

**Enbridge Line 6B MP 608
Marshall, MI Pipeline Release**

Work Plan for Assessing Large Woody Debris

Prepared for the Michigan Department of Environmental Quality

Enbridge Energy, Limited Partnership

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FIGURE

Figure 1 Large Woody Debris Survey

TABLE

Table 1 Sample Large Woody Debris Survey Data Form

LIST OF ACRONYMS

DBH	Diameter at Breast Height
Enbridge	Enbridge Energy, Limited Partnership
GPS	Global Positioning System
LDB	Left Descending Bank
LWD	Large Woody Debris
Line 6B	The pipeline owned by Enbridge Energy, Limited Partnership that runs just south of Marshall, Michigan
MC	Mid-channel
MDEQ	Michigan Department of Environmental Quality
MP	Mile Post
%	Percent
RDB	Right Descending Bank
Study Area	Area within the Kalamazoo River from its Confluence with Talmadge Creek to Morrow Lake
yd ³	Cubic Yards

1.0 INTRODUCTION

On July 26, 2010, Enbridge Energy, Limited Partnership (Enbridge) reported a release of crude oil from the pipeline owned by Enbridge that runs just south of Marshall, Michigan (Line 6B) in the vicinity of its pump station. The crude oil was released below grade level via a break in Line 6B at Mile Post (MP) 608, emerged onto the ground surface, flowed over land following the natural topography into Talmadge Creek, and proceeded to flow downstream into the Kalamazoo River. Following the release, Enbridge performed a variety of response activities under the direction of the United States Environmental Protection Agency and the Michigan Department of Environmental Quality to remove oil from the system and respond to the release.

Prior to the incident and response actions, considerable large woody debris (LWD) was present in the river. LWD provides habitat for fish, wildlife, and macroinvertebrates while also providing river bank stabilization and protection from erosive forces. Response actions that occurred in 2010 through and including 2012 resulted in the removal of LWD from the river. In many instances removed material was stockpiled on adjacent river banks. Storms and flooding events on the river have relocated and naturally replenished a portion of the LWD that was removed. Floodwaters have also pulled some of the LWD that was relocated to the floodplains and banks back into the river, and added new deadfalls and downed woody material to the river. Visual observations made by Enbridge consultants and members of the Kalamazoo River Bank Erosion Assessment Team (inclusive of a Michigan Department of Environmental Quality (MDEQ) representative) have confirmed this natural recruitment of LWD back into the river.

Removal actions and investigations completed in response to the Line 6B release included the documentation and removal of LWD from portions of the Kalamazoo River to facilitate the capture of oil and sheen producing material. This work plan was developed to assess the location, density, orientation, and attributes associated with the LWD currently present within the Kalamazoo River from its confluence with Talmadge Creek to Morrow Lake (Study Area). The evaluation of LWD will be performed by biologists experienced with identifying, evaluating, and installing different types of LWD within riverine systems and assessing LWD value. Consistency training of field biologists conducting the LWD field assessments for Enbridge will be coordinated by Mr. Stu Kogge of Cardno JFNew. MDEQ oversight staff will be notified and encouraged to participate in the consistency training to ensure appropriate and consistent information is gathered.

2.0 STUDY APPROACH

The objective of the study approach is to use a set of parameters that can be evaluated by a team of biologists working to identify, quantify, and qualify the location and attributes of LWD within proposed 2013 dredge areas and previously recorded Large Woody Debris Removal Areas as identified on the 2013 Large Woody Debris Survey Area Figure (See *Figure 1*). The use of snorkeling equipment, self-contained underwater breathing apparatus, or other methods that require direct submersion in the river will not be used due to safety concerns and the fact that LWD features, attributes, and parameters can be accurately assessed, identified, and documented from the water surface.

2.1 Methods

Two two-person teams will be utilized to identify and assess LWD at each bank of the river, with an overlapping of the mid-channel (MC) area of the river by both teams. Prior to the initiation of the LWD survey, the two teams will participate in consistency training to encourage the consistent recording and assessment of LWD features and attributes by both teams. Training will be conducted in accordance with the protocols set forth in this document.

The location, type, and physical features of the LWD will be recorded on LWD Survey Data Forms (See *Table 1*) and the location of the LWD structures will be mapped using a global positioning system (GPS) unit capable of providing sub-meter accuracy. The type, orientation, physical features, and location of LWD in the river will be documented along with the biologists' professional assessment as to the habitat for wildlife, fish, and/or macroinvertebrates, the contribution toward bank stability, and the potential for increased erosion resulting from the presence of LWD in the river. The teams will utilize the following definitions and record observations and assessments on the LWD Survey Data Forms (*Table 1*) to provide consistency with documentation and assessment of LWD. The LWD Survey Data Form will be modified as necessary to optimize efficiency and may be modified prior to implementation of field work if converted into an electronic form for use in the GPS unit.

2.1.1 Definitions

2.1.1.1 LWD

For the purposes of this assessment, LWD is defined as those portions of woody vegetation (alive or dead) that are equal to, or greater than, 3 inches in diameter, are a minimum of 8 feet in length, and that are partially submerged within the river during some portion of the year. This

includes LWD that is above the water surface and below the bankfull elevation of the river. LWD that is comprised of multiple trees or woody debris greater than 3 inches in diameter and greater than 8 feet in length would be considered a LWD Complex. It excludes branched shrubs or woody material less than 3 inches in diameter that are mobile or transient within the river channel and other woody material both standing and downed that is in the floodplain areas of the river, and that is not in contact with the river and above the bankfull elevation of the river. LWD is commonly characterized as providing cover for fish, resting platforms for wildlife, attachment sites for macroinvertebrates, and serving as a natural form of bank protection and stabilization for river banks subjected to natural and endemic erosion.

2.1.1.2 Location within River

The location of LWD within the river will be recorded as being within either the left, right, or central portions of the river, as divided into three longitudinal sections parallel with the river flow. The one-third section of the river that includes the left bank of the river as viewed looking downstream is identified as the left descending bank (LDB). The one-third section of the river along the opposite or right bank of the river, as viewed looking downstream is identified as the right descending bank (RDB). The central remaining section of the river is the MC section. LWD may extend across one or more of these areas depending upon its size. The primary location of the LWD will be recorded on the LWD Survey Data Form and mapped as a point using a GPS unit. Should the predominant distribution of LWD extend beyond one river section, both sections containing a predominance of LWD will be noted. The percentage of the river that is blocked by LWD within these sections of the river will also be recorded using 20 to 30 percent (%) increments (See *Table 1*). Additionally, in an effort to better assess the functional attributes of LWD present within the river, field biologists will visually estimate that portion of the LWD that is submerged below the existing water surface of the river. The submerged portion of the LWD present in each location will be visually assessed, with that portion of the LWD mass present below the water surface estimated using 10 percent (%) increments, and recorded on the LWD Survey Data Form (See *Table 1*).

Photographs will be taken to document the particular woody debris areas, as possible.

2.1.1.3 Trees

Trees represent one type of LWD that may be present. Trees are defined as woody structures containing a trunk and roots and/or branches. The number, size, and length of trees, as assessed visually, will be the primary feature of each LWD Complex assessed. When primary

features are not readily discernible, secondary features will be used to characterize the traits of LWD present at a particular site. The size and length of LWD will be recorded as follows:

Large –Tree with all or most branches still intact; length greater than or equal to 20 feet (primary feature to consider); and, diameter at breast height (DBH) greater than or equal to 10 inches (secondary feature).

Medium – Tree with few branches still intact. Can be smaller DBH with more branches intact; length between 15 and 20 feet (primary feature to consider); and, DBH between 6 and 10 inches (secondary feature).

Small –Tree with fewer branches; length between 8 and 15 feet (primary factor to consider); and DBH between 3 and 6 inches (secondary feature).

2.1.1.4 Tree Stumps or Root Masses

Tree stumps or root masses represent an additional type of LWD that may be present. The number and size of tree stumps or root masses present at a LWD site will be recorded as follows, based primarily on their diameter:

Large - Greater than or equal to 6 feet in diameter (includes groups of small or medium diameter stumps with roots extending past 6 feet in diameter).

Medium - From 3 to 6 feet in diameter (includes small diameter stumps with roots extending up to 6 feet in diameter).

Small - Less than 3 feet in diameter.

2.1.1.5 Logs

Logs are differentiated from trees by having few to no branches, lacking roots, and are often older pieces of trees, or just the trunk portions of trees. The overall average diameter of a log will be visually estimated by the field biologist. The number and size of logs present at a LWD site will be recorded as follows based primarily on their length:

Large - Length greater than or equal to 20 feet (primary feature to consider) and diameter greater than or equal to 12 inches (secondary feature).

Medium - Length between 15 and 20 feet (primary feature to consider) and diameter between 6 and 12 inches (secondary feature).

Small - Length between 8 and 15 feet (primary feature to consider) and diameter between 3 and 6 inches (secondary feature).

2.1.1.6 LWD Complex

This parameter takes into account the number and size of all the groups of LWD recorded at a site to assign a relative size to the entire LWD Complex. The LWD Complex will be recorded as follows:

Large - Accumulation of 10 or more pieces of woody material and/or greater than 10 cubic yards (yd³) of woody material.

Medium - Accumulation of 6 to 10 pieces of woody material and/or between 3 and 10 yd³ of woody material.

Small - Accumulation of less than 6 pieces of woody material and/or less than 3 yd³ of woody material.

2.1.1.7 Stability of LWD

The size of the LWD, the type or composition of the LWD, and the width of the river channel influences the stability of LWD within a stream or river system (Cramer, 2012). The position of the LWD in relation to the main flow of the river is also important. Submerged LWD will be assessed using visual observations from the watercraft supplemented by use of viewing scopes and/or viewing buckets where necessary. Field biologists will use the following parameters and the descriptions below to determine the stability rating of LWD:

Immobile - LWD is usually large (but can be of all sizes), has been waterlogged and/or submerged on the bottom of the river for an extended period of time (more than one year, as estimated by field biologists), is firmly anchored into the bed or bank of the river, is interlocked with other LWD material into the bed or bank of the river, and/or is showing no signs of being transported further downstream during either a typical or above normal flood event on the river. Most of this LWD is likely be located in the slower moving areas of the river.

Semi-fixed - LWD is usually of medium to small size but can be large, can be anchored to either the bed or banks of the river or just resting on the bottom of the river due to the size/weight of the LWD, and/or is showing some signs of possibly being transported

downstream during either a large or typical flood event on the river. This classification is also used when clear evidence is lacking whether the LWD is either immobile or mobile.

Mobile - LWD is usually small, but can be medium or large if not too heavy, is located within the central portions of the river channel where flows can move material around, not anchored or submerged within the bed or banks of the river, and is showing signs of having been transported and is capable of further transport downstream during the next flood or high flow event on the river.

2.1.1.8 LWD Attributes

Field biologists will assess the degree to which the LWD is providing the following attributes:

- Creating a pool (Yes or No). If 'Yes', length, width, and depth will be estimated and recorded.
- Providing Amphibian/Reptile Habitat (Yes or No). A 'Yes' answer is provided for any of the following:
 - Visual observation of amphibian/reptiles,
 - Presence of amphibian/reptile scats or evidence of past use on LWD, and/or
 - Easy access for amphibians/reptiles to utilize LWD from water or land.
- Providing Fisheries Habitat (Yes or No), A 'Yes' answer is provided for any of the following:
 - Created a pool,
 - Material is submerged below the water surface (and/or below the ordinary high water mark),
 - Visual observation of fish species,
 - Egg masses or other evidence of past fish use, and/or
 - Evidence of spawning beds or other fish use in proximity to LWD.
- Providing Bank Protection (Yes or No). The angle at which LWD is embedded into the bank will be recorded. A 'Yes' answer is provided for any of the following:
 - LWD positioned to ensure bank protection and/or to divert erosive flows away from the bank, and/or
 - LWD mass present is believed to be sufficient to divert and/or dissipate erosive flows.
- Orientation Causing Erosion (Yes or No). A 'Yes' answer is provided for any of the following:

- LWD position results in bank or bed erosion (includes diversion of flows towards the bank or bed), and/or
- LWD mass results in obstruction to river flow.
- Repositioning Capable of Reducing Erosion, Increasing Bank Protection, or Improving Habitat Values (Yes or No, If Yes, explain necessary actions). A 'Yes' answer is provided for any of the following:
 - Repositioning of LWD results in a better alignment to minimize erosion of bed and/or bank (includes diversion of flows away from the bank or bed),
 - Repositioning of LWD results in removal of an obstruction to river flow, and/or
 - Repositioning or the supplemental addition of LWD will result in improving amphibian, reptile, and/or fish habitat.

3.0 RESULTS AND DELIVERABLES

The results of the LWD assessment will be provided and summarized in a format similar to that of *Table 1*. A shapefile of the collected GPS points of identified LWD locations, an attribute table containing structure descriptive details (e.g., type, size, function of woody debris, etc.), and a photographic log of the survey will be produced.

The LWD assessment data will be provided in a format (e.g., Excel table) that will provide the opportunity to easily sort data and create maps or data tables that allow for analysis of historic data and for comparison of the range of other parameters assessed and recorded during the course of completing the 2013 LWD study.

4.0 SCHEDULE

The LWD assessment work is scheduled to commence on June 17, 2013 and continue for approximately three weeks or until the Study Area is completely assessed. Consistency training with the field biologists is expected to commence prior to or on June 17, 2013. A report of findings comprised of the tabulation of data and creation of maps/figures is anticipated to be complete within three weeks of completing the field work portion of the LWD assessment.

5.0 REFERENCES

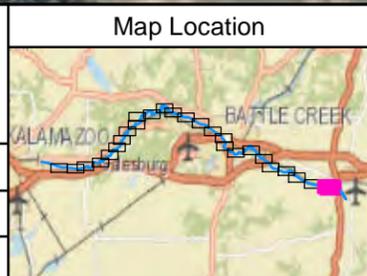
Cramer, Michelle L. (managing editor), 2012. *Stream Habitat Restoration Guidelines*. Co-published by the Washington Departments of Fish and Wildlife, Natural Resources, Transportation and Ecology, Washington State Recreation and Conservation Office, Puget Sound Partnership, and the U.S. Fish and Wildlife Service.

Figure



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 Approved: DP 8/5/2013
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- Legend**
- Large Woody Debris Survey Point
 - ▨ Large Woody Debris Survey Area
 - ▭ Riverine Banklines
 - Quarter Mile Grid Segment



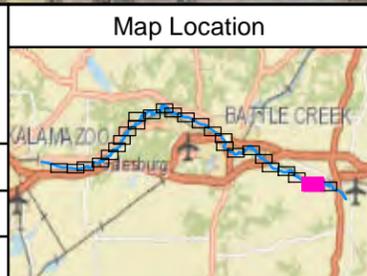
FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 1 OF 26

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP



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- Legend**
- Large Woody Debris Survey Point
 - ▨ Large Woody Debris Survey Area
 - ▭ Riverine Banklines
 - Quarter Mile Grid Segment

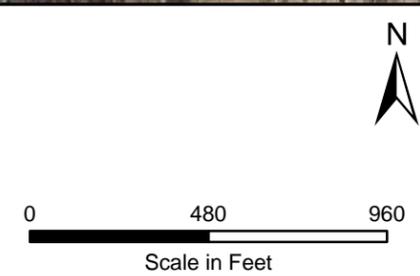


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 2 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - ▨ Large Woody Debris Survey Area
 - ▭ Riverine Banklines
 - Quarter Mile Grid Segment

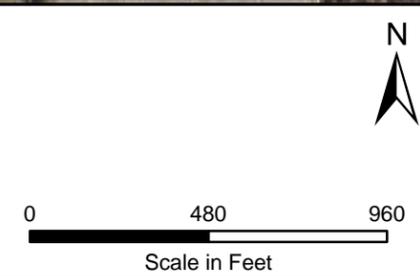
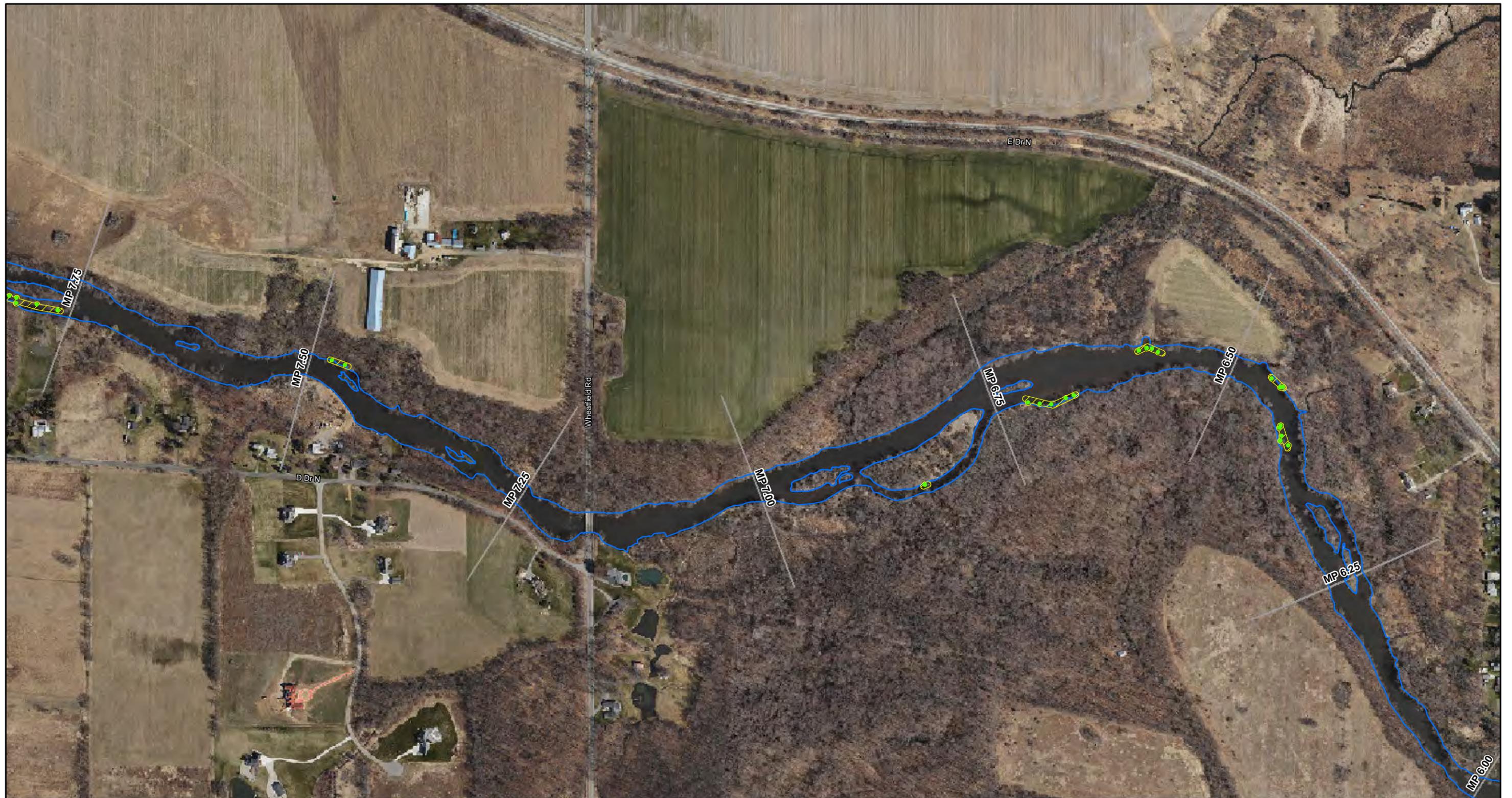


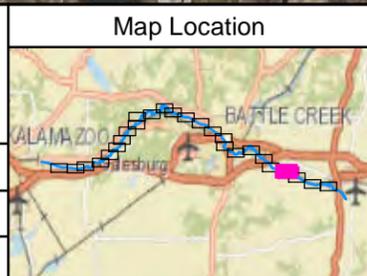
FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 3 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

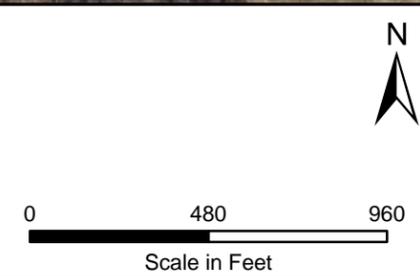
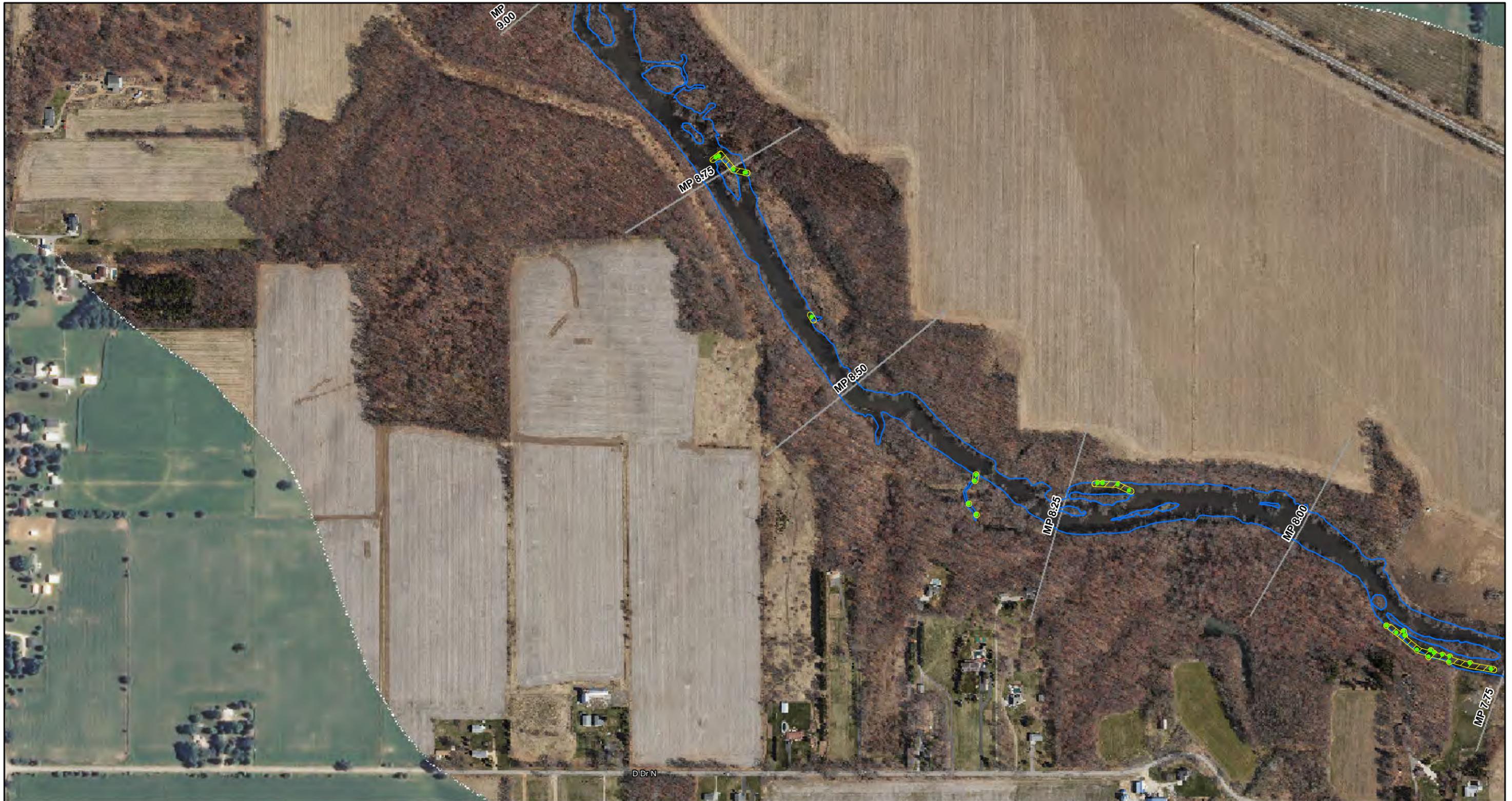


FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 4 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - ▨ Large Woody Debris Survey Area
 - ▭ Riverine Banklines
 - Quarter Mile Grid Segment



FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 5 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

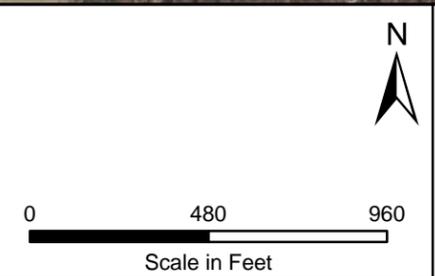


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 6 OF 26

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Legend

- Large Woody Debris Survey Point
- Large Woody Debris Survey Area
- Riverine Banklines
- Quarter Mile Grid Segment

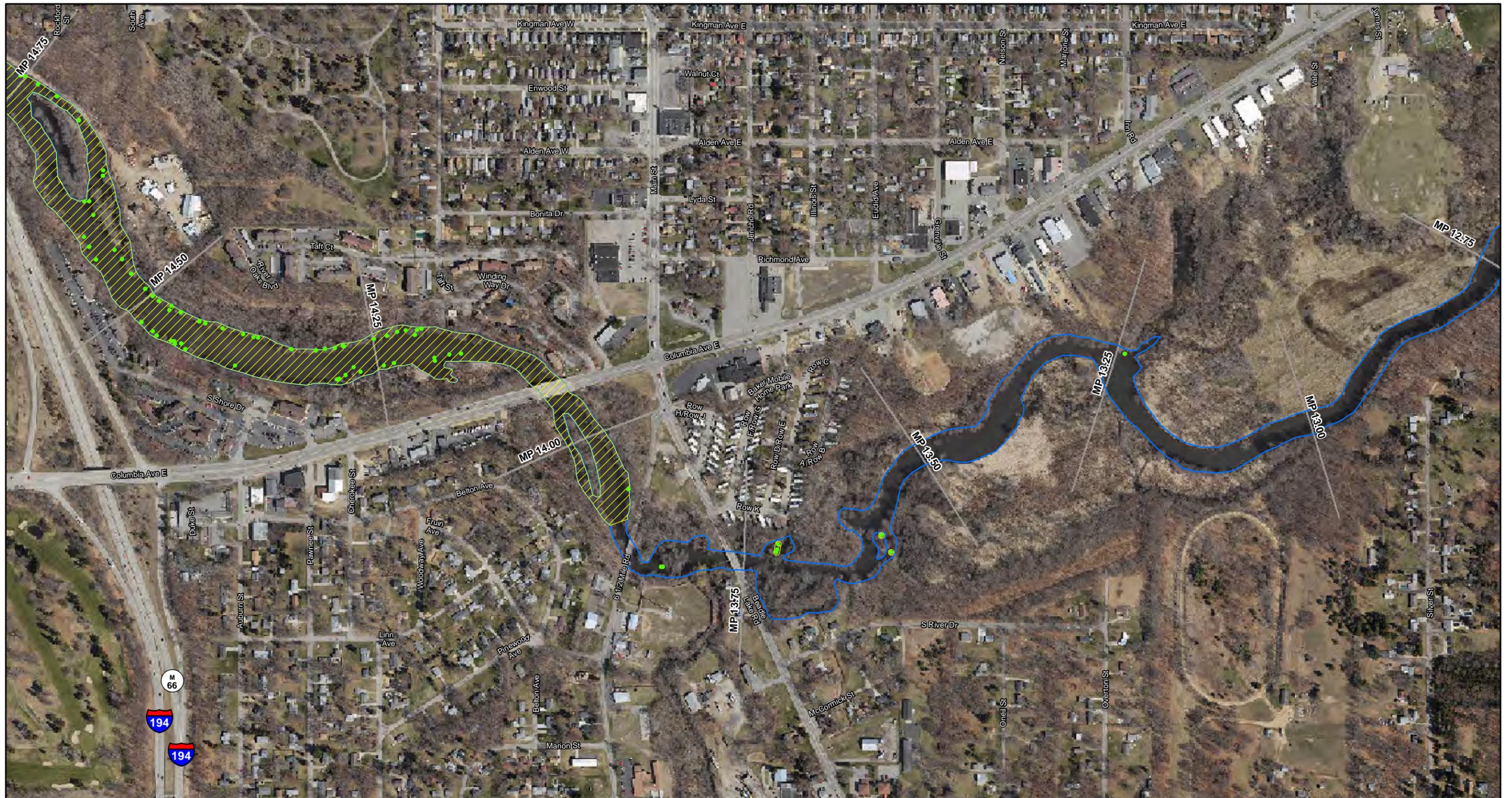
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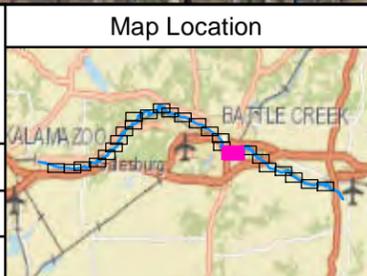
FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 7 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - ▨ Large Woody Debris Survey Area
 - ▭ Riverine Banklines
 - Quarter Mile Grid Segment

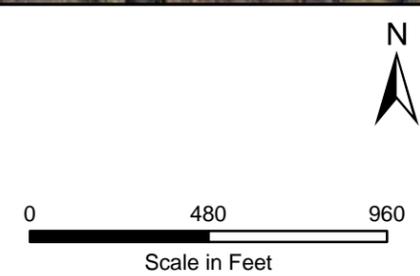
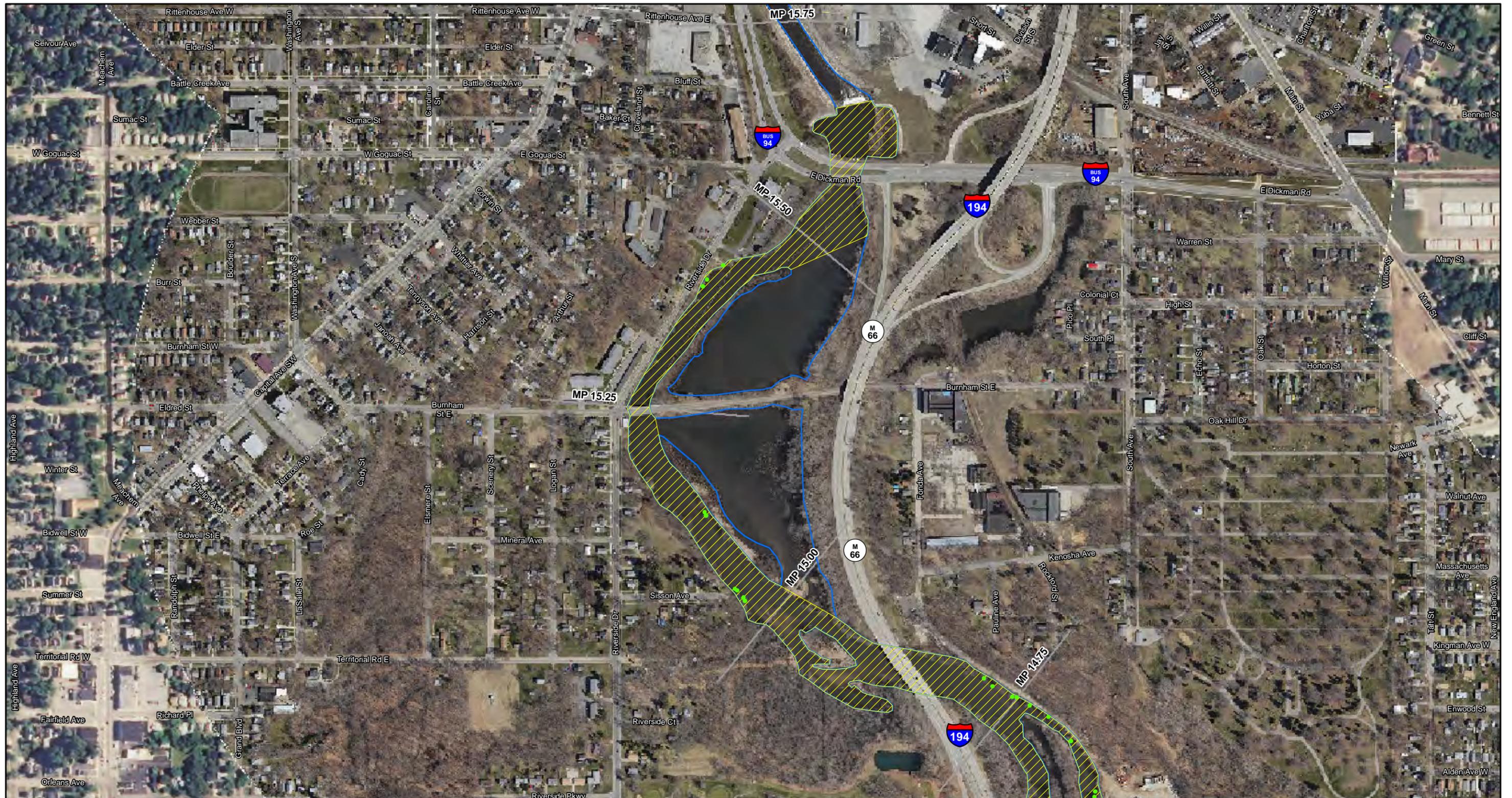


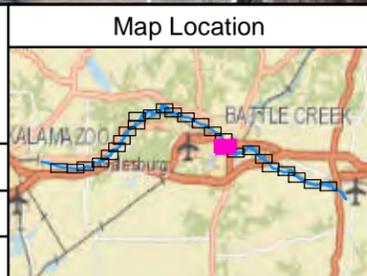
FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 8 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - ▨ Large Woody Debris Survey Area
 - ▭ Riverine Banklines
 - Quarter Mile Grid Segment

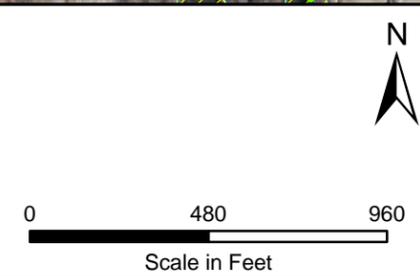
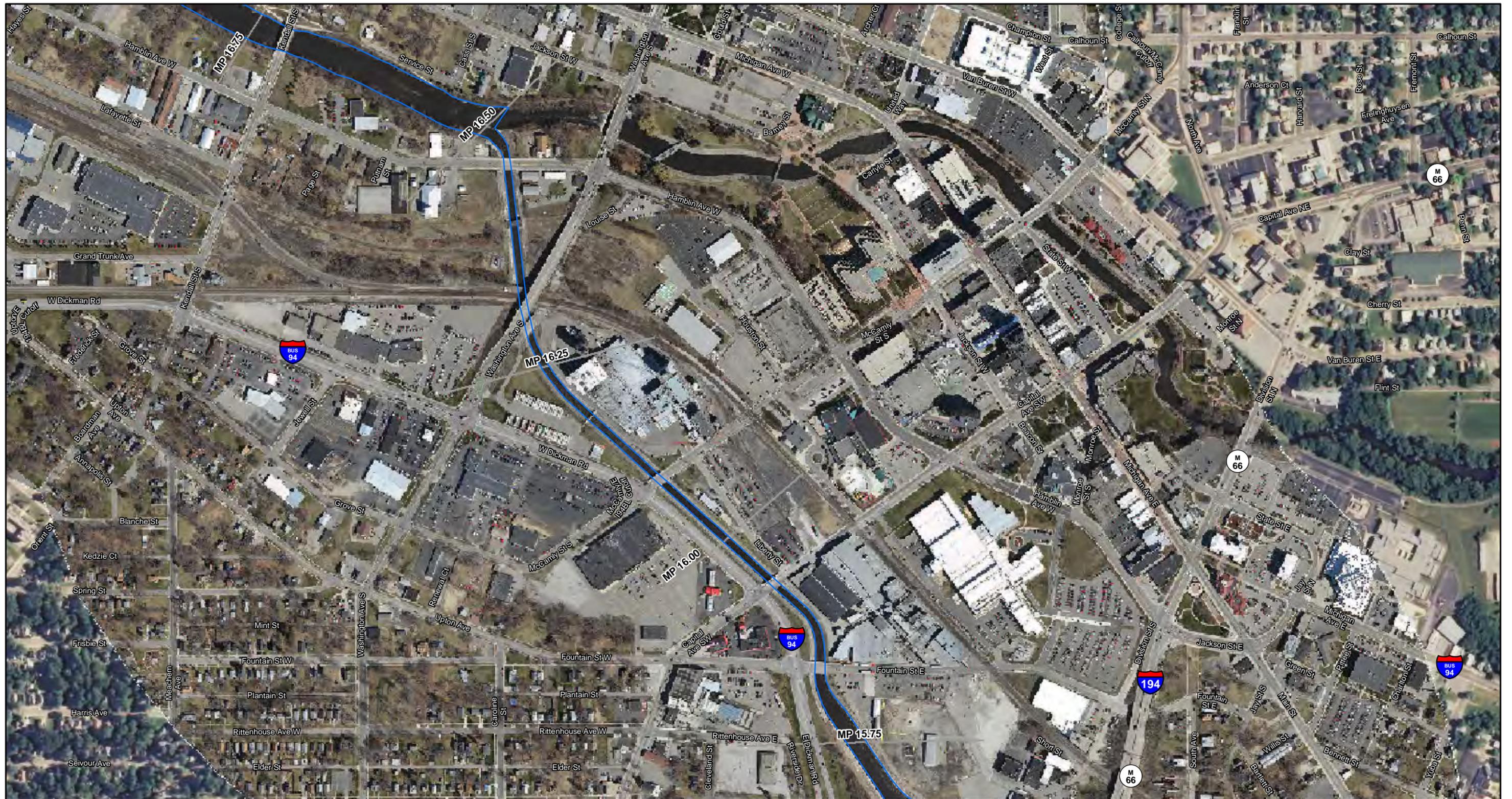


FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 9 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

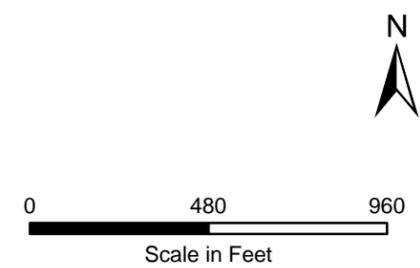


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 10 OF 26

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Legend

- Large Woody Debris Survey Point
- Large Woody Debris Survey Area
- Riverine Banklines
- Quarter Mile Grid Segment

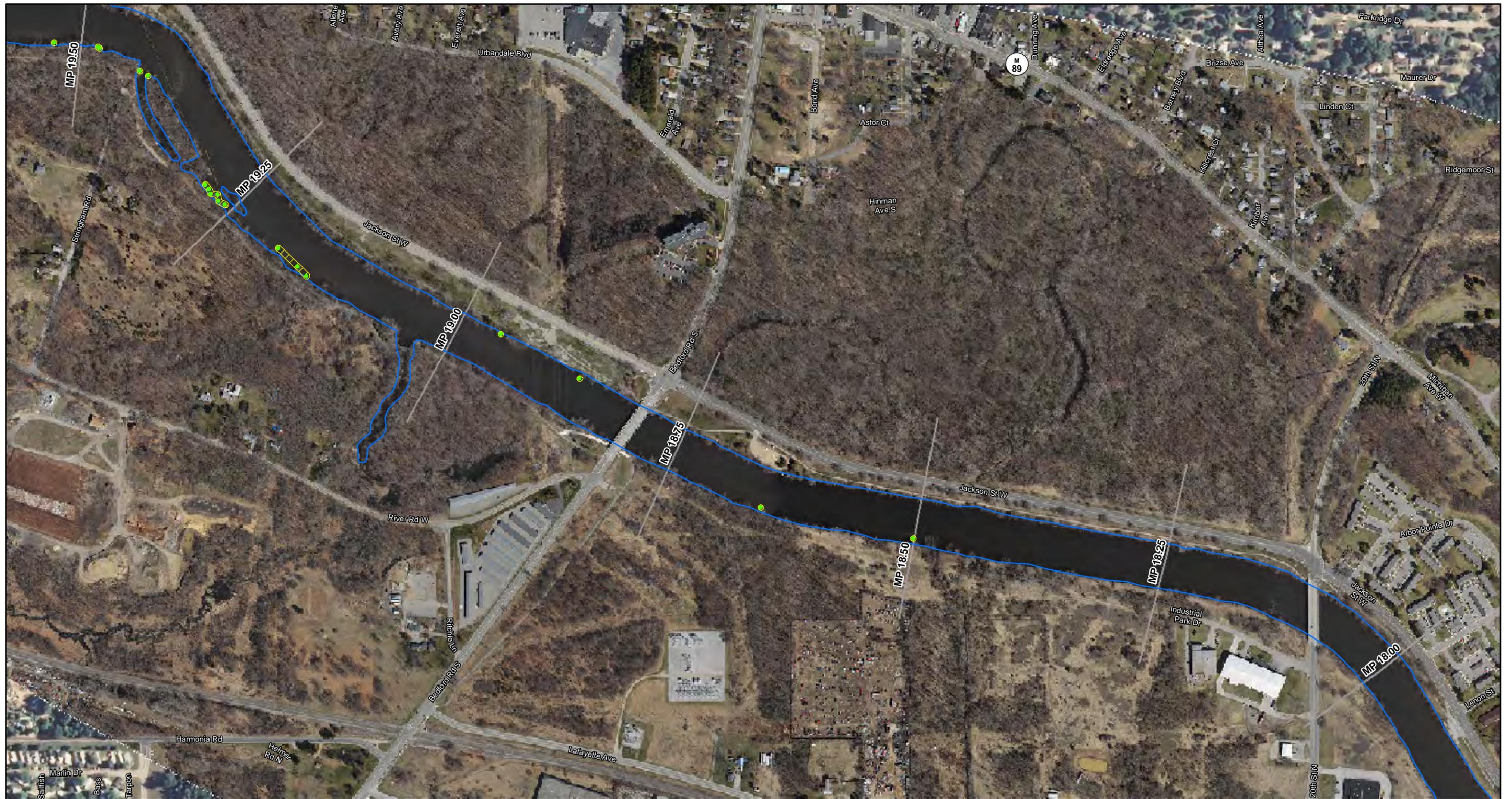
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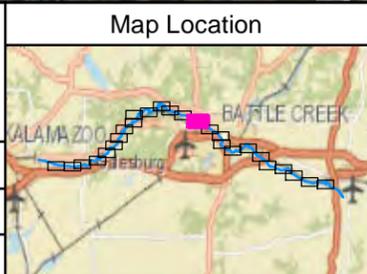
FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 11 OF 26

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- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment



FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 12 OF 26

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Legend

- Large Woody Debris Survey Point
- Large Woody Debris Survey Area
- Riverine Banklines
- Quarter Mile Grid Segment

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Scale in Feet

FIGURE 1

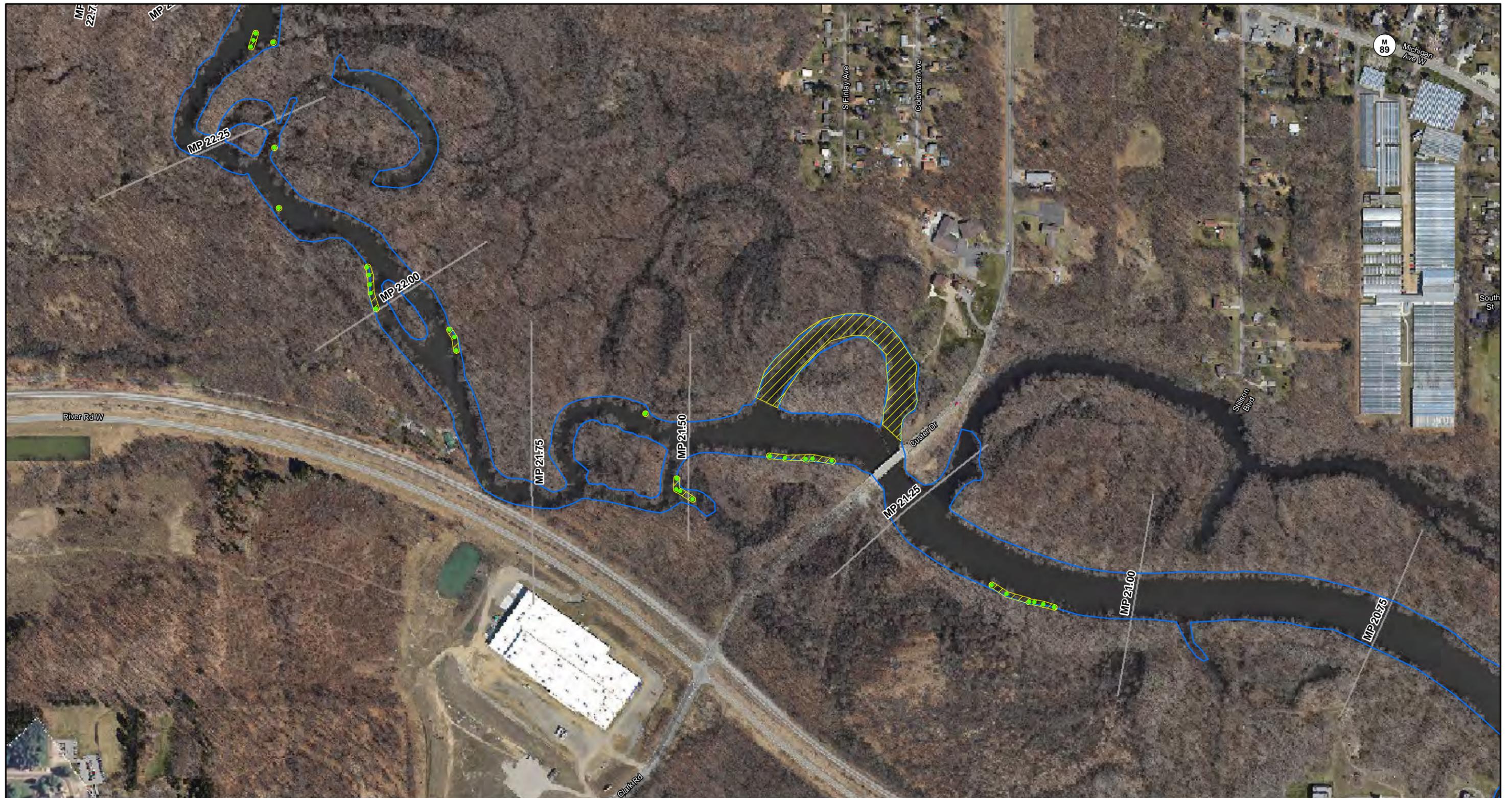
LARGE WOODY DEBRIS SURVEY

SHEET 13 OF 26

ENBRIDGE LINE 6B MP 608

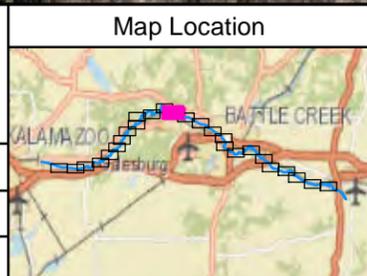
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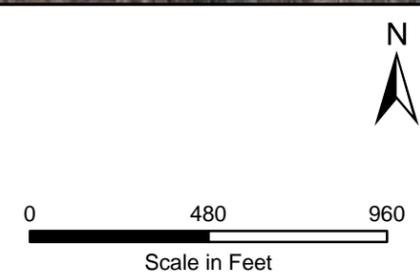


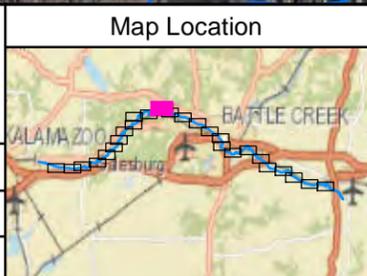
FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 14 OF 26

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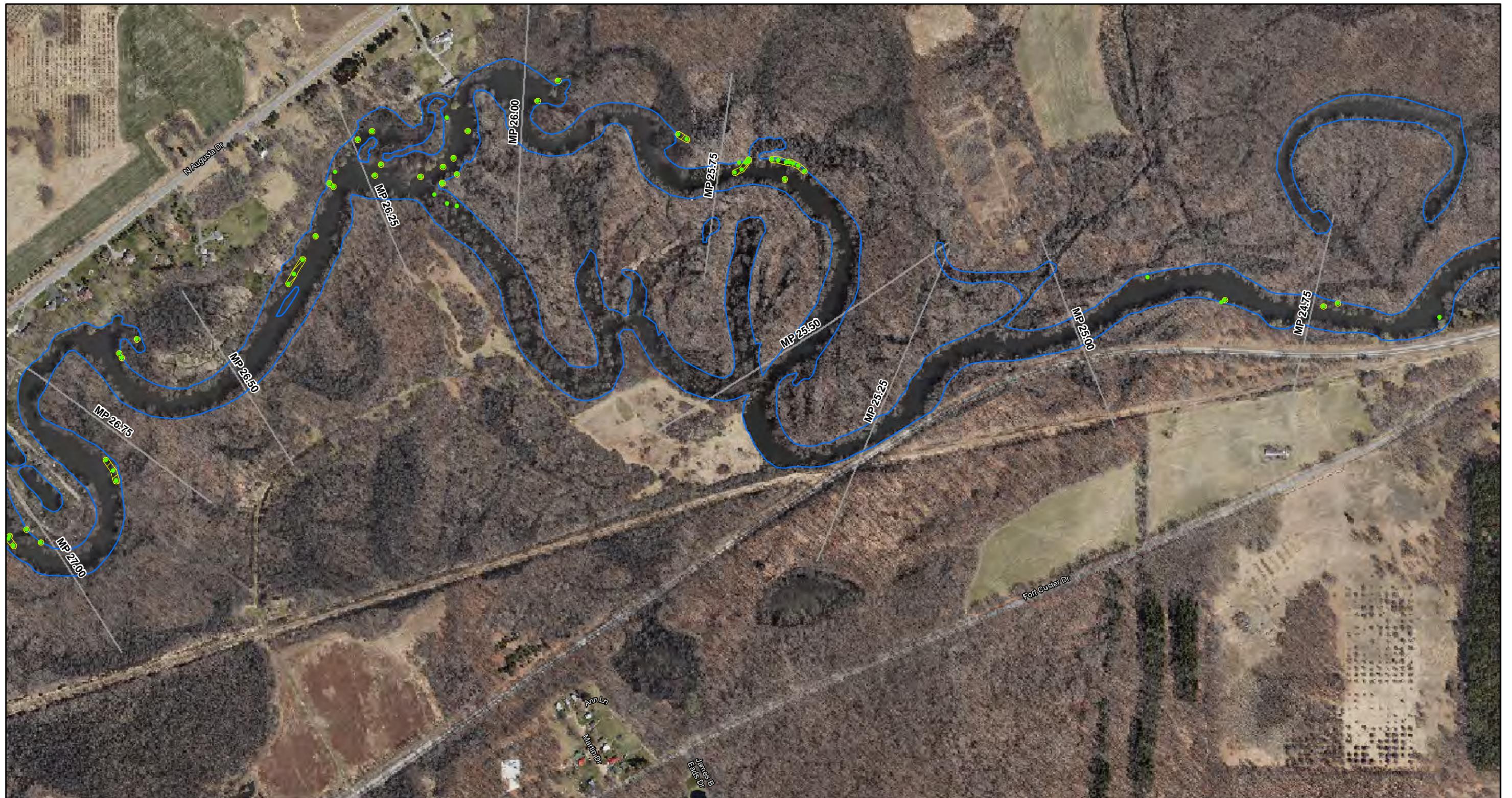


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- Large Woody Debris Survey Point
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 - Riverine Banklines
 - Quarter Mile Grid Segment



FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 15 OF 26

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP



ENBRIDGE

Drawn: JW 8/5/2013
 Approved: DP 8/5/2013
 Project #: 60284509



- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

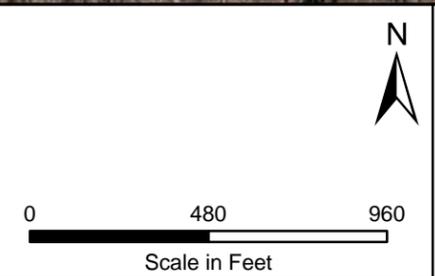


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 16 OF 26

ENBRIDGE LINE 6B MP 608
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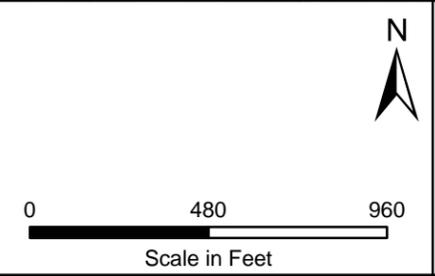


FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 17 OF 26

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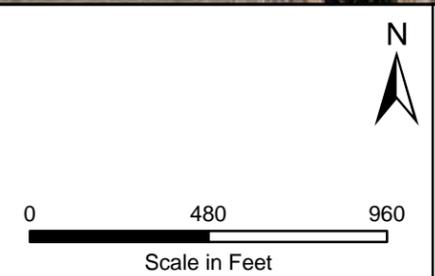
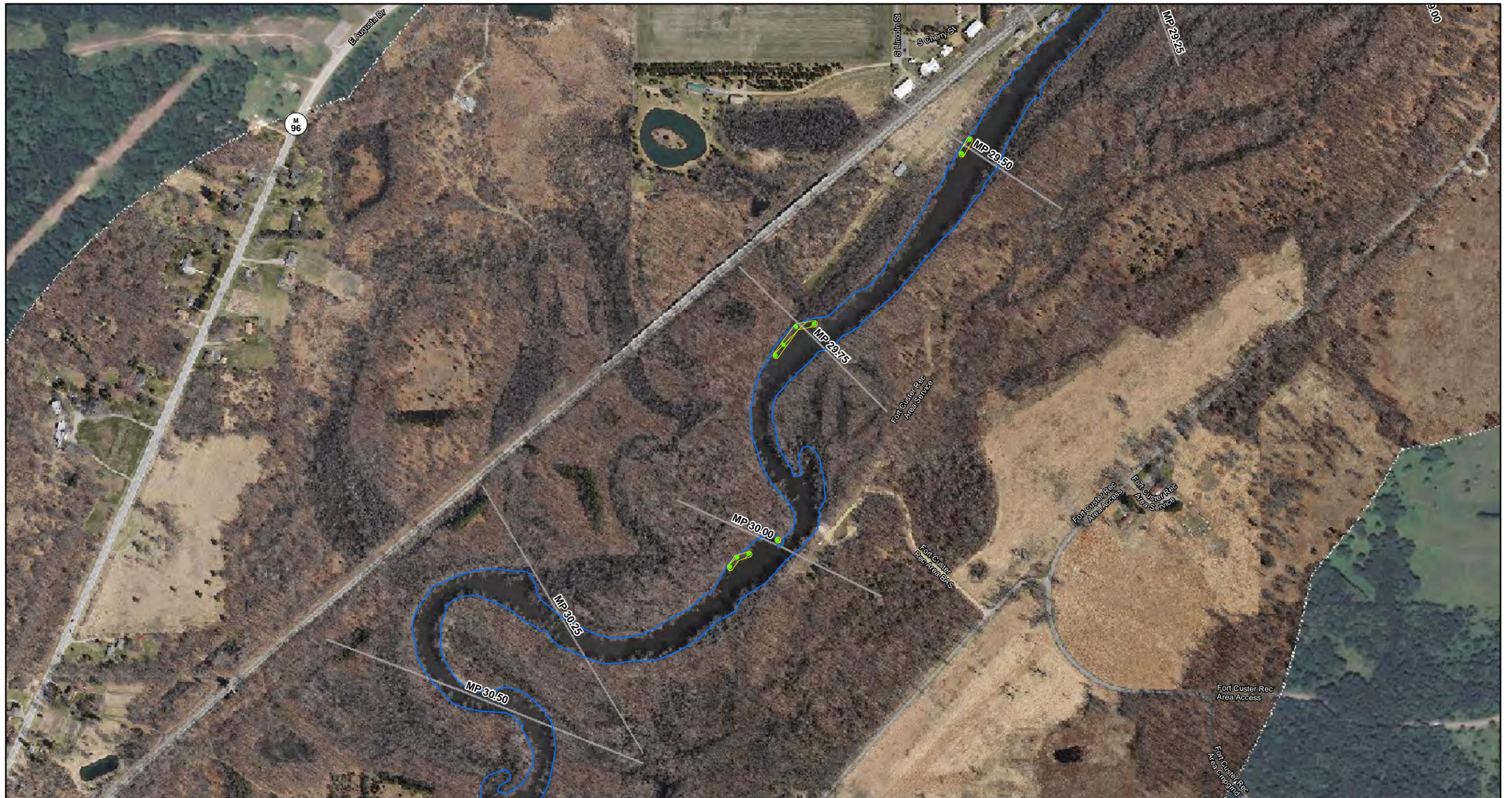


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 18 OF 26

ENBRIDGE LINE 6B MP 608
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 Project #: 60284509



- Legend**
- Large Woody Debris Survey Point
 - ▨ Large Woody Debris Survey Area
 - ▭ Riverine Banklines
 - Quarter Mile Grid Segment

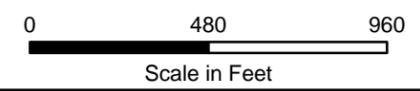


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 19 OF 26

ENBRIDGE LINE 6B MP 608
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- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

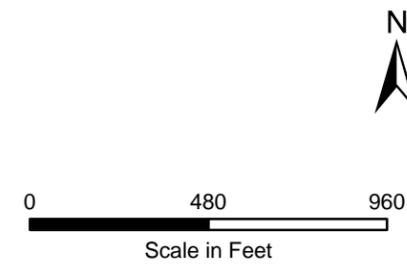


FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 20 OF 26

ENBRIDGE LINE 6B MP 608
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ENBRIDGE

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 Project #: 60284509



Legend

- Large Woody Debris Survey Point
- Large Woody Debris Survey Area
- Riverine Banklines
- Quarter Mile Grid Segment

N

0 480 960

Scale in Feet

FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 21 OF 26

ENBRIDGE LINE 6B MP 608
 MARSHALL, MI PIPELINE RELEASE
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- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

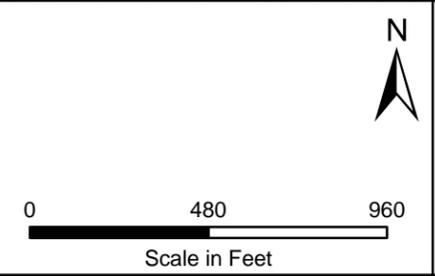
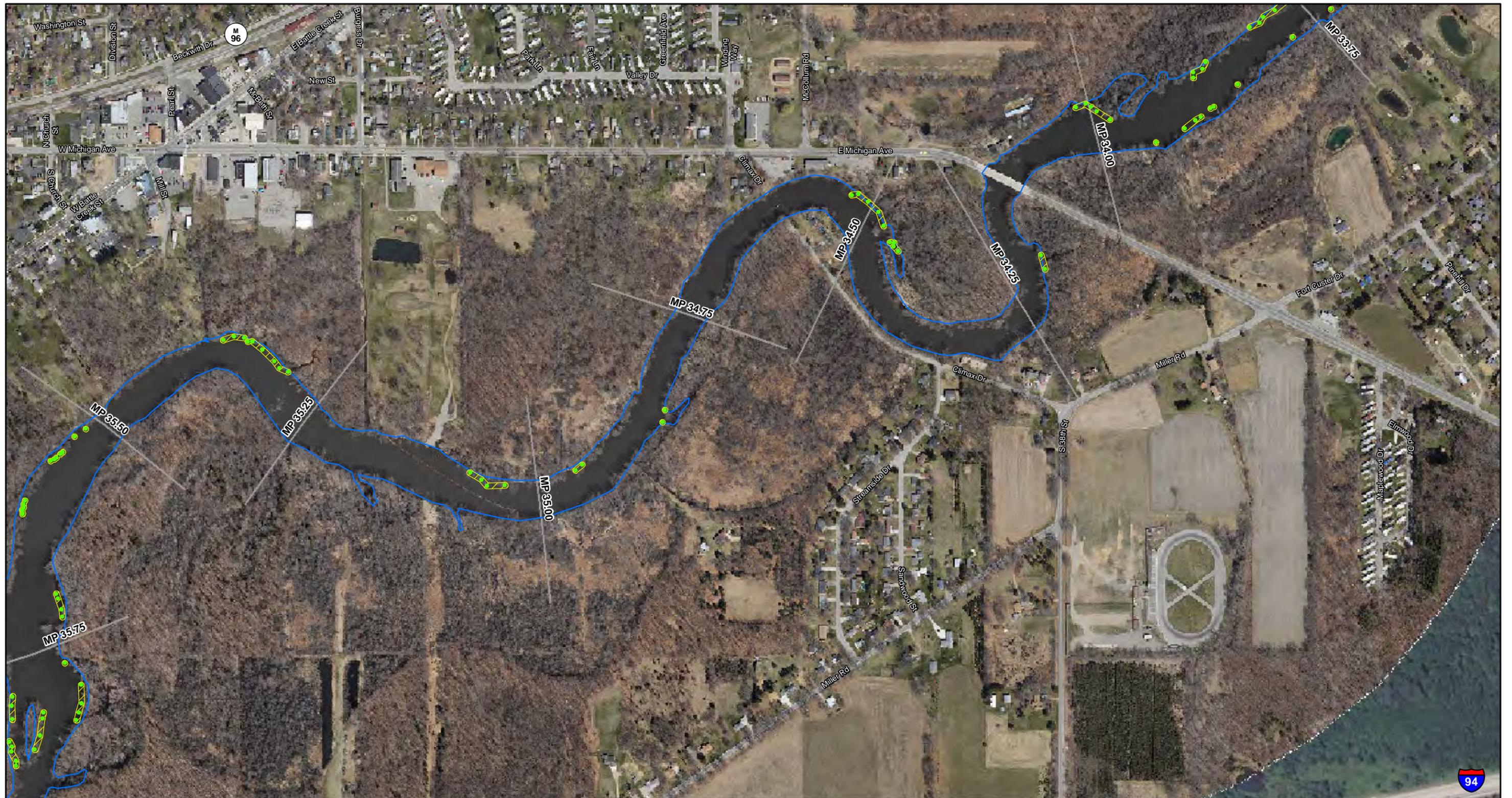


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 22 OF 26

ENBRIDGE LINE 6B MP 608
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- Legend**
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 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

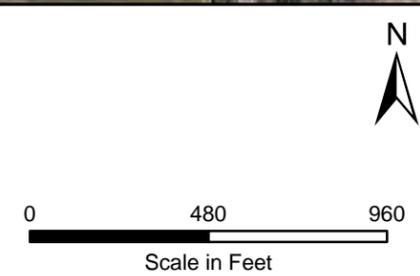
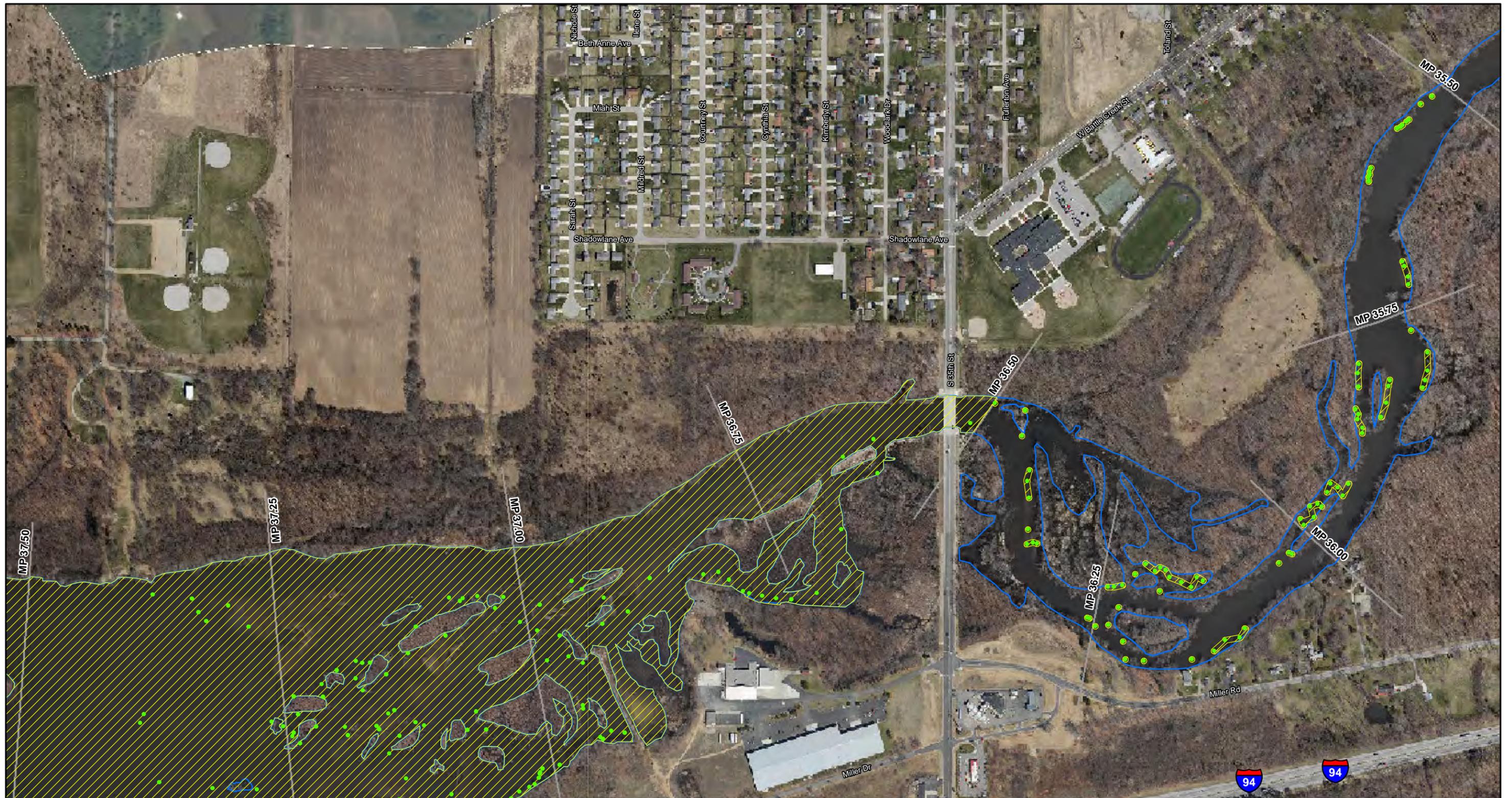


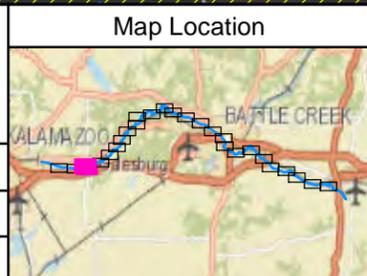
FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 23 OF 26

ENBRIDGE LINE 6B MP 608
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- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

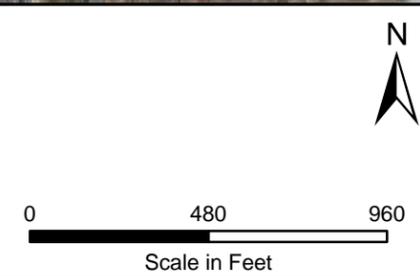
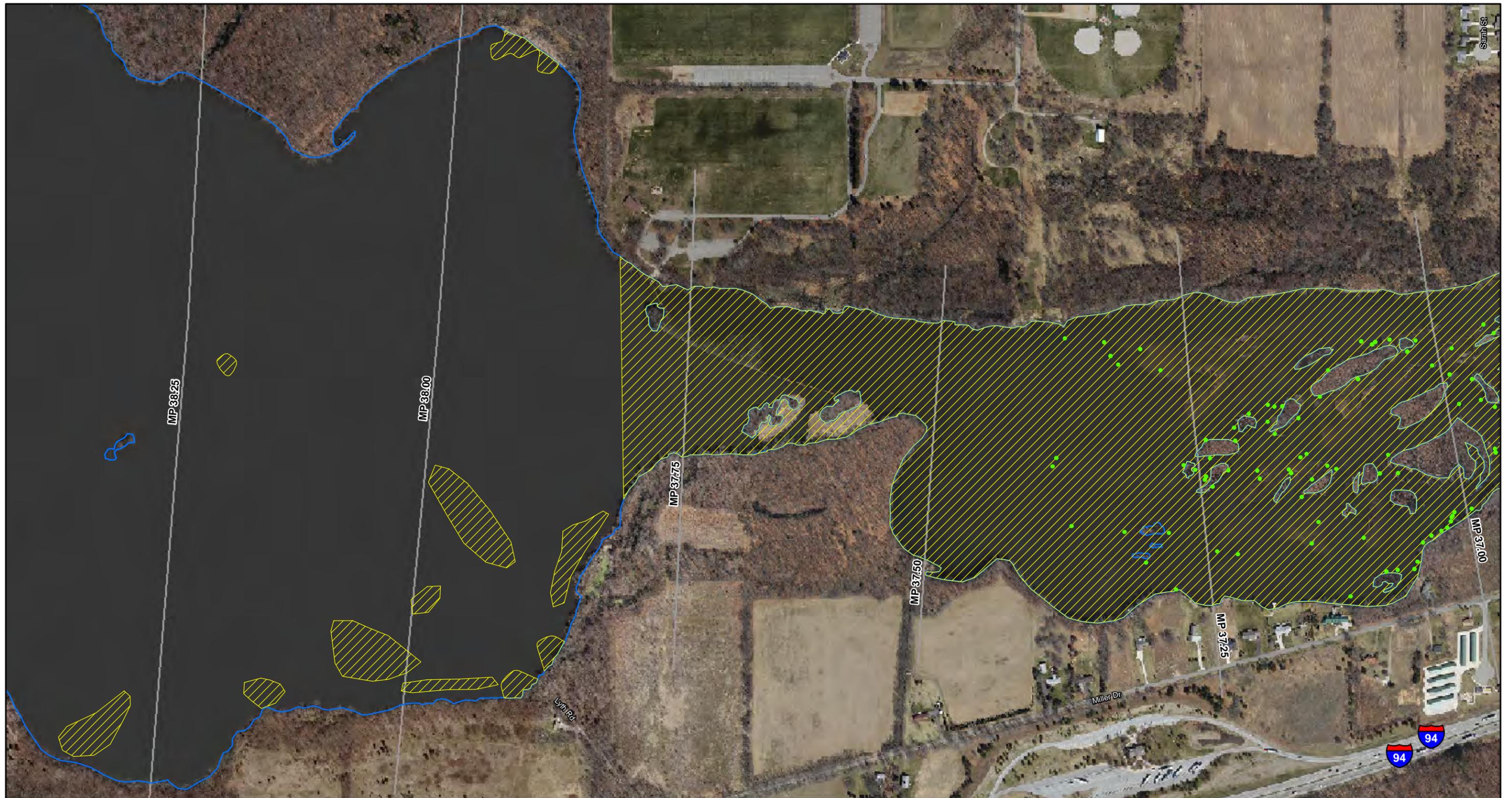


FIGURE 1
 LARGE WOODY DEBRIS SURVEY
 SHEET 24 OF 26

ENBRIDGE LINE 6B MP 608
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 ENBRIDGE ENERGY, LIMITED PARTNERSHIP



Sarah St

Lynd Rd

Miller Dr

MP 38.25

MP 38.00

MP 37.75

MP 37.50

MP 37.25

MP 37.00



Map Location



Legend

- Large Woody Debris Survey Point
- Large Woody Debris Survey Area
- Riverine Banklines
- Quarter Mile Grid Segment

Drawn: JW 8/5/2013
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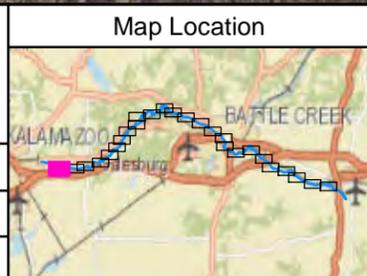
FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 25 OF 26

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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ENBRIDGE

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 Project #: 60284509



- Legend**
- Large Woody Debris Survey Point
 - Large Woody Debris Survey Area
 - Riverine Banklines
 - Quarter Mile Grid Segment

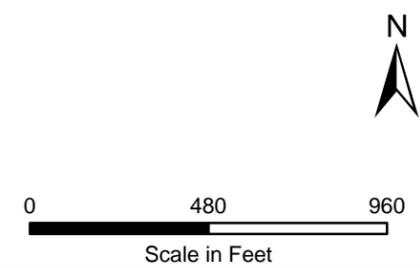


FIGURE 1
LARGE WOODY DEBRIS SURVEY
SHEET 26 OF 26

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Table

Data Point ID	Date	Mile Post	LWD Complex				Parameters						Attributes				Photograph	Comments/Observations
			Location within river (LDB, RDB, Mid-channel)	Tree Size - Number	Root Mass (Stump) Size - Number	Logs - Number	Overall LWD Complex Size (S, M, L)	% of River Blocked by LWD Complex (<30%, 30-50%, 50-75%, or >75%)	% of LWD Complex Submerged (0, 10% increments)	Stability of LWD Complex (Immobile, Semi-fixed, Mobile)	Dimensions of Any Pool Created by LWD (Length, Width, Depth)	Providing Amphibian/Reptile Habitat (Yes/No)	Providing Fisheries Habitat (Yes/No)	Providing Bank Protection (Yes/No)	Orientation Causing Erosion (Yes/No)	Repositioning Capable of Reducing Erosion, Increasing Bank Protection, or Improving Habitat Values (Yes-Explain, No)		

Legend:

- LDB Left Descending Bank
- MC Mid-channel
- RDB Right Descending Bank
- S Small
- M Medium
- L Large
- % Percent