERLINE PROFILE
SCALE: HORIZONTAL: 1" = 100'
VERTICAL: 1" = 5'

3 WORKING DAYS
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LRE
ENGINEERS & SURVEYORS

REVISIONS:	NO.	ISSUED FOR	DATE
	1.	ENGINEERING REPORT	6/10/2020

CLIENT: VAN-CASS INTERCOUNTY DRAIN DRAINAGE BOARD

PROJECT: VAN-CASS INTERCOUNTY DRAIN
VAN BUREN AND CASS COUNTIES

PROJECT NUMBER: 19-109

SURVEYED BY: RLB

DESIGNED BY: DVF

DRAFTED BY: KJB

QA/QC: NDI

DATE: 03/2020

DATE: 04/2020

DATE: 04/2020

PLAN & PROFILE
STA: 27+50 - 54+50

SHEET NUMBER

C4

As of 2020 - 4/20/20 in Michigan (1/1/20) Version: 100 (1/1/20) and Professional: 100 (1/1/20) [Date: 6/10/20]

