

**STREAM PASSAGE IMPEDIMENTS
AND AQUATIC HABITAT
FRAGMENTATION INVENTORY**

**MILWAUKEE RIVER AND LAKE
MICHIGAN TRIBUTARY STREAMS
OZAUKEE COUNTY, WISCONSIN**

November 16, 2006

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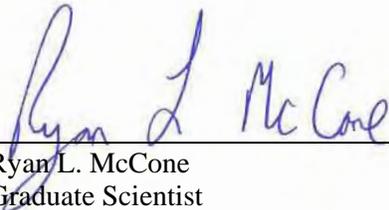
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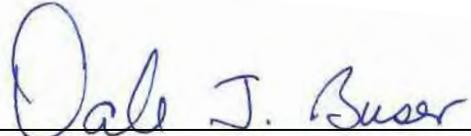
Project Number: OZC 01-5400-3000



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1.0 EXECUTIVE SUMMARY

Land-use changes in Ozaukee County have resulted in a variety of artificial barriers that preclude aquatic life passage and isolate existing habitats. Restoring habitat access will likely be more cost effective than restoring or creating artificial habitats. The first step toward reducing fragmentation in a stream is identifying impediments. This study included remote and “on-the-ground” investigation of barriers to northern pike (*Esox lucius*) passage and isolated habitats potentially suitable for northern pike spawning.

Eleven small tributaries to Milwaukee River and Lake Michigan were investigated, a hundred suspected barriers were identified, and 29 areas of potentially suitable habitat were confirmed. All of the suspected barriers fell into one of three general categories: those of a natural origin, those directly resulting from human actions, and those indirectly resulting from human actions.

We conclude that the latter two categories present numerous opportunities to reduce stream fragmentation in Ozaukee County by removing suspected barriers that isolate existing habitat suitable to host spawning northern pike.

2.0 INTRODUCTION

Land-use changes in Ozaukee County have adversely affected rivers, streams, wetlands, lakes, aquatic organisms, and recreational patrons. Various-sized dams, impassable culverts, accumulated debris, pervious fill, and other artificial barriers to passage have resulted from land-use changes. Barriers fragment waterways, isolate important aquatic habitats in tributary watersheds, and prevent some native species from reaching critical habitats that are otherwise intact and available. Restoring habitat access will likely cost less and be more productive than restoring or creating artificial habitats, will improve aquatic communities, and will increase the natural resources available in Ozaukee County.

The first step toward reducing fragmentation in a stream is identifying impediments. This requires attention to both the barriers themselves and the aquatic species of concern. Aquatic species differ in their capacity to negotiate obstacles, meaning that a barrier to one species may not preclude passage by another. An example of this is the comparison of Pacific salmon (*Oncorhynchus sp.*) and northern pike (*Esox lucius*). Strong-swimming salmon species have evolved abilities that allow them to negotiate stream impediments that are barriers to weaker-swimming northern pike. The capacity to traverse obstacles can also differ amongst the age groups of a single species. For instance, larval northern pike migrating from their natal stream may encounter barriers that were passable to their stronger-swimming parents.

Just as aquatic species vary, so do impediment types, origins, and effects. Evaluating how a suspected impediment functions can be critical in determining:

- ▲ If it is a barrier
- ▲ Under what conditions it is a barrier
- ▲ What species or specific age classes it blocks

Northern pike historically migrated up low-gradient streams in Southeast Wisconsin to spawn. They were chosen as the target species for this study; however, the stream barriers and aquatic habitat fragmentation investigated likely influence a wide variety of fish and wildlife species. Very little scientific documentation of northern pikes' capacity to negotiate stream obstacles was found during a literature review. Similarly, little information about barriers specific to northern pike is available. Adult northern pike are commonly known as "burst" swimmers, and it is generally believed that they are not particularly adapted for traversing obstacles or fast moving water over long distances.

The Wisconsin Conservation Department's 1963 publication *Surface Water Resources of Ozaukee County* identifies 26 named and unnamed streams. Northern Environmental Technologies, Incorporated (Northern Environmental) identified, evaluated, and inventoried impediments to northern pike passage in eleven of Ozaukee County's Milwaukee River and Lake Michigan tributary streams (Figure 1), including:

- ▲ Fredonia Creek
- ▲ Girl Scout Camp Creek (Section 3, Township 11 North, Range 21 East)
- ▲ Lac du Cours Outlet (Section 36, Township 9 North, Range 21 East)
- ▲ Mole Creek
- ▲ Mud Lake Outlet (Section 7, Township 10 North, Range 20 East)
- ▲ River Edge Creek
- ▲ Sucker Creek
- ▲ Trinity Creek
- ▲ Ulao Creek
- ▲ Unnamed Creek 1 (Section 11, Township 10 North, Range 21 East)
- ▲ Unnamed Creek 2 (Section 14, Township 11 North, Range 21 East)

These eleven project streams were chosen to concentrate effort on streams that had potential to host migrating northern pike, were not known to have natural corridors at the study onset, and were distributed throughout the entire county. The eleven inventories will ultimately facilitate barrier removal and help restore aquatic life access to isolated aquatic habitats in Ozaukee County.

3.0 INVESTIGATIVE METHODS

Both remote and “on-the-ground” methods were developed, refined, and used on each of the eleven project streams to:

- ▲ Identify “potential sites” (i.e., sites where a barrier may exist) to northern pike passage (i.e., adult access during typical spring high-flow conditions or larval egress during lower-flow conditions)
- ▲ Investigate potential sites to locate “suspected barriers” (i.e., those likely to impede adult or juvenile northern pike passage under certain conditions)

The most-efficient way to locate potential sites was remote identification using high-resolution aerial photographs and other information. The entire channel length of Lac du Cours Outlet Creek and Unnamed Creek 1 were field inspected to ground truth the precision and accuracy of remotely identifying potential sites. This allowed us to pinpoint remotely identified potential sites, refine our process, and establish a baseline method for remotely identifying potential sites. Field inspection of the remaining nine project streams was closely targeted at the specific locations of potential sites and used to confirm or refute the presence of a suspected barrier. Potential sites located during the course of targeted site inspections were included in the project and were thoroughly inspected on site.

3.1 Remote Investigation – Potential Sites And Spawning Habitat

High-resolution aerial photographs (typically scaled 1 inch:300 feet) provided by the Ozaukee County Planning, Resources, and Land Management Department were the primary resource used to remotely locate potential sites (Appendices A through K). Aerial photographs were inspected independently by two Northern Environmental scientists to identify the locations of suspected impediments. Suspected impediments generally included:

- ▲ Small dams
- ▲ Impassable culverts
- ▲ Pervious channel fill
- ▲ Lined channels
- ▲ Channels lost to infiltration or dispersion
- ▲ Constricted channels
- ▲ Channels choked by excessively dense vegetation
- ▲ Debris jams

Northern pike spawn on vegetation growing on streambeds and banks. As such, densely vegetated stream banks and both floodplain wetlands and the shallow littoral zone of ponds with good stream connectivity are all habitat potentially targeted by spawning northern pike. Areas suspected to provide this habitat type were identified during aerial photograph inspection and listed for confirmation. Field inspection and/or local resident interviews were used to confirm the areas that either met the general criteria of northern pike spawning habitat or were recently/historically observed to host spawning northern pike.

3.2 Field Inspection – Suspected And Suspected Barriers

Inspecting aerial photographs yielded a list of potential sites for each project stream. We confirmed or refuted that a stream barrier existed at these locations by combining direct field inspection and interviews of property owners and/or residents. Specifically, remotely identified potential sites were field inspected, with the exception of:

- ▲ Those located on property across which we were not granted land-owner access
- ▲ Those that could not be safely accessed (e.g., some I-43 crossings)
- ▲ Those that were prohibitively distant from an access point
- ▲ Those for which sufficient reliable information was gleaned from owner/resident interviews

A small fraction (e.g., approximately 15 percent) of potential sites were not field inspected for the reasons above. All non-inspected potential sites that could not be confirmed or refuted with information from a resident interview were considered suspected barriers.

3.3 Field Inspection – Potential Northern Pike Spawning Habitat

Basic ecological data was collected upstream and downstream of suspected barriers during extensive field inspections of the Lac du Cours Outlet Creek and Unnamed Creek 1. This basic data was field-assessed using the U.S. Environmental Protection Agency's (the USEPA) *Rapid Bioassessment Protocol* for low-gradient streams (USEPA, Undated). We chose the USEPA protocol because a small field crew (e.g., one or two people) can complete it effectively and concisely. The time and manpower investment required to use alternative protocols (Simonson et al., 1995) (Wang et al., 1998) (WDNR, 2002) were beyond that feasible for this project.



Photograph 1 – Mud Lake Outlet Creek
Creek bank hydrophytic vegetation

During field inspection of the Lac du Cours Outlet Creek and Unnamed Creek 2, it became apparent that the majority of habitat variables included in the USEPA protocol did not effectively discern between habitat generally suitable for northern pike spawning and unsuitable habitat. Discussion with a Wisconsin Department of Natural Resources (WDNR) fisheries biologist confirmed this suspicion (Wawrzyn, 2006). The WDNR indicated that only a few habitat variables likely influence northern pike spawning-habitat suitability, including:

- ▲ Channel connectivity to riparian areas during regular high flows (i.e., channel entrenchment)
- ▲ Herbaceous hydrophytic vegetation density in the channel, on banks or floodplain, or in a littoral area (Photograph 1)
- ▲ Regular riparian flooding (e.g., evidenced by watermarks on trees, drainage patterns, etc.)

Extensively measuring and evaluating the variables above is required to use the available alternative protocols (Simonson et al., 1995) (Wang et al., 1998) (WDNR, 2002). Using these alternative protocols was beyond the scope of this project. However, in order to improve the value of our basic ecological assessments, we heeded a suggestion from the WDNR and used information from the alternative protocols to

guide our habitat data collections. This led us to replace the US EPA protocol with a qualitative assessment of suspected spawning habitat that included the variable above. These assessments were completed during all remaining field inspections to confirm or refute suspected areas of spawning habitat.

4.0 INSPECTION RESULTS

Suspected barriers to northern pike access and/or egress were confirmed in all eleven project streams (Figure 1). Individual summaries of suspected barriers and potential spawning habitat in each project stream are included in Appendices A through K.

4.1 Suspected Barriers

In all, 213 potential sites were identified and 100 were confirmed as suspected barriers to northern pike passage (Table 1). An individual summary of suspected barriers in each stream is included in Appendices A through K).

Table 1 Flow Regimes and Results of Barrier and Northern Pike Spawning Habitat Inventory

Stream Name	2006 Field Inspection Date(s)	Stream Discharge				Number of Barriers		Number of Potential Habitat Areas
		Flow Regime ¹	Field Inspection Flow Condition			Potential Sites	Suspected Barriers	
			Headwater	Mid-Reach	Outlet			
Fredonia Creek	Sept. 12	Intermittent	Base Flow	No Flow ²	Moderate ³	21	8	3
Girl Scout Camp Creek	Sept. 28	Perennial	No Flow	Base Flow	Base Flow	13	10	2
Lac du Cours Outlet Creek	Aug. 31	Intermittent	No Flow	No Flow	No Flow	4	4	2
Mole Creek	Sept. 25 & 27	Perennial	Base Flow	Base Flow	Base Flow	41	9	5
Mud Lake Outlet Creek	Sept. 6 & 7	Intermittent	No Flow	No Flow	No Flow	18	9	3
River Edge Creek	Sept. 13	Perennial	Moderate ³	Moderate ³	Moderate ³	17	12	2
Sucker Creek	Sept. 11	Intermittent	No Flow ⁴	No Flow ⁴	Base Flow	25	14	1
Trinity Creek	Sept. 25 & 26	Intermittent	No Flow	Base Flow	Base Flow	28	14	2
Ulao Creek	Sept. 26 & 27	Intermittent	Base Flow	No Flow ²	Base Flow	32	10	3
Unnamed Creek 1	Sept. 6	Intermittent	No Flow	No Flow	No Flow	4	4	4
Unnamed Creek 2	Sept. 28	Intermittent	No Flow	No Flow ⁵	Base Flow	10	6	2
Totals:						213	100	29

Notes: 1 - Classified as intermittent if any observed reach lacked base flow or greater discharge during field inspection

2 - Flow completely lost to groundwater infiltration in some reaches during field investigation

3 - Observed stream discharge was approximately 1/2 bankfull capacity following September 11 - 12 precipitation

4 - Small standing pools was the only water observed during field inspection

5 - Flow was interstitial in some reaches where the channel has been lost due to excessive sedimentation

4.2 Potential Northern Pike Spawning Habitat

In all, 29 areas of potential northern pike spawning habitat were located. Quantifying the relative size and quality of these wetlands, ponds, and floodplains is beyond the scope of this project. A general description of the potential spawning habitats identified is included in an individual summary of each creek (Appendices A through K).

5.0 CONCLUSIONS AND RECOMMENDATIONS

This study confirmed a considerable degree of stream habitat fragmentation resulting from impediments to aquatic life passage in these eleven streams. Some of the suspected barriers are natural.

- ▲ Log, debris, and sediment jams
- ▲ High-gradient reaches
- ▲ Infiltration to groundwater
- ▲ Channel dispersion in wetlands

Others suspected barriers are indirect consequences of human changes to a watershed.

- ▲ Channel loss to excessive sediment aggradation in agricultural areas
- ▲ Entrenchment resulting from channelization and development
- ▲ Channel loss to densely ingrown invasive vegetation

Yet other suspected barriers are the direct result of human actions.

- ▲ Small dams
- ▲ Improperly designed/installed culverts
- ▲ Pervious fill deposits
- ▲ Artificially lined channels
- ▲ Channel-constricting bridge abutments
- ▲ Debris jams and channel aggradation at crossings

A general deficiency of information that accurately defines the conditions constituting a barrier to northern pike passage (e.g., adult migration up streams or juvenile egress from streams) exists. For this reason, the term “suspected barrier” was chosen to describe impediments likely to preclude passage instead of a more definitive term.

Lac du Cours Outlet Creek Barrier Removal Case Study

Of the suspected barriers found, those directly or indirectly resulting from human actions offer several opportunities to reduce stream fragmentation in Ozaukee County by removing suspected barriers that isolate existing habitat. The Lac du Cours Outlet Creek provides one such opportunity. Two man-made suspected barriers are located between the mouth of the Lac du Cours Outlet Creek and where it flows out of a small unnamed lake (Appendix C). This short reach (roughly 500-foot long) could provide spawning northern pike with access to the unnamed lake’s desirable littoral areas, as well as the vegetated and connected floodplain found adjacent to it. Unfortunately, adult pike access appears blocked by excessively-constrictive bridge abutments where River Road crosses the Lac du Cours Outlet Creek near the Ozaukee County – Milwaukee County border (Photograph 2).



Photograph 2 – River Road Bridge
Lac du Cours Outlet Creek



Photograph 3 – Lac du Cours Outlet Creek
Concrete riprap deposit

Between these abutments, the bankfull cross-sectional area of the channel is roughly one-tenth of that found in the stable reach upstream. The constriction likely results in swift flow velocities that are too fast for adult northern pike to traverse during spring-melt (the season when creeks are often swollen and northern pike migrate to spawn). If by chance adult northern pike did make it upstream to the small unnamed lake, another barrier could prevent their offspring from returning to the Milwaukee River. This barrier is a small deposit of concrete riprap that was placed across the channel, likely as a foot crossing (Photograph 3). During flooded conditions it is most likely irrelevant to stream and habitat connectivity. At less than bankfull flows, however, the pervious fill is likely a barrier to larval northern pike passage.

The relatively short length of this reach, apparent habitat value of the unnamed lake and floodplain, and simplicity of removing these barriers (i.e., removing the pervious riprap fill and replacing the current road crossing with one that is fish-friendly) make it an ideal opportunity to reduce stream fragmentation.

Further reducing stream habitat fragmentation in Ozaukee County will be most efficiently accomplished by developing remediation plans for the different types of suspected barriers identified and prioritizing remediation work based on:

- ▲ The potential for reconnecting isolated key resources
- ▲ The significances of affected resources
- ▲ The likelihood and feasibility of removal

In addition, public outreach that informs Ozaukee County residents and visitors of these barriers and how they are created should help prevent new barriers from being created.

6.0 GLOSSARY

Accuracy	How closely a measure conforms to a standard or true value.
Bankfull	The water surface and stream bank elevation that corresponds to a channel-forming discharge.
Base Flow	The portion of stream discharge that is derived from groundwater or other natural storage and not from surface runoff.
Burst Swimmer	A fish species that rapidly accelerates to a fast swimming velocity and maintains that velocity for only a short duration. These can be predator-species that catch prey by ambushing it from cover.
Bioassessment	An evaluation of habitat condition, quality, and/or suitability.
Discharge	The rate at which a volume of water flows past a point during a specific unit of time.

Ecological	Pertaining to the interrelationship of organisms and their environment.
Entrenchment	The degree of vertical incision of a stream channel.
Floodplain	The area adjoining a water body that becomes inundated during periods of overbank flooding.
Habitat	The totality of physical, chemical, and biological conditions needed to support an organism, population, or community. This area typically provides basic life requirements, including: food, water, and cover.
Hydrophytic	Plant species specifically adapted to living in aquatic or wet conditions.
Impediment	Something that prevents, hinders, or interferes with passage.
Intermittent	A stream that flows in intervals separated by periods of no flow, often flowing only when sufficient surface runoff is available.
Larval	An early and immature life stage.
Littoral	Shallow shore areas of a water body where light penetrates to the bottom and rooted aquatic plants commonly grow.
Low-Gradient	A stream channel that changes 3 vertical feet or less over a horizontal distance of 1000 feet (i.e., stream bed grade less than or equal to 0.003 ft/ft or 16 ft/mi).
Migrate	To periodically move from one habitat to another to feed or breed.
PB_	Prefix label for a suspected barrier location that is typically preceded by an abbreviation for the project stream.
Perennial	A stream that flow continuously under normal hydrologic conditions.
Pervious	Permeable and capable of passing water.
Potential Habitat	Areas with traits suitable for hosting spawning northern pike. Typically includes stable stream banks with dense herbaceous hydrophytic plants and lakes, ponds, and wetlands with dense vegetation and good connectivity to a stream channel during typical flood conditions.
Potential Site	Locations identified remotely or in the field that may have a barrier and warrant investigation.
Precision	A measure of conformity to a pattern or convention.
Protocol	A detailed plan for completing a scientific experiment or procedure.
Qualitative	Describing something based on specific inherent characteristics or features.

Riparian	The interface zone between aquatic and terrestrial ecosystems.
Riprap	Large stone and/or concrete particles. Often used to armor streambeds and banks to curb or prevent erosion.
Sedimentation	The action of process of depositing sediment particles.
Suspected Barrier	Impediment likely to impede adult or juvenile northern pike passage under certain conditions.
Tributary	A stream that flows into or joins a larger water body.
Watermark	A pattern of staining on mature tree trunks resulting from regular extended periods of inundation. The stain elevation roughly corresponds to the typical floodwater surface elevation.
Watershed	A region or area drained by surface and groundwater flow in rivers, streams, and/or other waterways.

7.0 REFERENCES

Simonson, T. D., J. Lyons, and P. D. Kanehl *Guidelines for Evaluating Fish Habitat in Wisconsin Streams*, U.S. Forest Service, General Technical Report NC-164, 1995.

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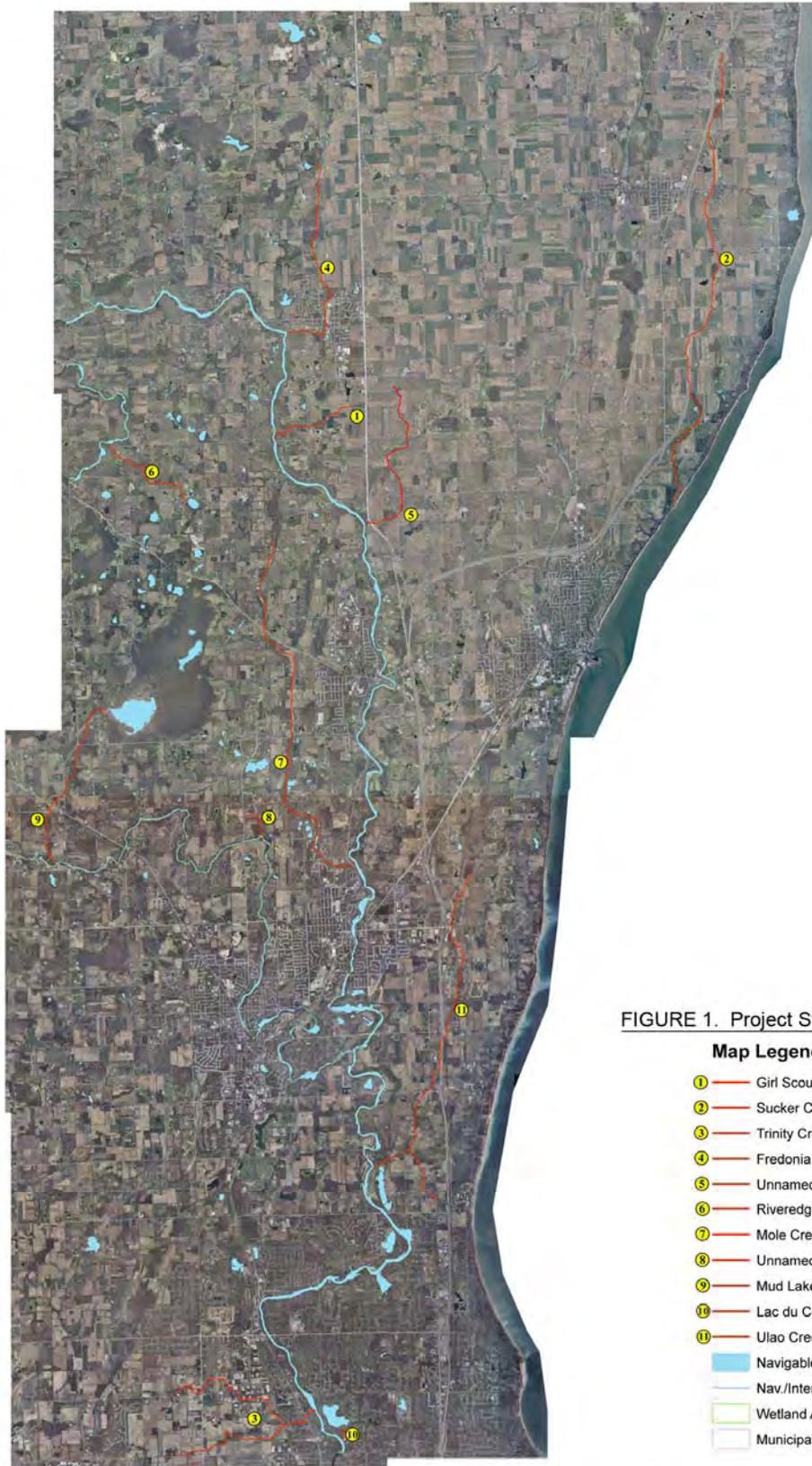


FIGURE 1. Project Stream Locations

APPENDIX A

FREDONIA CREEK SUMMARY – BARRIERS AND HABITAT

FREDONIA CREEK SUMMARY – BARRIERS AND HABITAT

General Description

Fredonia Creek (the Creek) drains from a small unnamed lake (Unnamed Lake 2) in northern Ozaukee County and flows to its confluence with the Milwaukee River at Waubedonia Park in Fredonia, Wisconsin. Its channel remains low-gradient (0.003 ft/ft overall) throughout and flows through urban and suburban areas near Fredonia and active and fallow agricultural areas elsewhere. The Creek bed is predominately fine-silt and muck, and there are both perennial and intermittent reaches. Moderately turbid flowing water was observed from Willow Valley Road downstream to the Milwaukee River confluence and from Unnamed Lake 2 downstream to Belgium Kohler Road during a September 12, 2006 field investigation. No flowing water was observed between Willow Valley and Belgium Kohler Roads. By inspecting high-resolution aerial photographs, 21 potential sites were identified.

Suspected Barriers

Of the 21 potential sites identified remotely, eight were classified as suspected barriers following field inspection. Interestingly, field inspection and landowner interview revealed that one barrier originally suspected to be a farm-crossing barrier is actually located in an infiltrating wetland that naturally fragments the Creek during low flow. The six suspected barriers most likely fragmenting the Creek include:

- ▲ A low-head concrete dam located just north of County Highway H in Fredonia (FC PB8; Photograph 1)
- ▲ Two railroad ballast deposits at two stream crossings between Fredonia and Willow Valley Road (FC PB10 and PB11; Photograph 2)
- ▲ Three perched corrugated metal culverts at the Willow Valley Road crossing (FC PB14; Photographs 3 and 4)
- ▲ Areas of natural channel loss to infiltration and vegetation overgrowth (cattail marsh) between Willow Valley and Belgium Kohler Roads (FC PB 15 and PB16; Photograph 5)

The other suspected barriers identified were culverts under farm and snowmobile trail crossings (FC PB2 and PB4; Photograph 6) in and adjacent to Waubedonia Park. The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

Riparian habitat suitable for northern pike spawning and contiguous with the Creek during high-flow events was observed in Waubedonia Park. Testimony of historic pike spawning in that reach was also garnered through a conversation with a long-time local fisherman. Suitable habitat was also observed between Fredonia and Willow Valley Road, although it is isolated by a low-head concrete dam and two railroad crossing ballast-stone deposits. Further, the littoral zone of Unnamed Lake 2 and floodplain wetlands downstream of the lake offer suitable habitat but appear naturally isolated during low flow by areas of channel loss to infiltration between Belgium Kohler and Willow Valley Roads.

Suspected Barrier Photographs



Photograph 1 – Low-head concrete dam (FC PB8)



Photograph 2 – Railroad crossing ballast stone deposit (FC PB10)



Photograph 3 – Perched culvert outlet (FC PB14)



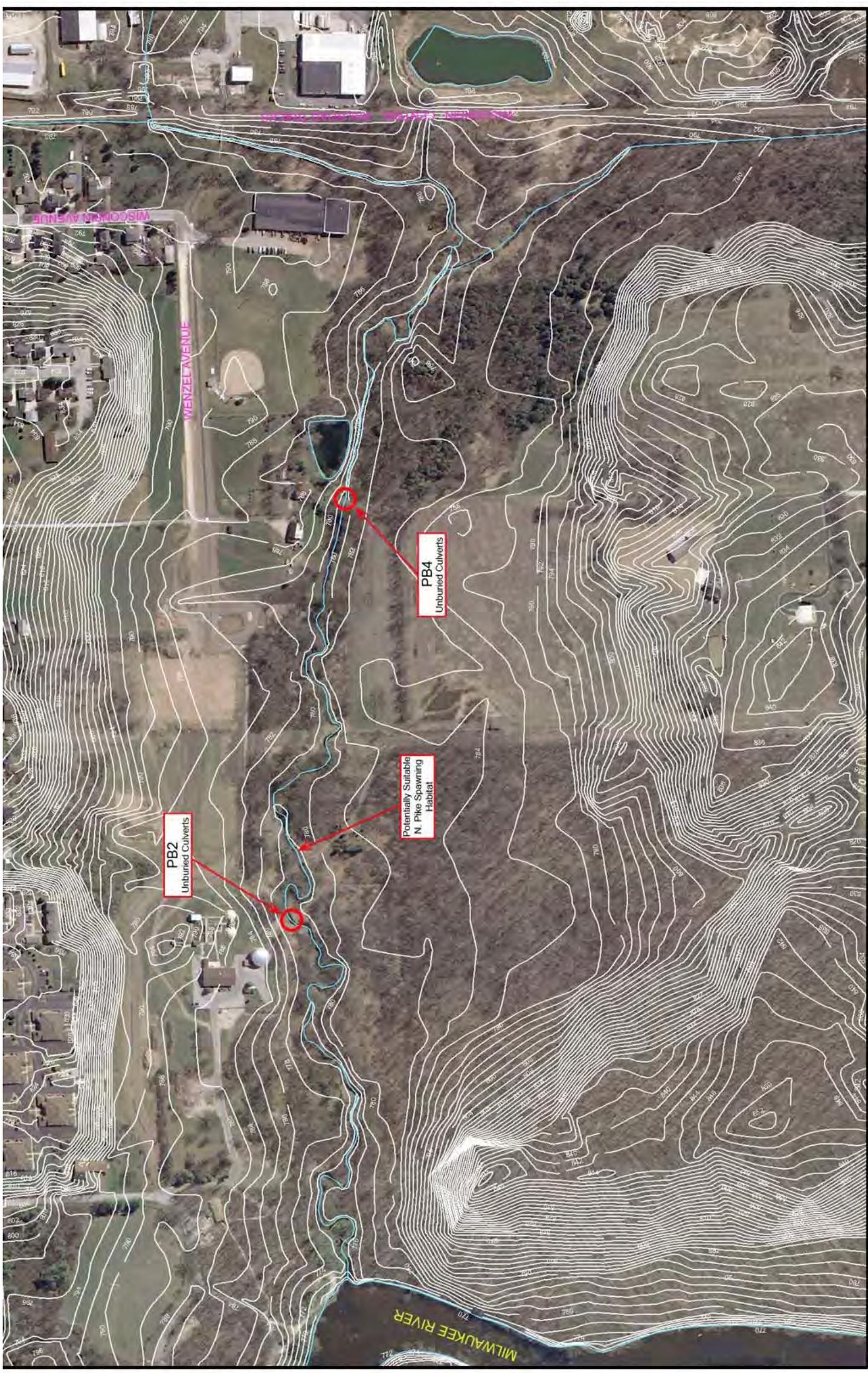
Photograph 4 – Perched culvert outlets (FC PB14)



Photograph 5 – Channel lost to wetland infiltration (FC PB15)

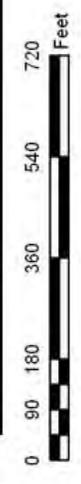


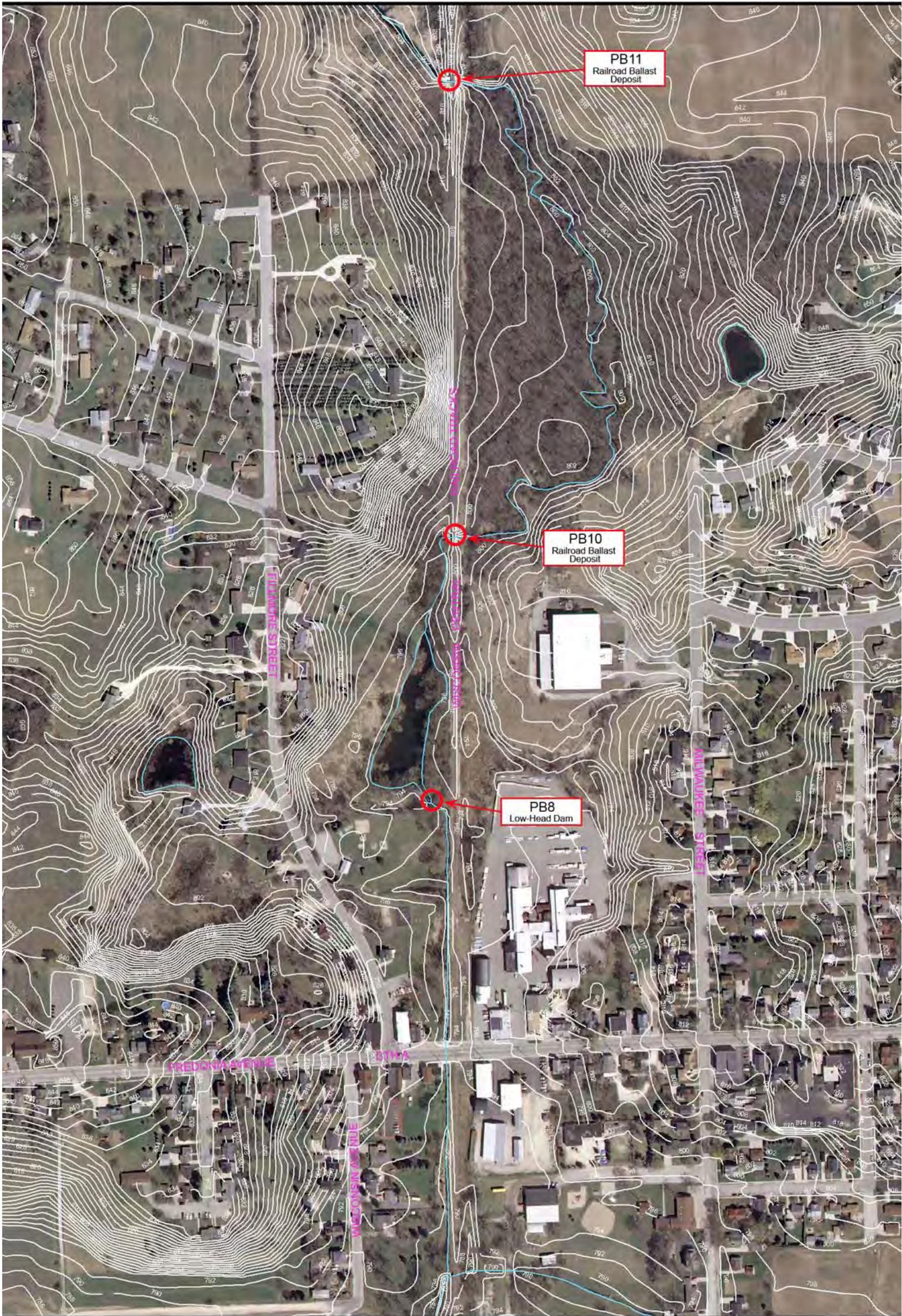
Photograph 6 – Culverts under Waubedonia Park snowmobile trail with downstream scour pool (FC PB15)



Scale = 1:3,000

Wisconsin Coastal Management - Ozaukee County PLRM Department
Fredonia Creek - Sheet #1

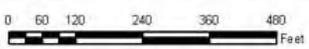


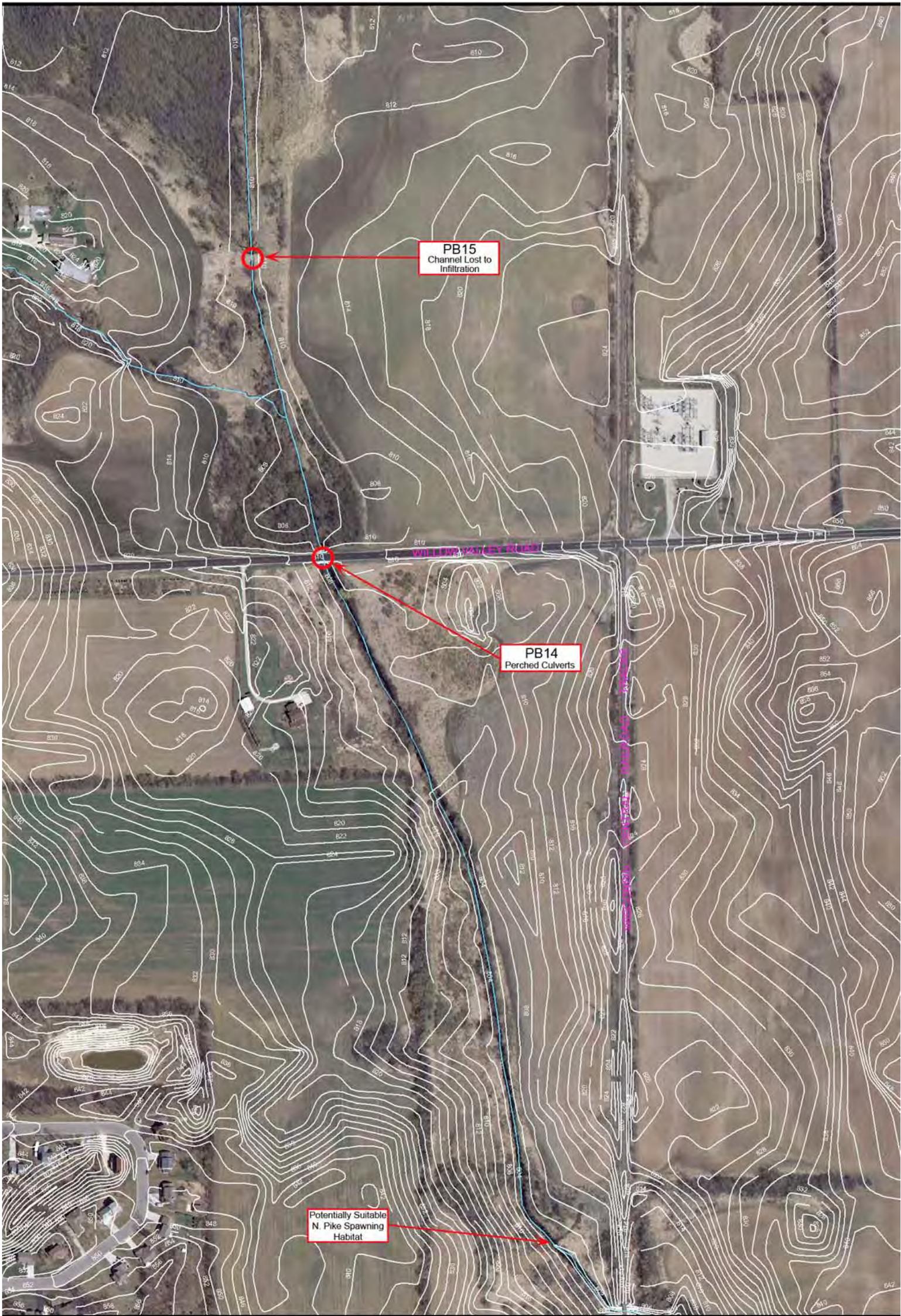


PB11
Railroad Ballast
Deposit

PB10
Railroad Ballast
Deposit

PB8
Low-Head Dam



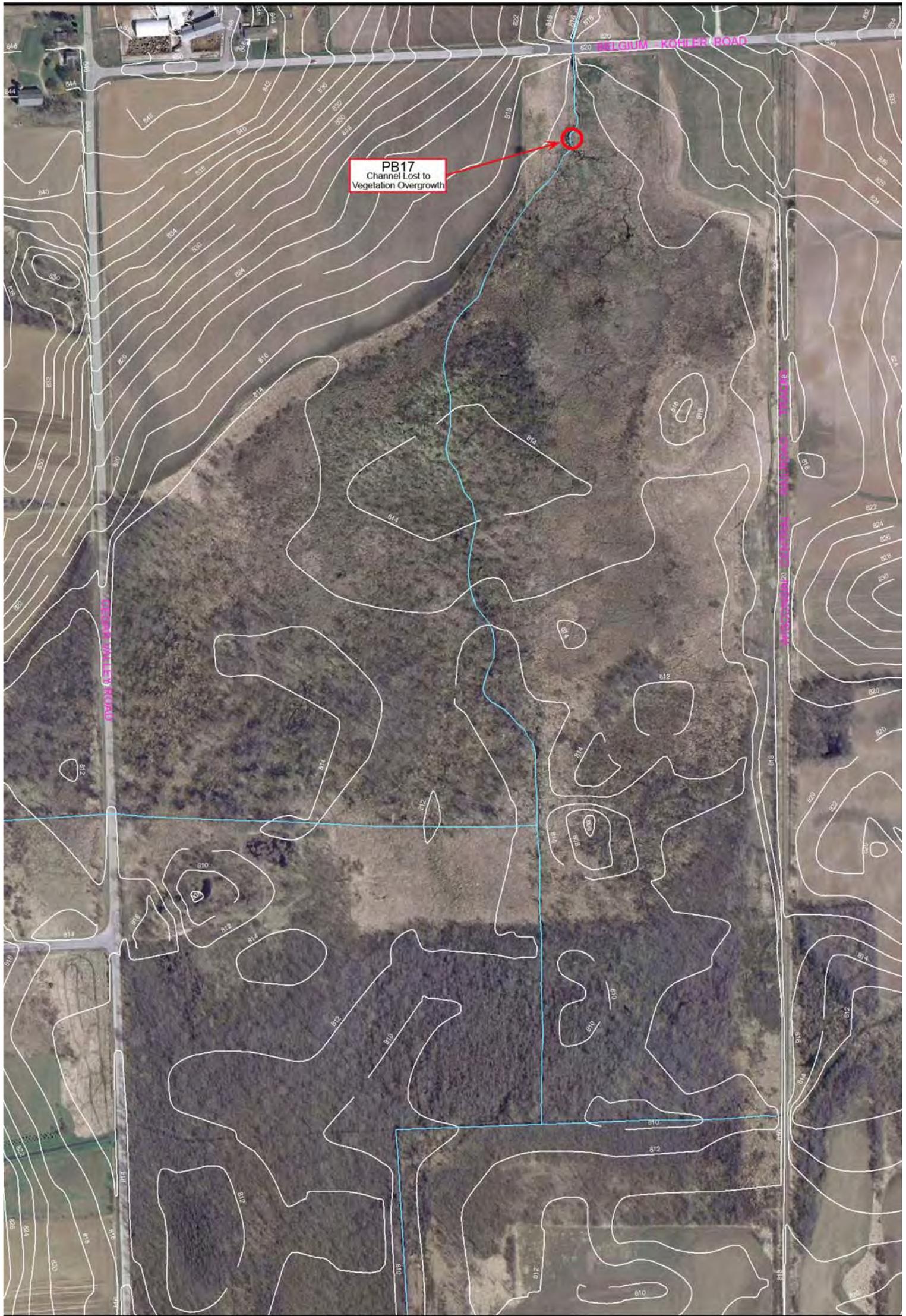


PB15
Channel Lost to
Infiltration

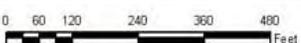
PB14
Perched Culverts

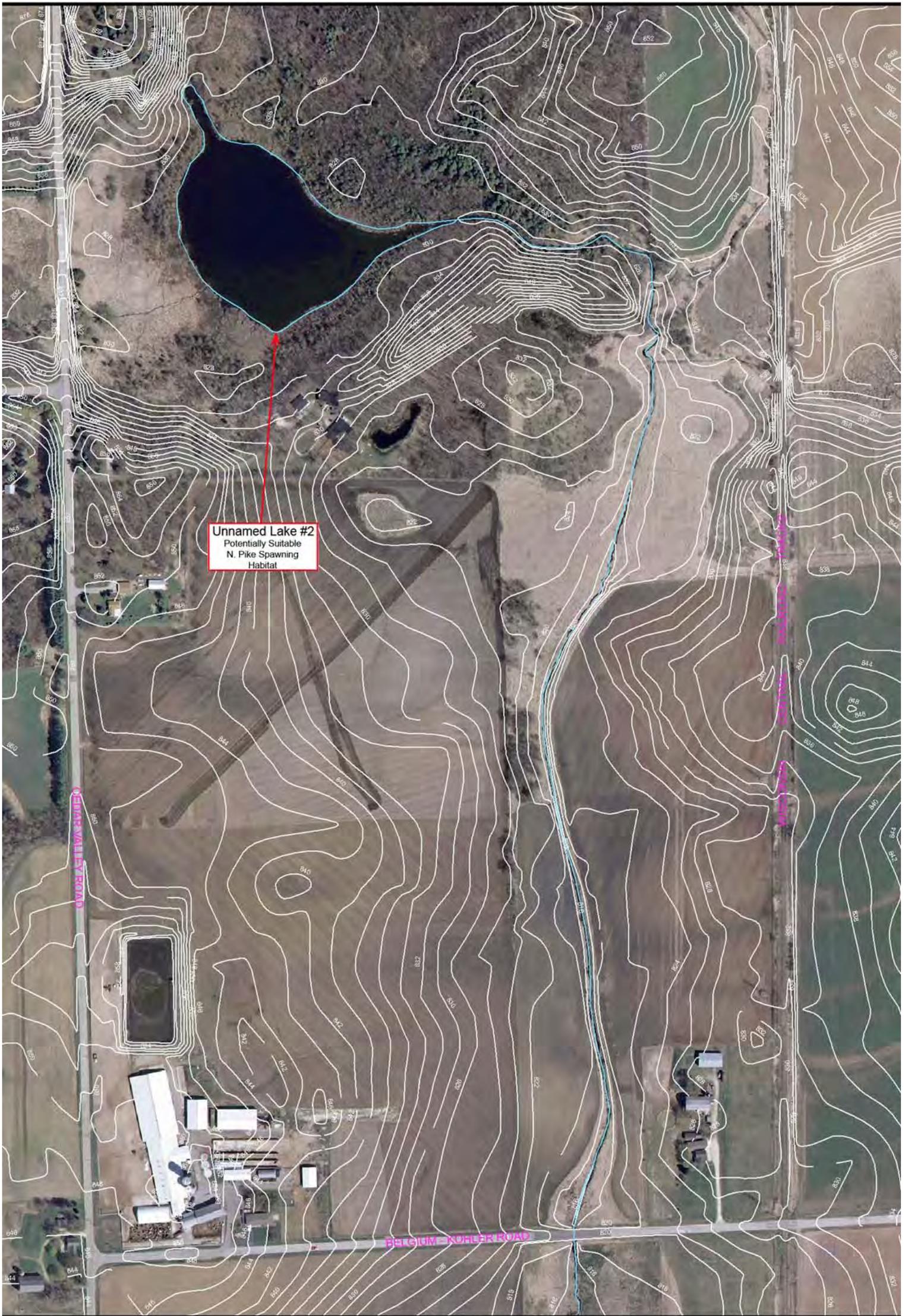
Potentially Suitable
N. Pike Spawning
Habitat





PB17
Channel Lost to
Vegetation Overgrowth

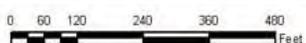




Unnamed Lake #2
Potentially Suitable
N. Pike Spawning
Habitat

CEDAR VALLEY ROAD

FREDERICK MUELLER ROAD



APPENDIX B

GIRL SCOUT CAMP CREEK SUMMARY – BARRIERS AND HABITAT

GIRL SCOUT CAMP CREEK SUMMARY – BARRIERS AND HABITAT

General Description

The Girl Scout Camp Creek (the Creek) main branch (the Main Branch) has perennial flow, drains a large cattail marsh west of State Highway 57, and forms a low-gradient (approximately 0.001 ft/ft) channel with fine-particle bed materials that passes through two small manmade ponds, one of which was built to retain flood water. No water was observed in the cattail marsh headwaters during a September 28, 2006 field investigation. The Main Branch then passes through forested and agricultural areas before crossing Blueberry Road just north of Hawthorne Drive. Water observed east of Blueberry Road was flowing almost indistinguishably due to dense reed canary grass in the channel. West of Hawthorne Drive, the Main Branch has a moderate gradient (approximately 0.01 ft/ft), cobble/pebble bed materials, and little to no in-channel vegetation. It remains this moderate gradient until its confluence with the Milwaukee River.

The north branch of the Creek (the North Branch) is intermittent and low gradient (approximately 0.002 ft/ft) and flows from a marshy wetland east of Blueberry Road where it is completely ingrown with reed canary grass, red osier dogwood, sandbar willow, and other hydrophytic species. It passes south, largely through ditches along Blueberry Road, before meeting the Main Branch east of Blueberry Road. No flowing water was observed in the North Branch during the field investigation.

By inspecting high-resolution aerial photographs, twelve potential sites were identified. An additional potential site was identified through conversation with an individual familiar with the Creek.

Suspected Barriers

Of the thirteen potential sites identified, ten were classified as suspected barriers following field inspection and a landowner interview. The seven barriers most likely fragmenting the Creek include:

- ▲ Dual constricting corrugated metal culverts under a driveway approximately midway from the Milwaukee River outlet to Blueberry Roads (GSC PB2; Photograph 1)
- ▲ A long, slightly perched (at low flow), unburied corrugated metal culvert with a rusted-out bottom and blocked by ingrown vegetation and sediment deposits at the inlet (GSC PB3; Photograph 2)
- ▲ An earthen dam that discharges through top-draw trickle-tube spillway (GSC PB4)
- ▲ A pond-outlet culvert elevated to pass water only during high-flow events (GSC PB5)
- ▲ A large cattail stand that thoroughly chokes the channel (GSC PB7; Photograph 3)
- ▲ A 50-foot long, unburied corrugated metal culvert under Blueberry Road that is completely ingrown with dense hydrophytic vegetation at both ends (GSC PB10)
- ▲ A densely ingrown reach of channel that is thoroughly choked by hydrophytic vegetation (GSC PB11 & PB12; Photograph 4)

The other suspected barriers included a debris jam (GSC PB1A) near the channel outlet where a secondary channel flows to the Milwaukee River during high-flow events and unburied corrugated metal culverts (GSC PB6 and PB9) where accelerated flow velocities may exceed the limiting velocities of adult northern pike.

The identified suspected barriers included both types that can impede adult northern pike access to upstream habitats during high flow and types that can impede juvenile egress during lower-flow conditions.

Habitat

The best northern pike spawning habitat is likely the two manmade ponds found along the Main Branch east of Blueberry Road. An impassable dam (GSC PB4) at the outlet of the downstream-most pond prevents fish access even during high-flows. The owner of these ponds indicated that fish were observed in the scour pool downstream of the dam approximately 10 years ago, but conclusive evidence that they were northern pike was not available. The headwater wetlands of the Main Branch and North Branch are each densely overgrown with invasive vegetation that likely prevents adult northern pike access and juvenile egress even during high-flow conditions, and therefore are not suitable habitat.

Suspected Barrier Photographs



Photograph 1 – Constricting culverts
(GSC PB2)



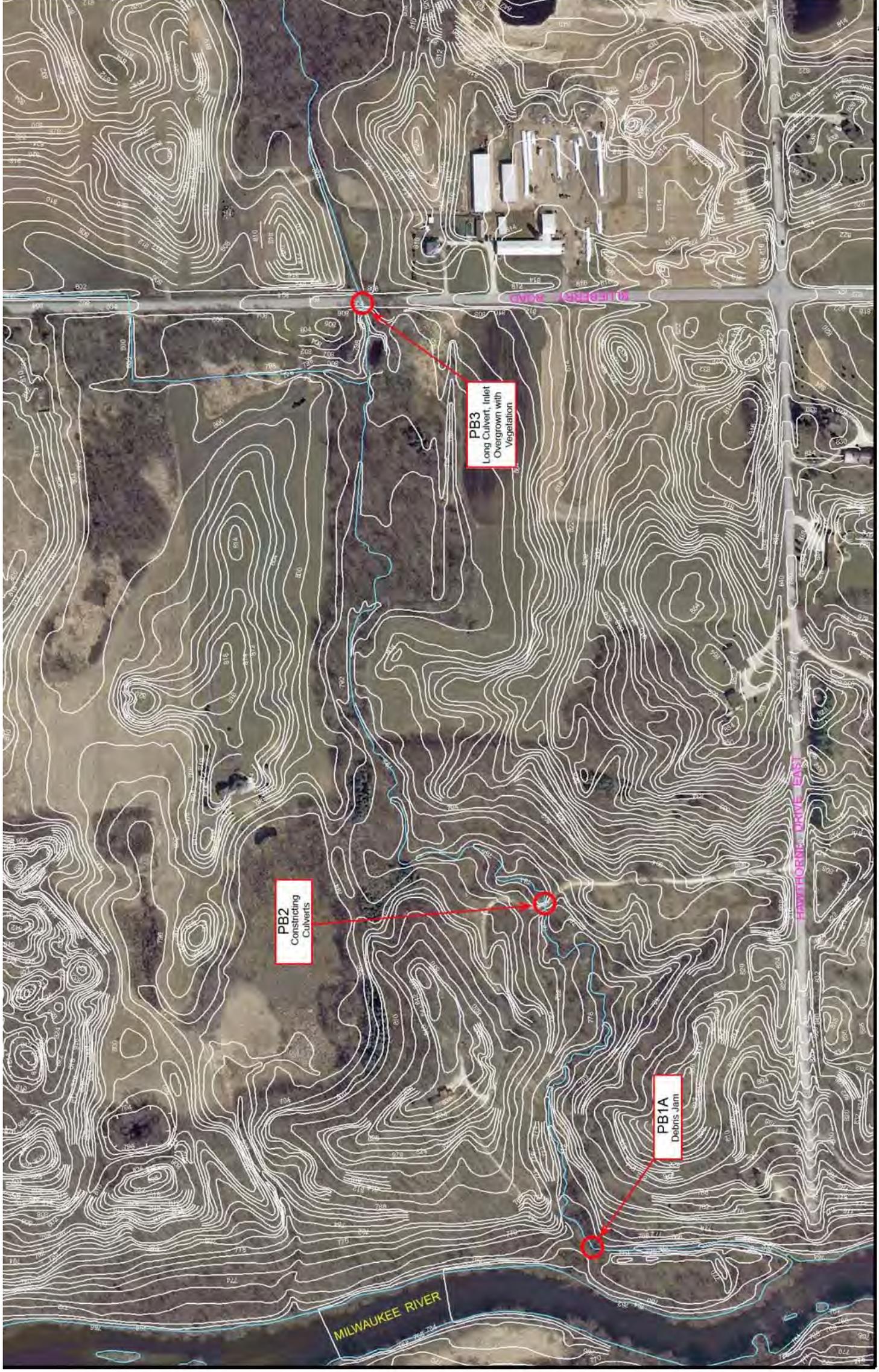
Photograph 2 – The ingrown inlet of a long,
unburied, corrugated metal culvert (GSC PB3)

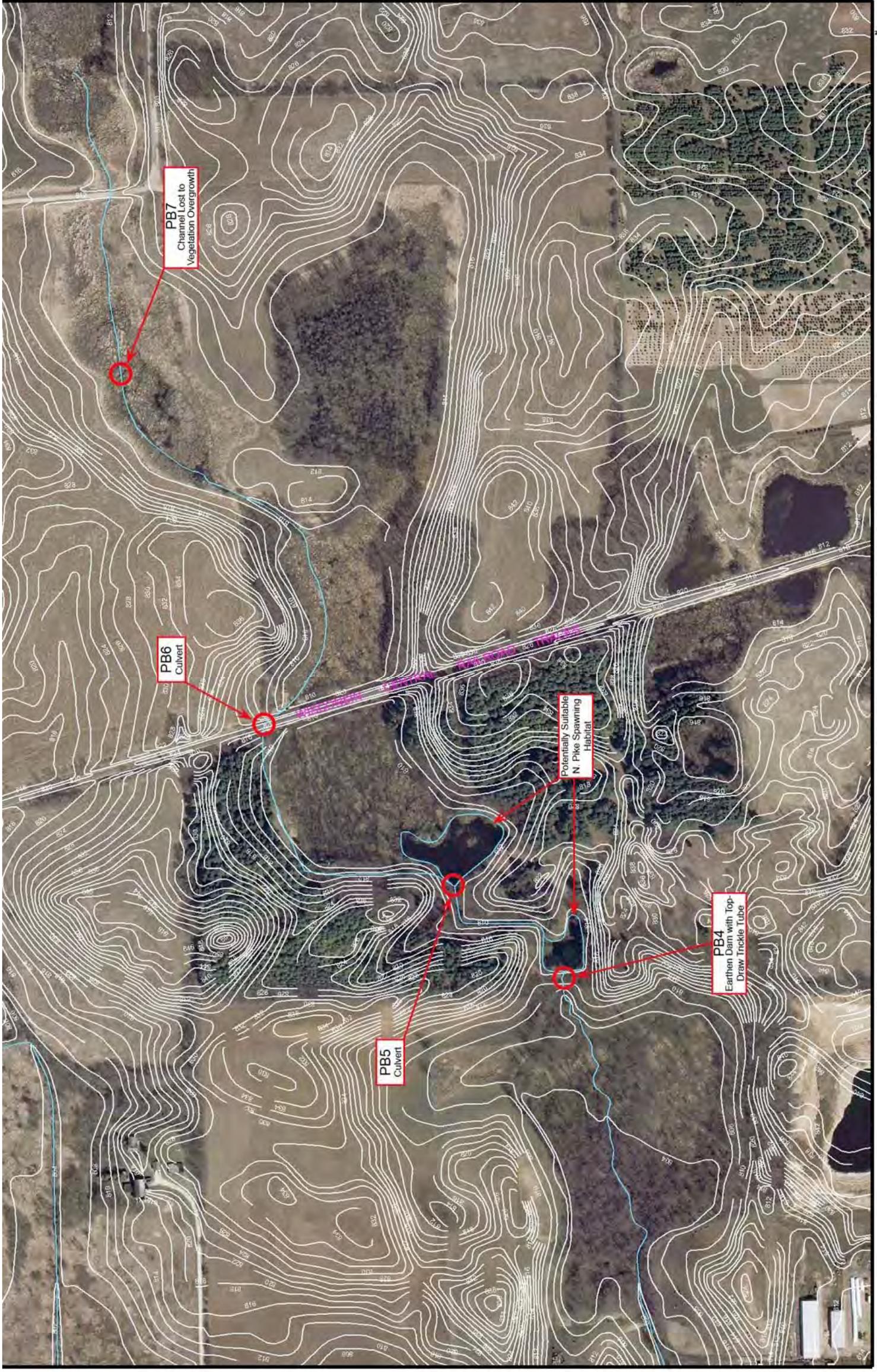


Photograph 3 – Channel lost to densely
ingrown cattails (GSC PB7)



Photograph 4 – Channel lost to densely
ingrown vegetation (GSC PB11 & PB12)





Scale = 1:3,000

Wisconsin Coastal Management - Ozaukee County PLRM Department
Girl Scout Camp Creek - Sheet #2





PB11
Channel Lost to
Vegetation Overgrowth

PB10
Long Untuned
Culvert with Overgrown
Vegetation at
Inlet and Outlet

PB9
Unburied Culverts

0 55 110 220 330 440
Feet

Wisconsin Coastal Management - Ozaukee County PLRM Department
Girl Scout Camp Creek - Sheet #3

Scale = 1:3,000



APPENDIX C

LAC DU COURS OUTLET CREEK SUMMARY – BARRIERS AND HABITAT

LAC DU COURS OUTLET CREEK SUMMARY – BARRIERS AND HABITAT

General Description

The Lac du Cours Outlet Creek (the Creek) originates from the south shore of Lac du Cours in southern Ozaukee County and passes south into a small lake (Unnamed Lake 1) formed from an old non-metallic mining site. The channel reforms on the west side of Unnamed Lake 1 and continues south to its confluence with the Milwaukee River. The Creek is low gradient (0.001 ft/ft) and intermittent (no observed flow on August 31, 2006), with shallow standing water present only upstream of Lemont Road where water elevation is controlled by the road-crossing culvert. Bed materials include fine silt and muck. Inspecting high-resolution aerial photographs revealed 3 potential sites. An additional potential site was identified during a site inspection.

Suspected Barriers

All four potential sites were assessed during an August 31, 2006 field inspection and classified as suspected barriers. They included:

- ▲ A narrow concrete/stone bridge abutment under North River Road that constricts the channel and forms a scour cascade at the Milwaukee River confluence (LDC PB1; Photograph 1)
- ▲ Pervious rip rap fill deposit to form a walkway downstream of Unnamed Lake 1 (LDC PB2; Photograph 2)
- ▲ A round corrugated metal culvert with integrated water-level control feature that has altered the local channel morphology, created a scour cascade, and caused the upstream channel to backwater (LDC PB3; Photograph 3)
- ▲ A very narrow and non-functional concrete dam with riprap channel lining at the Lac du Cours outlet that constricts the channel and causes significant downstream changes to channel morphology (LDC PB4; Photograph 4)

The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

Suitable northern pike spawning habitat was observed in Unnamed Lake 1 and the Creek reach downstream (extending to the Milwaukee River confluence). Unnamed Lake 1 has a shallow littoral zone with dense coontail growth and a fringe of arrowhead and other hydrophytic species. Large numbers of common carp were also observed in Unnamed Lake 1. The Creek reach downstream of Unnamed Lake 1 has dense reed canary grass bank cover. Both this reach and Unnamed Lake 1 have good riparian connectivity and a wide riparian buffer width.

Between Unnamed Lake 1 and Lemont Road, the Creek is deeply entrenched, lacking bank vegetation, disconnected from a common buckthorn dominated riparian zone, lacking bank and channel vegetation, and generally poor for northern pike spawning habitat. Between Lemont Road and Lac du Cours the Creek is extremely wide and shallow and also lacks riparian connectivity and in-stream vegetation. Lac du Cours itself may provide spawning habitat, although interviewing a lake resident revealed that the lake is now chemically treated to curb nuisance plant growth, a practice that may diminish suitable habitat. If common carp have not already inhabited Lac du Cours, it may be the barriers between itself and Unnamed Lake 1 (LDC PB3 and PB4) that have prevented their invasion.

Suspected Barrier Photographs



Photograph 1 – Narrow concrete bridge abutments (LDC PB1)



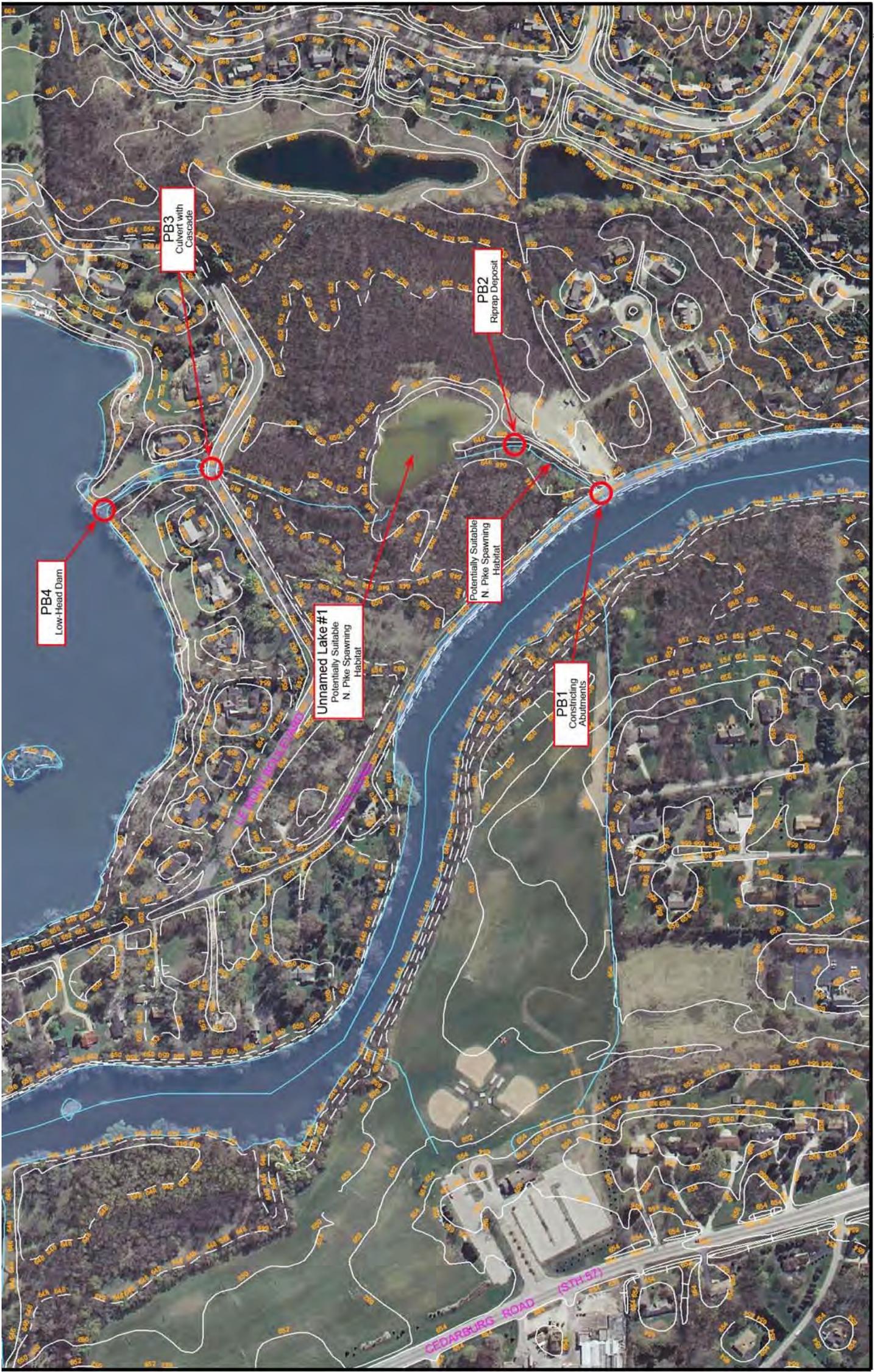
Photograph 2 – Pervious riprap fill placed in channel (LDC PB2)



Photograph 3- Round corrugated metal culvert with water-level control and scour cascade (LDC PB3)



Photograph 4 – Non-functional low-head dam with riprap channel lining (LDC PB4)



Scale = 1:3,000



APPENDIX D

MOLE CREEK SUMMARY – BARRIERS AND HABITAT

MOLE CREEK SUMMARY – BARRIERS AND HABITAT

Mole Creek General Description

Mole Creek (the Creek) originates as wetland springs west of Saukville, Wisconsin and flows south to its confluence with the Milwaukee River near Grafton, Wisconsin. It flows perennially, is believed to be the only cold-water stream in Ozaukee County, passes through a predominantly agricultural and residential watershed, and can be generally divided into two sections. The first section has a moderately low gradient (0.004 ft/ft overall) and extends upstream from the Milwaukee River confluence to the outlet of a natural pond located west of Shady Lane. Cobble and pebble bed materials are common throughout this section and much of the riparian zones are either shrub forest (i.e., common buckthorn, etc.) or power line clearings dominated by reed canary grass and other invasive species. The second section extends from the natural pond west of Shady Lane to the headwater springs west of Saukville, has a low-gradient (0.002 ft/ft overall) channel, flows predominantly through agricultural land, and has a bed dominated by silt and other fine-particle materials. Flowing water was observed in all reaches of the Creek during field inspections on September 25 and 27, 2006. By inspecting high-resolution aerial photographs, 37 potential sites were identified. During field inspections, four additional potential sites were identified.

Suspected Barriers

Of the 41 potential sites identified, nine were classified as suspected barriers following field inspections and/or landowner interviews. Of the nine suspected barriers, the three most likely to fragment the Creek include:

- ▲ A corrugated metal culvert under North Green Bay Road that has an artificial cascade at the inlet and a perched outlet jammed with woody debris and stone forming an artificial waterfall (MC PB2; Photograph 1)
- ▲ A farm crossing south of State Highway 33 with a perched corrugated metal culvert that outlets to cascaded covered by concrete slabs (MC PB29; Photograph 2)
- ▲ A fallow agricultural area south of Center Road where the channel is lost to densely ingrown reed canary grass (MC PB34A)

Several other suspected barriers were identified, including a concrete bridge that has riprap at the inlet and outlet and a children's "fort" built inside (MC PB5), a large single-log jam immediately downstream of Pleasant Valley Road (MC PB14; Photograph 3), and several relatively long unburied corrugated metal culverts (MC PB30, PB31, and PB33). In addition, many of the high gradient reaches of the Creek likely have swift spring flow velocities that may naturally impede northern pike passage. The identified suspected barriers included both types that can impede adult northern pike access to upstream habitats during high flow and types that can impede juvenile egress during lower-flow conditions.

Habitat

During field inspections, five areas characteristic of northern pike spawning habitat were observed. The first is the small natural pond west of Shady Lane at the top of the high gradient section. The pond has littoral vegetation and good connectivity to the floodplain. A second area is found upstream of the Pleasant Valley Road crossing where the channel and floodplain have good connectivity and herbaceous wetland plants were observed. The third area, located immediately upstream of Cedar Sauk Road, also has good floodplain connectivity and a prevalence of herbaceous wetland plants along the banks (Photograph 4). Immediately upstream of the perched culvert south of State Highway 33 (MC PB29) is a wide open, well connected

riparian flood plain covered by dense reed canary grass and bisected by an open channel. The final area is the reed canary grass dominated floodplain immediately south of Center Road. The channel in this area, unlike that south of State Highway 33, is completely grown in with reed canary grass which may render it unsuitable. This suspicion was corroborated during the interview of a long-time site who indicated that no fish had ever been seen there.

Suspected Barrier Photographs



Photograph 1 – Improperly elevated corrugated metal culvert with cascading inlet, perched outlet, and stone/wood debris Jam (MC PB2)



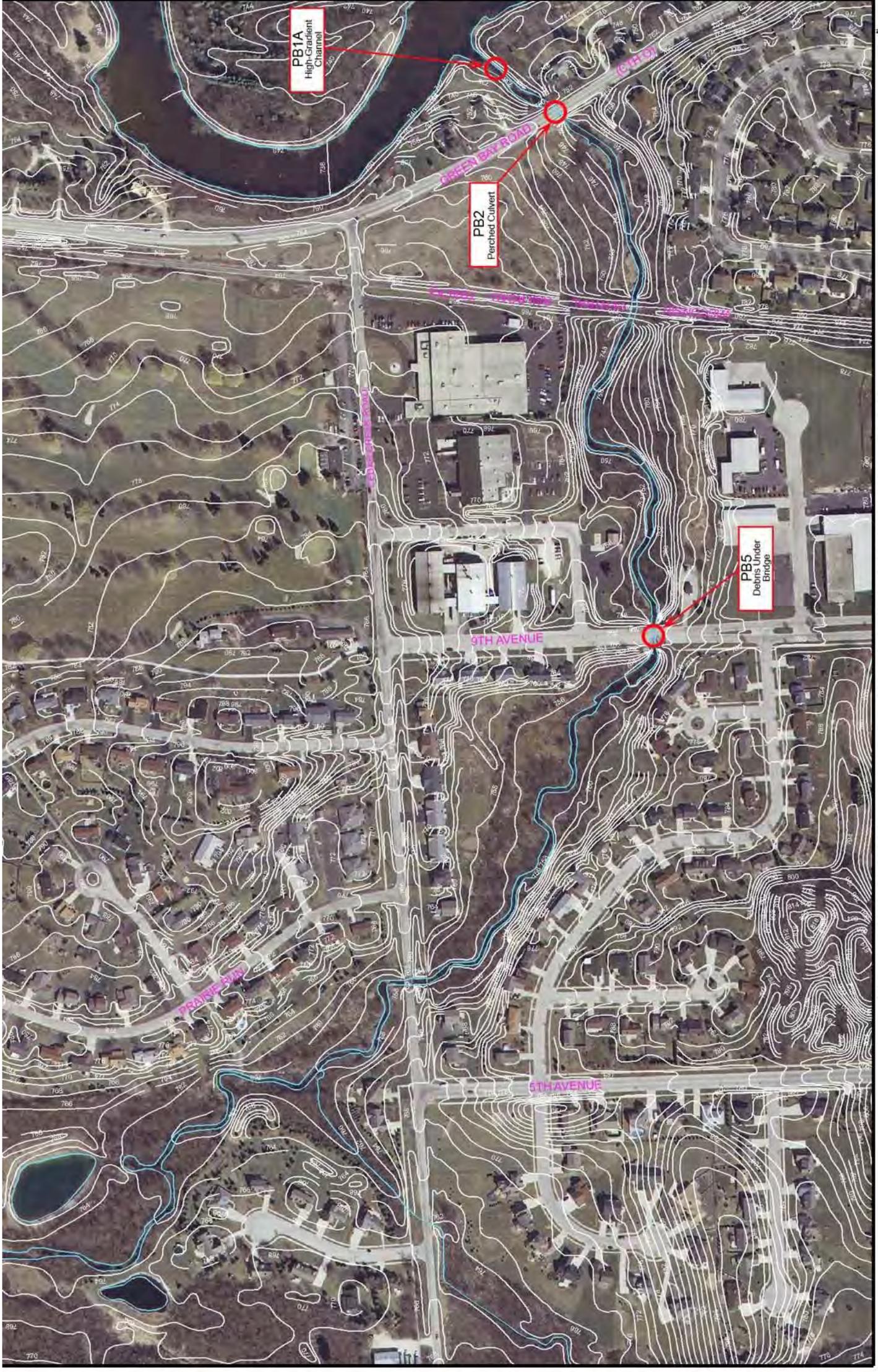
Photograph 2 – Perched culvert with concrete riprap cascade outlet (MC PB29)

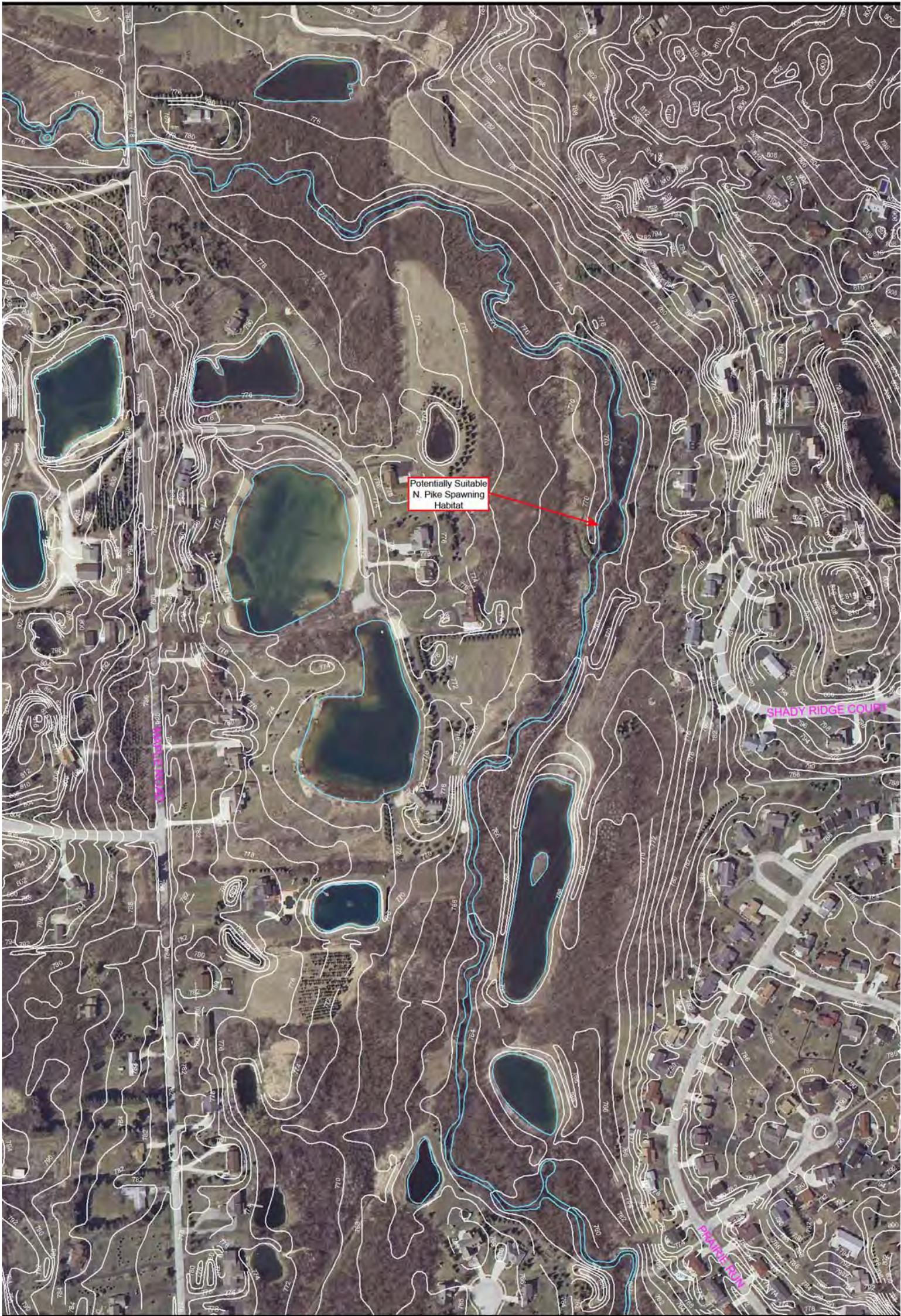


Photograph 3 – Single-log jam causing channel widening and pool (MC PB14)



Photograph 4 – Habitat conditions suitable for northern pike spawning (located north of Cedar Sauk Road)





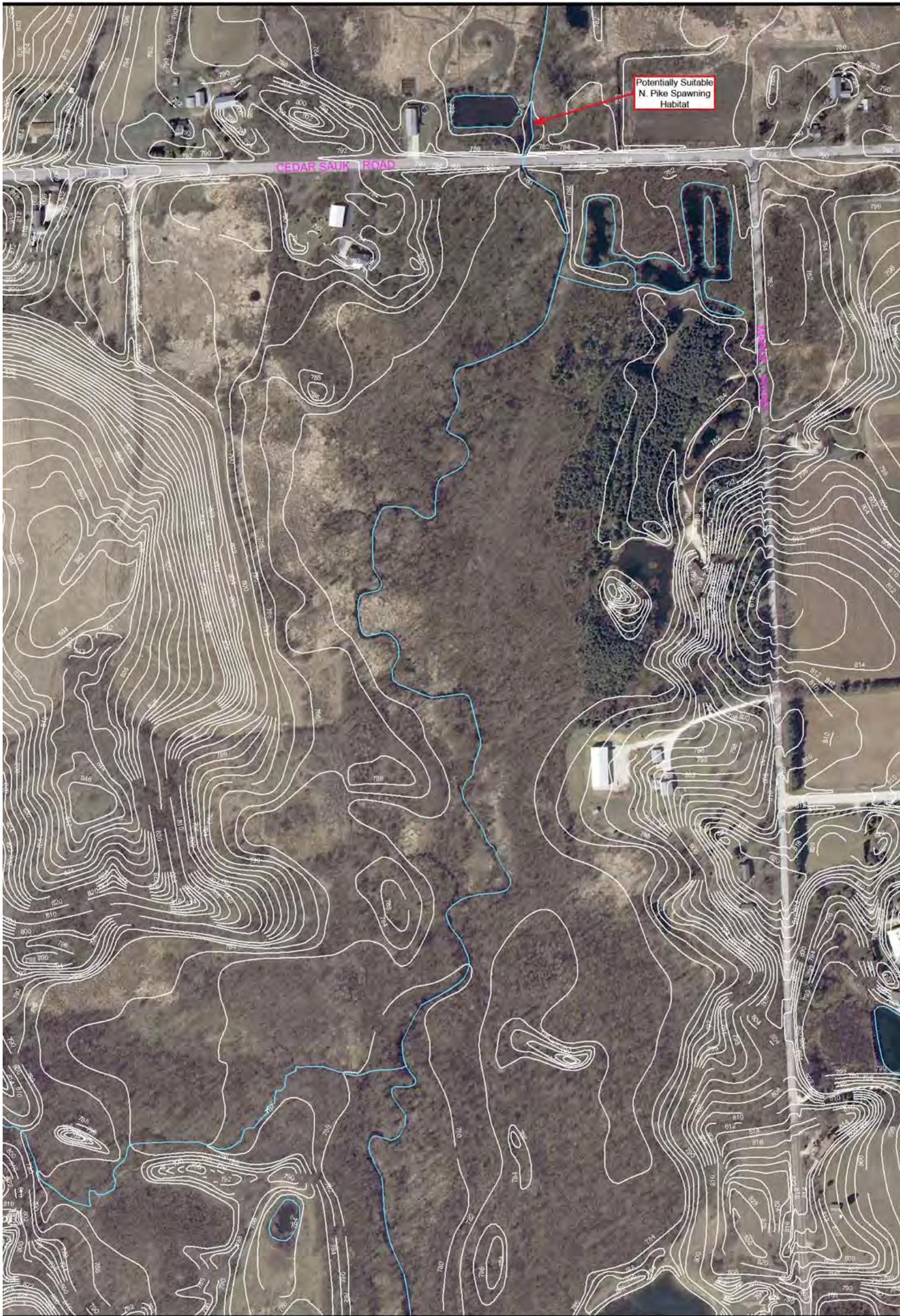


Potentially Suitable
N. Pike Spawning
Habitat

PB14
Log Jam

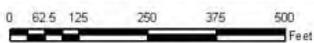
PLEASANT VALLEY ROAD





Potentially Suitable
N. Pike Spawning
Habitat

CEDAR SAUK ROAD



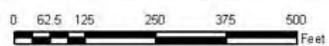
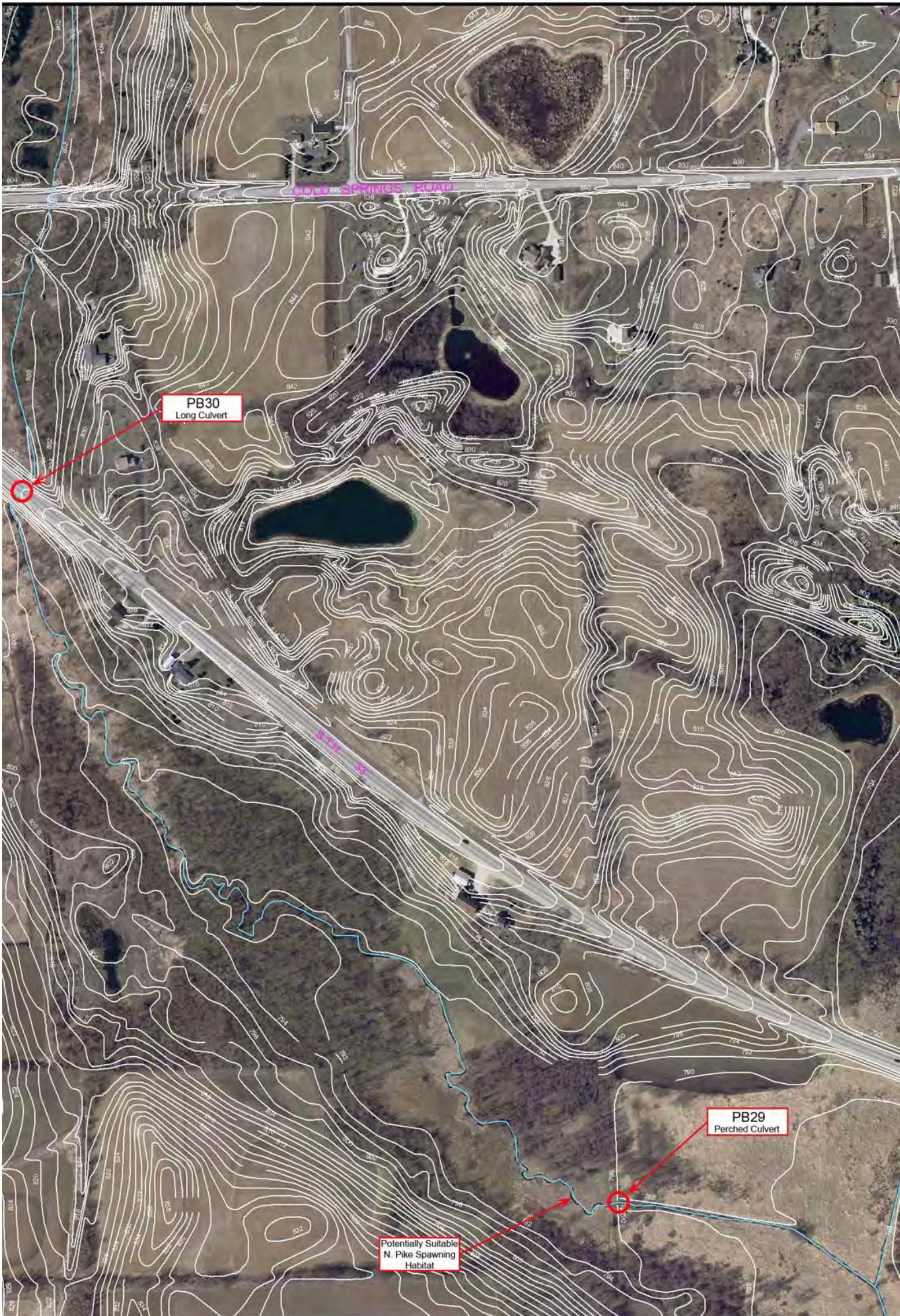


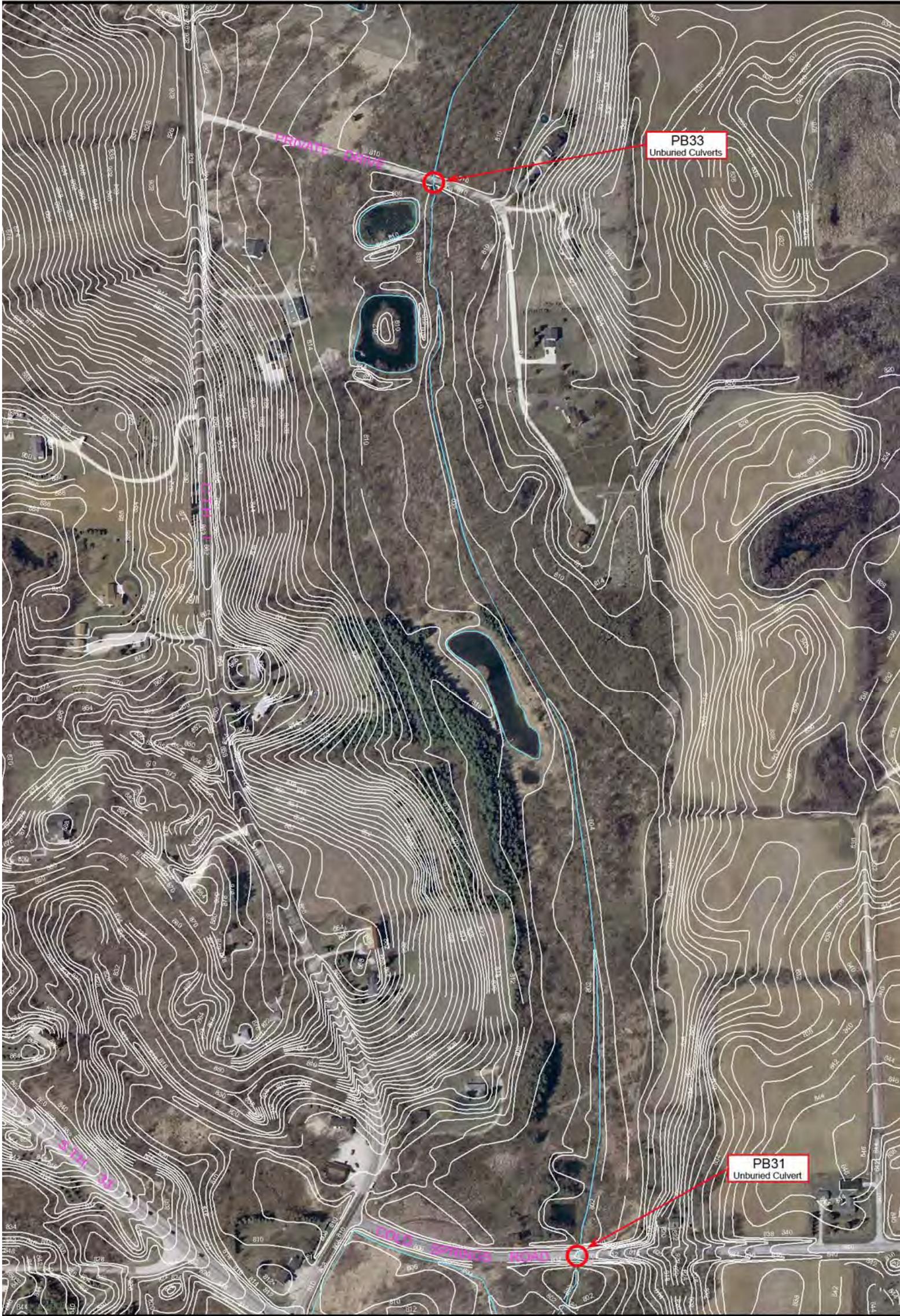
Wisconsin Coastal Management - Ozaukee County PLRM Department
Mole Creek - Sheet #5

Scale = 1:3,000





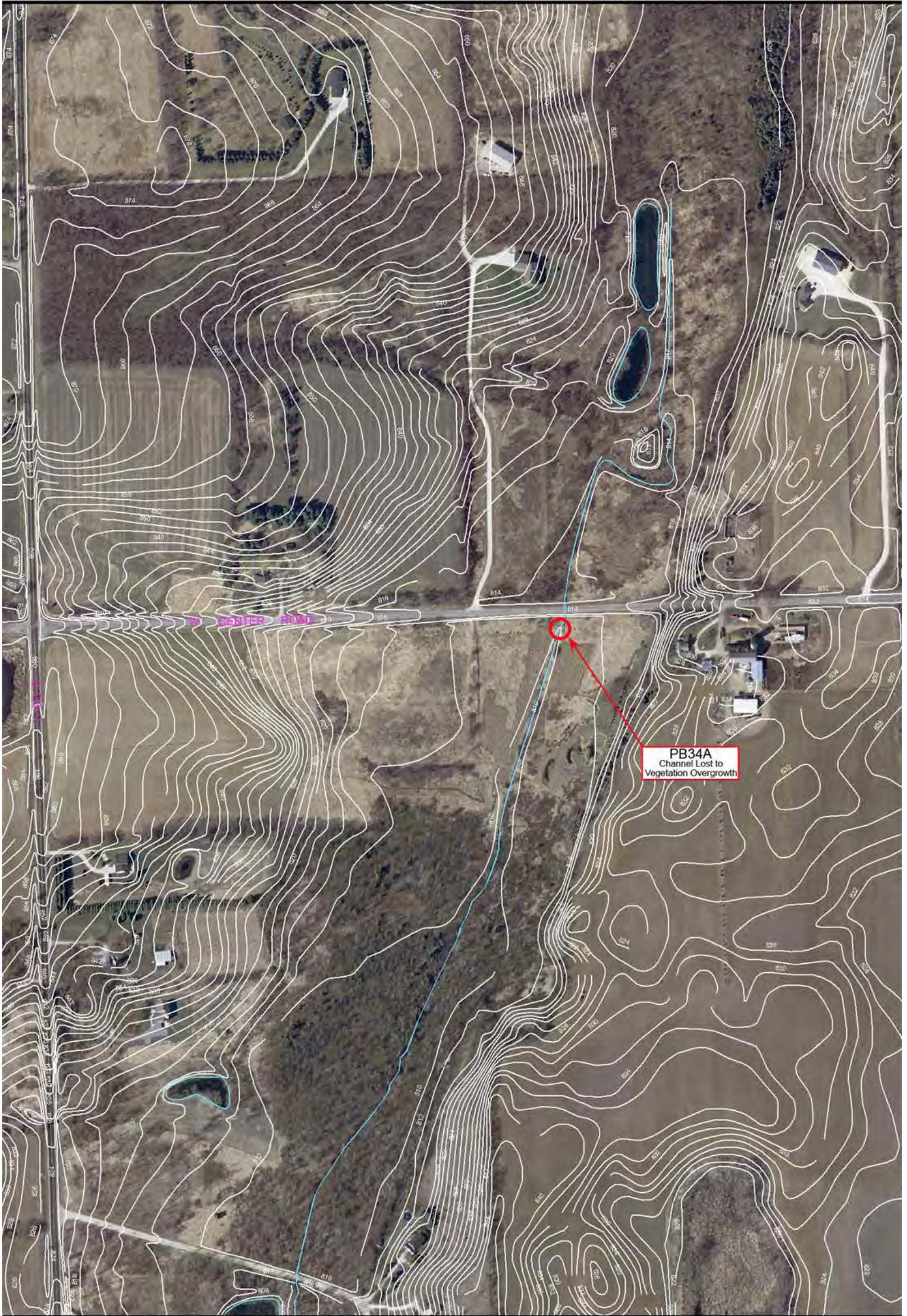




PB33
Unburied Culverts

PB31
Unburied Culvert





APPENDIX E

MUD LAKE OUTLET CREEK SUMMARY – BARRIERS AND HABITAT

MUD LAKE OUTLET CREEK SUMMARY – BARRIERS AND HABITAT

General Description

Mud Lake Outlet Creek flows from Mud Lake (located southwest of Newburg, Wisconsin) to its confluence with Cedar Creek, a large tributary to the Milwaukee River. It remains low-gradient (0.002 ft/ft) throughout its entire length, flows through three large floodplain wetland complexes, has a predominantly fine silt and muck bed, and was observed to be dry on September 6 and 7, 2006 in all reaches except for standing backwater from the Cedar Creek confluence upstream approximately 900 feet. This intermittent flow regime, and the seasonal entry of forage fish it once sustained, was documented by the Wisconsin Conservation Department in their 1963 publication *Surface Water Resources of Ozaukee County*. Inspecting high-resolution aerial photographs revealed sixteen potential sites. An additional potential site was identified during field inspection of the first sixteen.

Suspected Barriers

Of the seventeen potential sites, nine were classified as suspected barriers during field inspection. The suspected barriers most likely impeding passage include:

- ▲ Severe channel constriction by a farm-crossing culvert approximately 1,000 feet upstream of the Cedar River confluence (ML PB1; Photograph 1)
- ▲ A course woody debris jam approximately 1,500 feet upstream of the Cedar River confluence that has altered local channel morphology (ML PB2)
- ▲ Three reaches with channel loss due to extreme overgrowth by vegetation including sandbar willow and cattails (ML PB3, PB10, and PB12; Photograph 2)
- ▲ Two culverts under County Highway NN with aggraded sediment at the inlet, scour cascades, and altered local channel morphology (ML PB5)
- ▲ An old concrete and stone bridge slightly downstream of Mud Lake that has pervious stone fill at the inlet and that appear near collapse, an event that would completely block access to and egress from Mud Lake (ML PB15; Photograph 3)

Other suspected barriers included pervious rock fill at the culvert inlet under Pleasant Valley Road (ML PB4) and a pervious debris jam north of County Highway NN (ML PB8A) that resulted from wind-blown woody debris and steel supports from an old farm crossing. The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

One large floodplain wetland complex that is contiguous with the channel during high-flow events was observed extending from the Cedar Creek confluence upstream approximately 1000 feet (Photograph 4). No barriers isolate this habitat from Cedar Creek. A second large floodplain wetland complex spans from just north of County Highway NN all the way to Mud Lake. Several barriers within and downstream of this wetland fragment aquatic life passage and isolate it as well as Mud Lake from downstream reaches. A long-time resident (i.e., since 1960) and local landowner in this second wetland complex said that in the past he had observed large numbers of northern pike migrating upstream to Mud Lake. During the past decade, however, he has only observed one fish (an approximately 40-inch long pike) swimming in his flooded yard to bypass a cattail-blocked reach. Observations of Mud Lake at its outlet to the Creek indicate that it could provide excellent pike spawning habitat during relatively wet springs if barriers did not preclude pike access.

Suspected Barrier Photographs



Photograph 1 – Constricting culvert at old farm crossing (ML PB1)



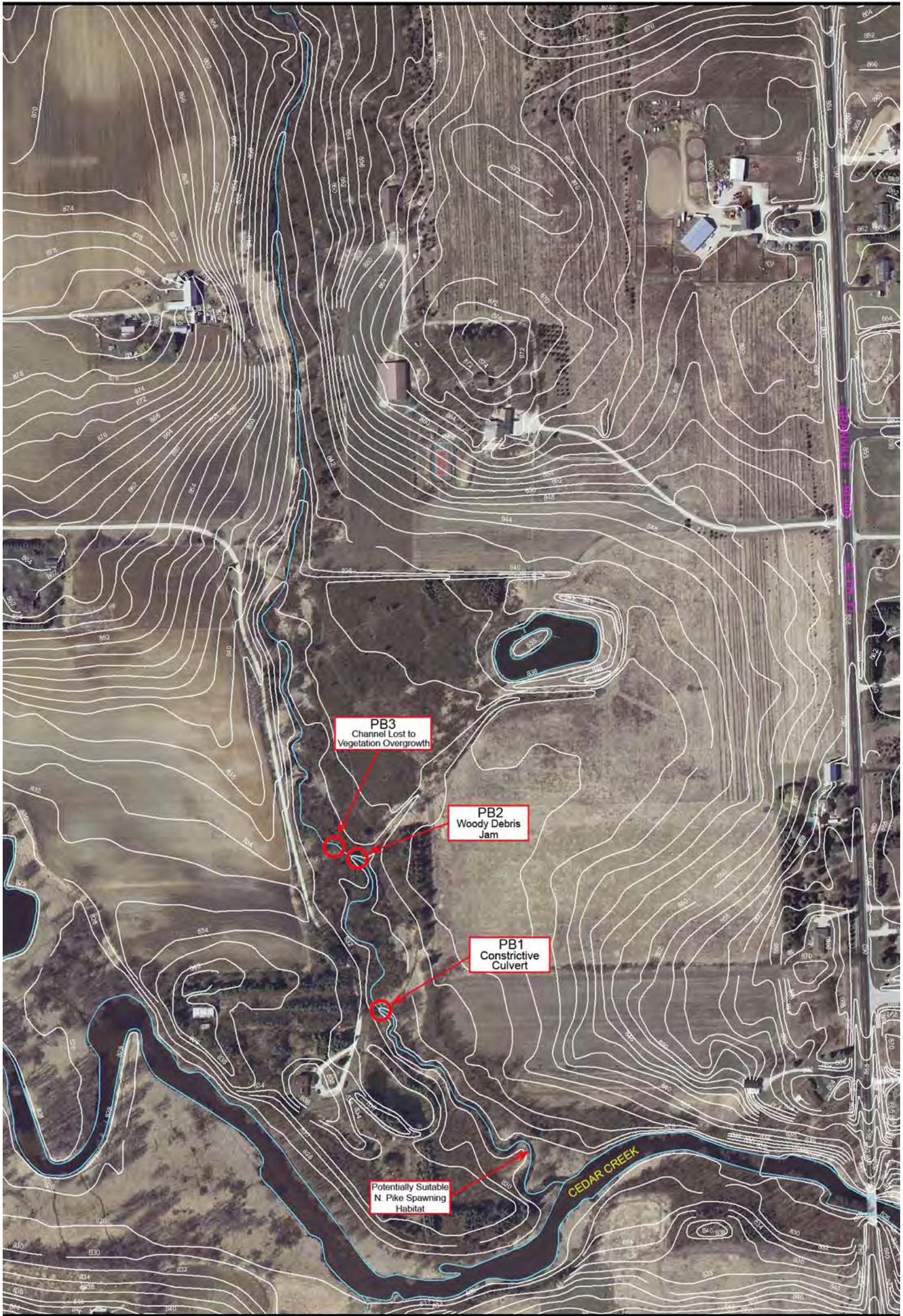
Photograph 2 – Channel lost to densely ingrown sandbar willow (ML PB3)



Photograph 3 – Old concrete bridge nearing collapse and with stone fill at inlet (ML PB15)



Photograph 4 – Habitat conditions suitable for northern pike spawning – located near Cedar Creek confluence



PB3
Channel Lost to
Vegetation Overgrowth

PB2
Woody Debris
Jam

PB1
Constrictive
Culvert

Potentially Suitable
N. Pike Spawning
Habitat

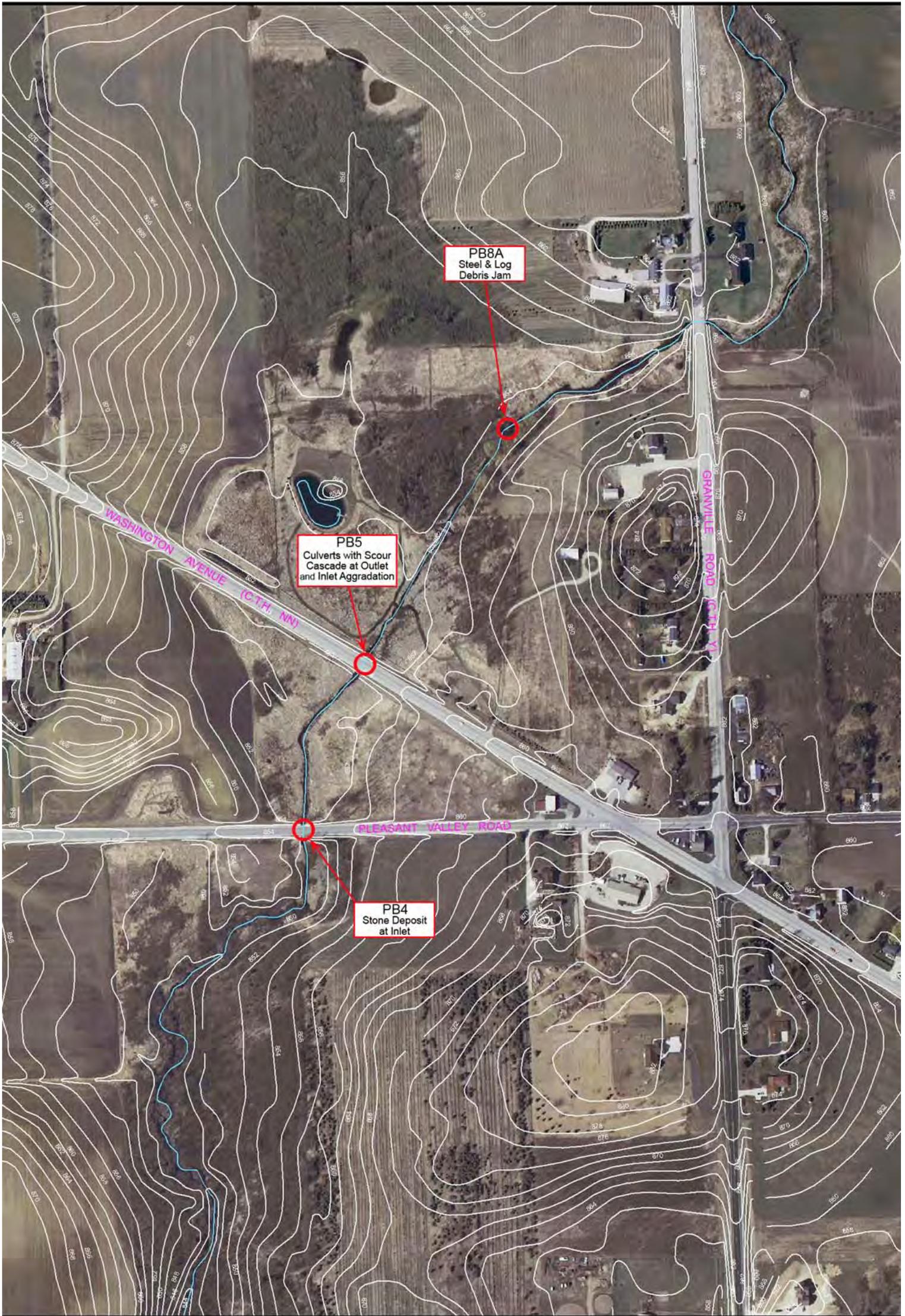
CEDAR CREEK

0 55 110 220 330 440
Feet

Wisconsin Coastal Management - Ozaukee County PLRM Department
Mud Lake Outlet - Sheet 1

Scale = 1:3,000





PB8A
Steel & Log
Debris Jam

PB5
Culverts with Scour
Cascade at Outlet
and Inlet Aggradation

PB4
Stone Deposit
at Inlet



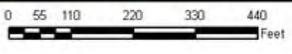
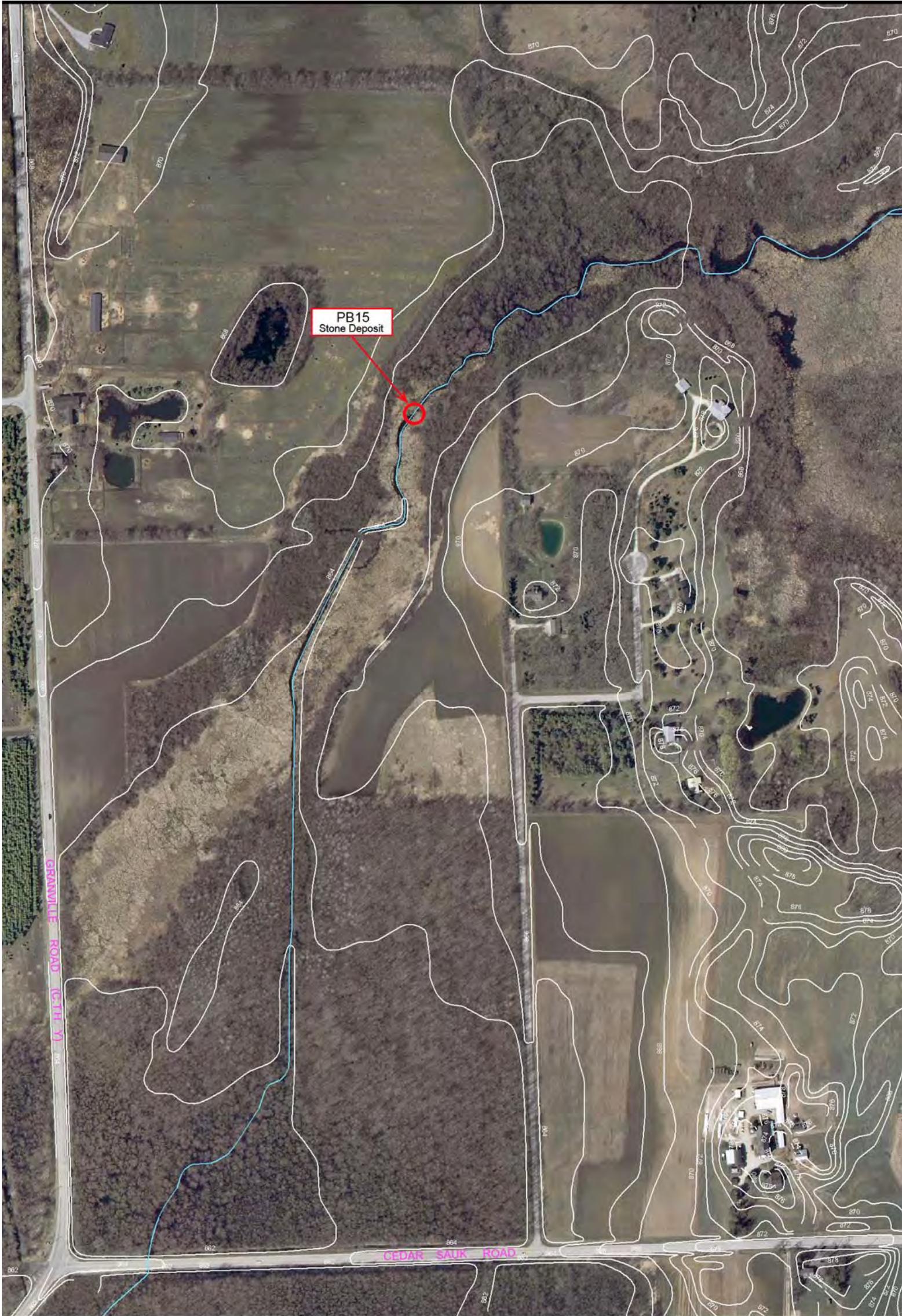


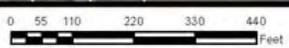
PB12
Channel Lost to
Vegetation Overgrowth

Potentially Suitable
N. Pike Spawning
Habitat

PB10
Channel Lost to
Vegetation Overgrowth







APPENDIX F

RIVER EDGE CREEK SUMMARY – BARRIERS AND HABITAT

RIVER EDGE CREEK SUMMARY – BARRIERS AND HABITAT

General Description

River Edge Creek (the Creek) originates from a small unnamed lake (Unnamed Lake 3) and disperses into a shallow flooded marsh complex before flowing through the forested riparian corridor in local agricultural land and the River Edge Nature Preserve. It outlets to the Milwaukee River is just north of Newburg, Wisconsin. Considerable flow was observed on September 13, 2006 in all reaches downstream of the marsh complex suggesting a perennial regime, although the Wisconsin Conservation Department's 1963 publication *Surface Water Resources of Ozaukee County* indicates the Creek historically became intermittent during drought years.

The Creek has both a moderate-gradient section and low-gradient sections. The moderate-gradient section (0.009 ft/ft) extends approximately 3000 feet southeast of County Highway Y, has a stable channel, clean cobble and pebble bed, and swift flow velocity even during low-flow. Lower-gradient sections include the small Milwaukee River confluence reach northwest of County Highway Y as well as the moderately-steep wetland and agricultural-flanked reaches (0.004 ft/ft overall gradient) upstream of the moderate-gradient reach. These low-gradient reaches had fine silt and much beds, slow-flowing water, and dense bank vegetation. Inspecting high-resolution aerial photographs revealed thirteen potential sites, and four additional potential sites were identified during site inspections.

Suspected Barriers

Of the seventeen potential sites identified and evaluated, twelve were classified as suspected barriers to fish access, egress, or both. Of the twelve suspected barriers, the five that likely cause the greatest fragmentation are:

- ▲ Channel loss due to red osier dogwood overgrowth at the creek mouth (RE PB1; Photograph 1)
- ▲ Overly-narrow County Highway Y bridge abutments (RE PB3)
- ▲ Log jam at narrow abutments of walking trail bridge (RE PB4)
- ▲ The perched culvert under a farm crossing midway up the Creek (RE PB8; Photograph 2)
- ▲ Channel loss due to flow dispersion (not infiltration) in a marsh complex (RE PB9, PB11, and PB12A; Photograph 3)

Several other suspected barriers, including pervious rock fill (RE PB7), natural woody-debris jams with scour cascades (RE PB8A – PB8C; Photograph 4), and a long undersized road culvert (RE PB12) were identified and evaluated. In addition, many of the reaches flowing through the River Edge Nature Preserve are moderate gradient. Swift spring flow velocities within this relatively higher gradient profile alone will likely impede northern pike passage. Further, the perched culvert (RE PB8) prevents access to the headwater marsh complex, and the perched culvert (RE PB8), channel loss in the marsh complex (RE PB9, PB11, and PB12A), and an undersized culvert near the Unnamed Lake 3 outlet (RE PB12) prevent access from that lake. The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

Two desirable northern pike-spawning habitats were identified. These included Unnamed Lake 3 and the shallow marsh complex directly downstream of it. Both have a dense hydrophyte community but are isolated from the Milwaukee River by numerous barriers.

Suspected Barrier Photographs



Photograph 1 – Channel lost to densely ingrown red osier dogwood near Milwaukee River confluence (RE PB1)



Photograph 2 – Perched culvert outlet under farm crossing (RE PB8)



Photograph 3 – Channel lost to dispersion in wetland (RE PB9)

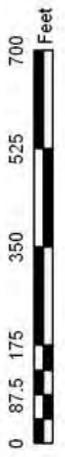


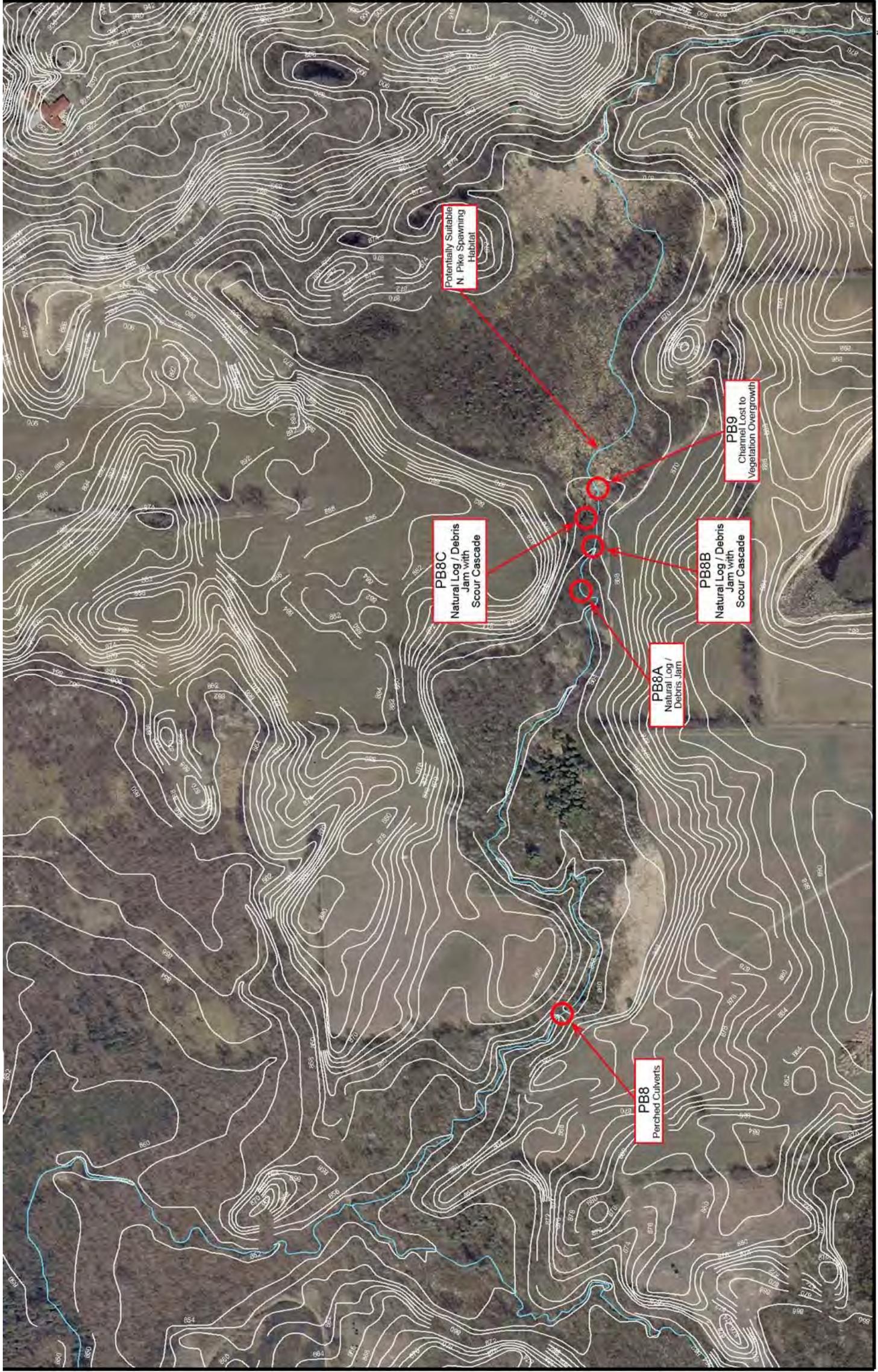
Photograph 4 – Natural wood debris jam and slow-water pool (RE PB8A)



Scale = 1:3,000

Wisconsin Coastal Management - Ozaukee County PLRM Department
Riveredge Creek - Sheet 1







Wisconsin Coastal Management - Ozaukee County PLRM Department
Riveredge Creek - Sheet 3

Scale = 1:3,000



APPENDIX G

SUCKER CREEK SUMMARY – BARRIERS AND HABITAT

SUCKER CREEK SUMMARY – BARRIERS AND HABITAT

General Description

Sucker Creek (the Creek) is directly tributary to Lake Michigan; has intermittent flow; and can be generally divided into two sections. The first is a moderately low gradient (0.006 ft/ft) section with cobble and pebble bed materials that extend from the Lake Michigan outlet upstream to Lake Drive north of Port Washington, Wisconsin (Photograph 1). This section traverses a predominantly forested riparian corridor and only very low (i.e., less than 1-inch depth) flow was observed during a September 11, 2006 field investigation. The second section makes up the remainder of the creek. It has a very-low gradient (0.0009 ft/ft), fine silt and muck bed materials, scattered pools of standing water, and was historically channelized in many areas. This section passes through largely agricultural lands with a narrow forested or reed canary grass riparian corridor. Adjacent agricultural land-use and silt bed materials were also noted in the Wisconsin Conservation Department's 1963 publication *Surface Water Resources of Ozaukee County*.

“A small, shallow drainage stream originating above Lake Church and entering Lake Michigan above Port Washington. Several intermittent streams enter the creek throughout its length. Fishery value is low with only forage minnows and suckers present. Pollution from barnyards and other sources detracts from its value. The bottom is predominantly gravel, which is covered with silt in the lower regions.”

Inspecting high-resolution photographs revealed 25 potential sites.

Suspected Barriers

Of the 25 potential sites identified, eight were classified as suspected barriers following field investigation and six were inaccessible to field inspection but classified as suspected barriers. The fourteen suspected barriers included:

- ▲ Lake Michigan outlet sediment bar (SC PB1; Photograph 2)
- ▲ A narrow-abutment bridge under Lake Drive with sediment aggraded at the inlet and pervious fill placed downstream (SC PB6)
- ▲ Six road crossings, including inaccessible I-43 crossings, that are extremely long passages (SC PB7 – PB10, PB22, and PB25)
- ▲ A constricted and concrete-lined channel under the Sandy Beach Road crossing (SC PB12; Photograph 3)
- ▲ Culverts at three farm-crossings that constrict the channel and alter local channel morphology (SC PB13, PB 15, and PB18; Photograph 4)
- ▲ One inaccessible farm-crossing the landowner indicates is a concrete culvert (SC PB17)
- ▲ A large culvert under Cedar Beach Road that alters local channel morphology and has sediment aggraded at the inlet (SC PB16)

No additional suspected barriers were identified during site inspections for remotely identified potential sites. The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

The moderately-low gradient section has clean cobble and pebble bed materials, suggesting it may have swift spring flows that are naturally impassable to northern pike. Also, little suitable habitat was observed

downstream of Lake Drive. A local resident did report that Chinook salmon ascended this section of the Creek during the 1970s.

Much of the low-gradient section is channelized. Although monotypic reed canary grass stands cover the majority of the banks, some reaches of the channel appear entrenched and riparian zones are generally narrow. As such, the low-gradient section generally has some northern pike-spawning habitat value. One exception is a floodplain wetland with channel connectivity observed in the areas adjacent to Jay Road. This wetland appears to be characteristic of good northern pike-spawning habitat. Regardless, the low-gradient section as a whole is largely fragmented and isolated by fourteen suspected barriers.

Suspected Barrier Photographs



Photograph 1 – Moderately low gradient channel near High Point Beach Road



Photograph 2 – Sediment bar at Lake Michigan outlet (SC PB1)



Photograph 3 – Constricted and concrete-lined channel (SC PB12)



Photograph 4 – Channel constricted by culvert and pervious stone fill (SC PB18)



PB1
Sand Bar

LAKE
MICHIGAN

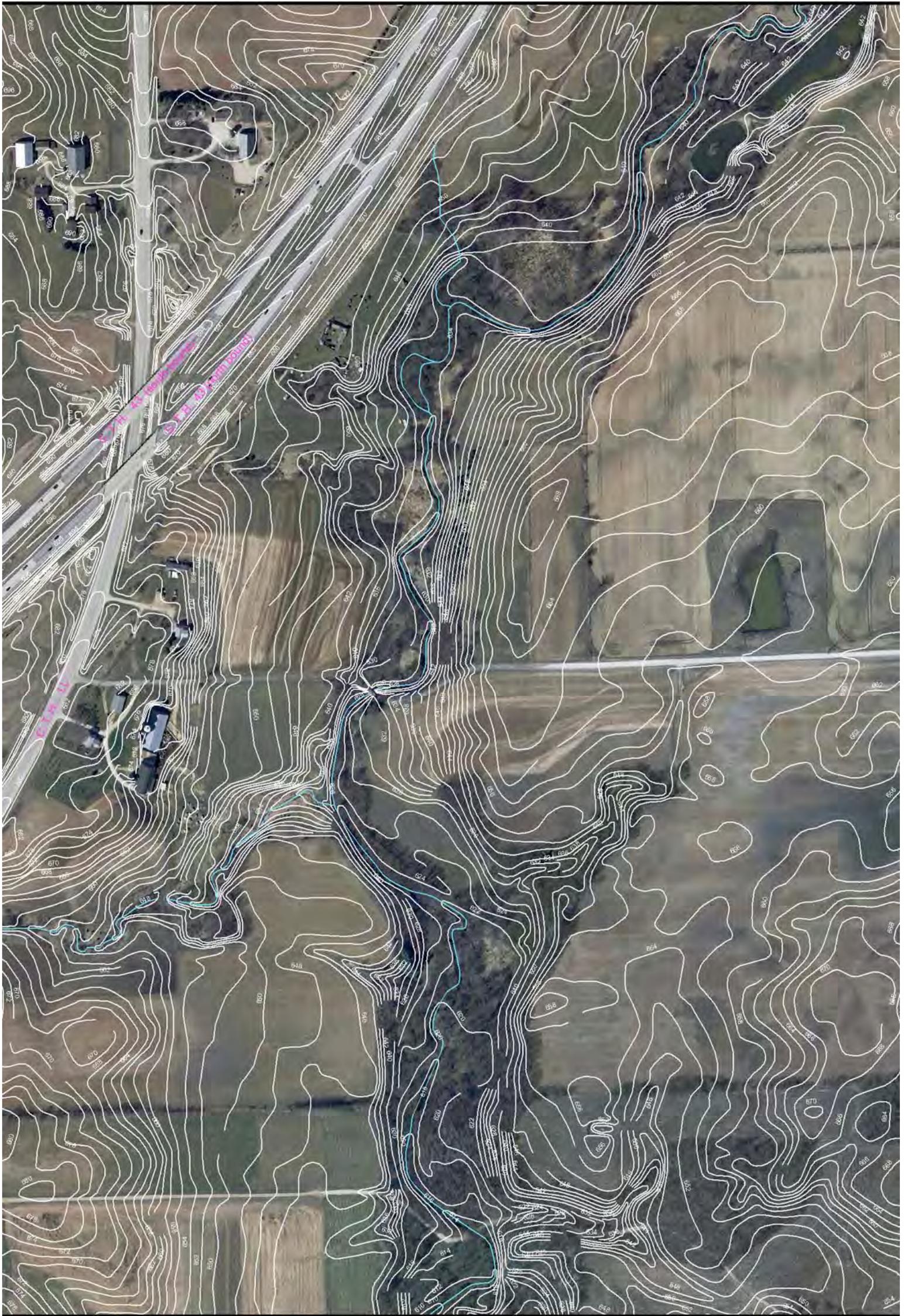
0 62.5 125 250 375 500
Feet

Wisconsin Coastal Management - Ozaukee County PLRM Department

Sucker Creek - Sheet 1

Scale = 1:3,000

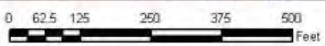


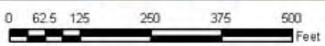
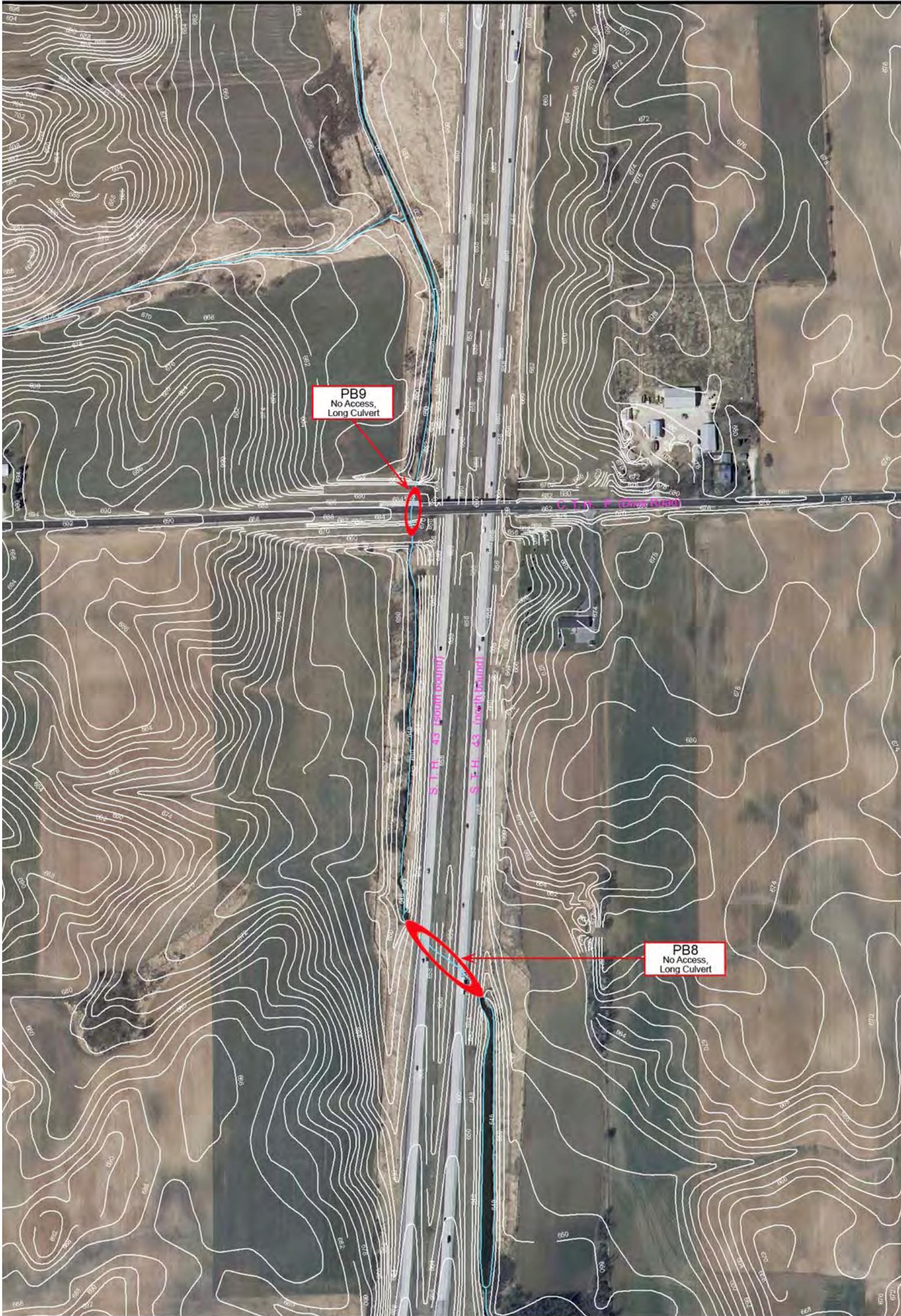




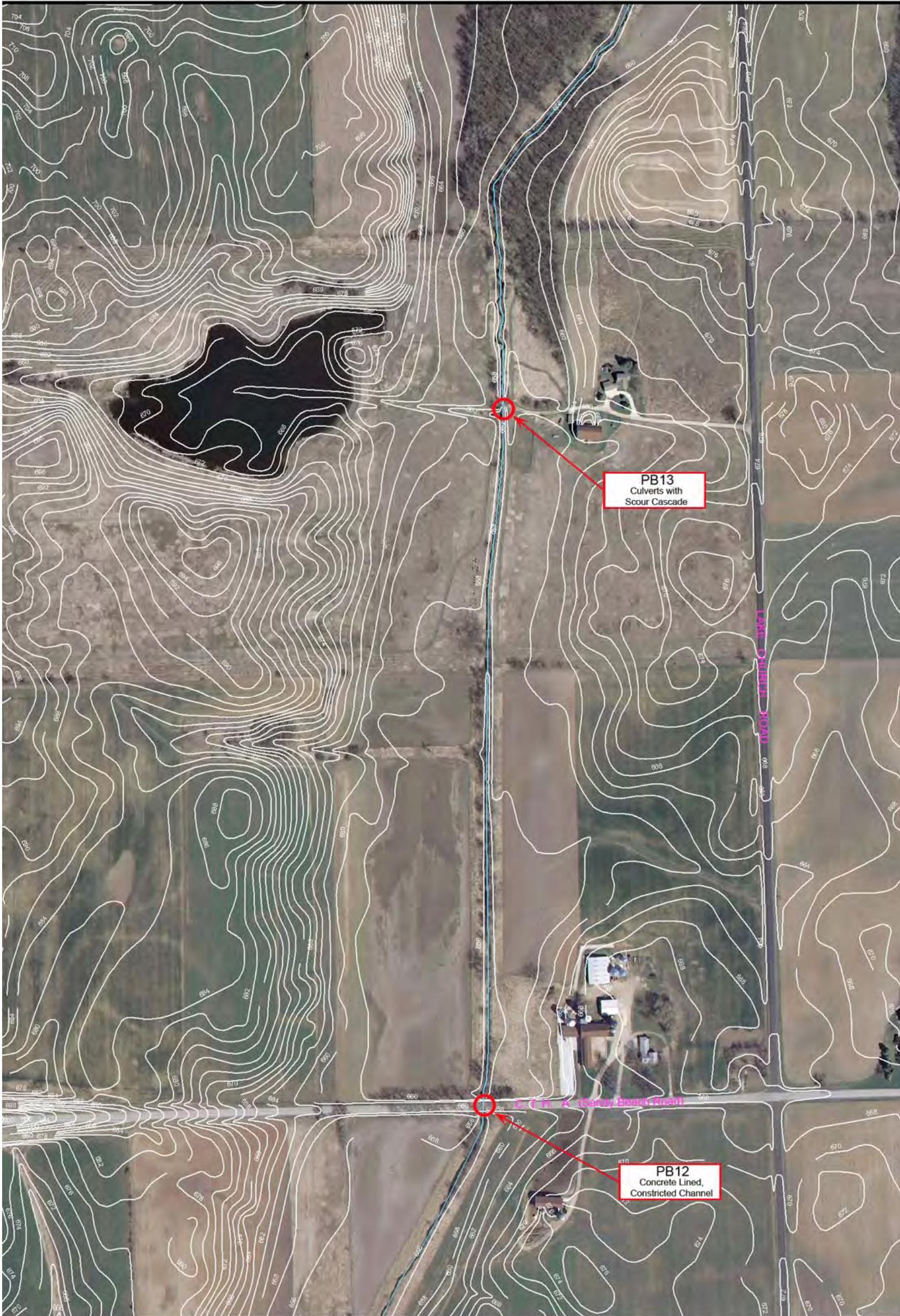
PB7
No Access,
Presume Barrier

PB6
Narrow Abutments,
Inlet Aggraded,
Pervious Stone
Deposit



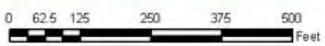


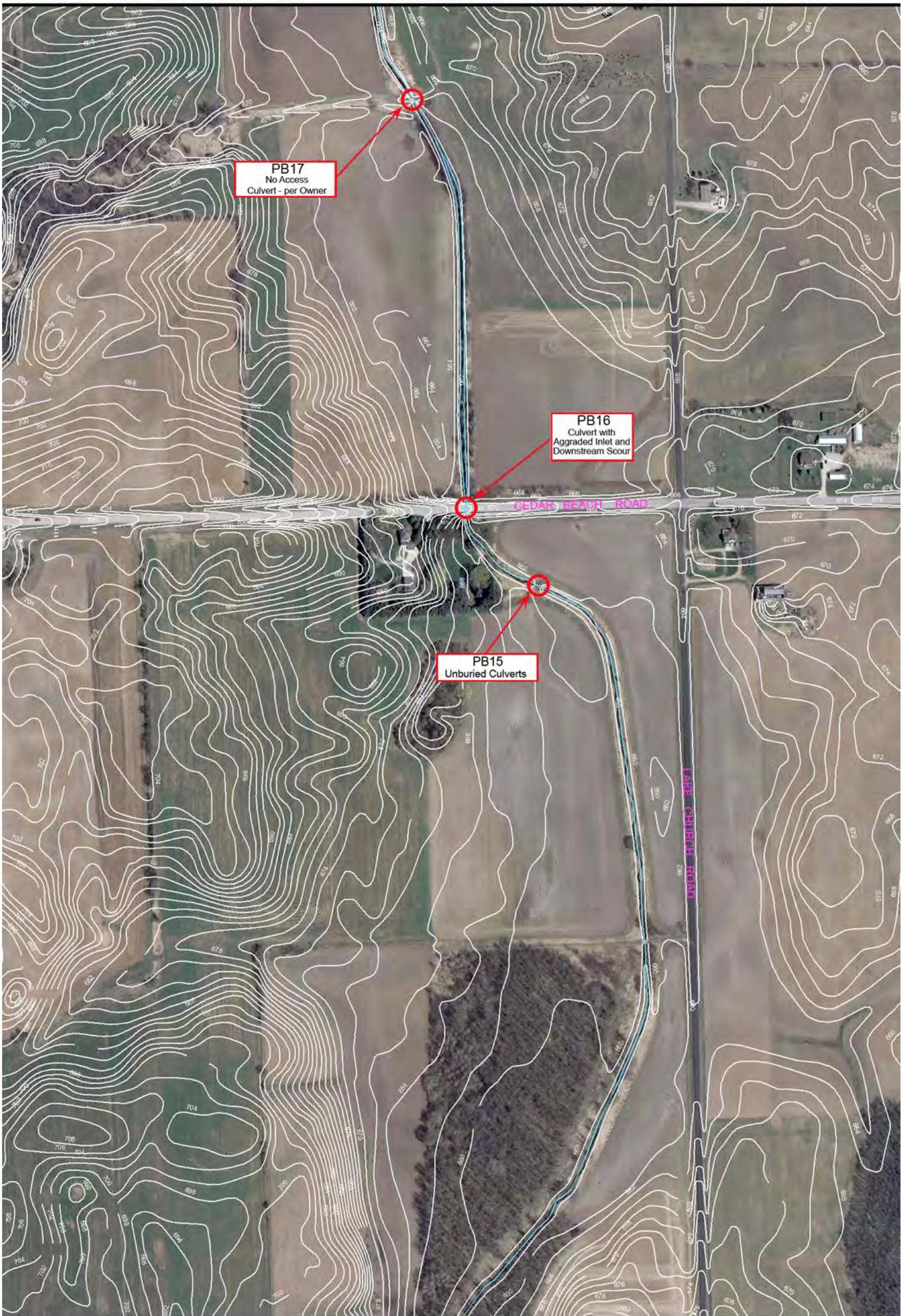




PB13
Culverts with
Scour Cascade

PB12
Concrete Lined,
Constricted Channel





PB17
No Access
Culvert - per Owner

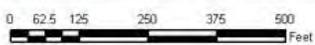
PB16
Culvert with
Aggraded Inlet and
Downstream Scour

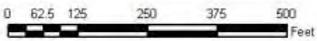
PB15
Unburied Culverts

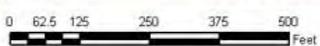


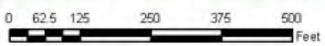


PB18
Constricting Culvert,
Stone Deposit at Inlet











PB25
No Access,
Long Culverts

Potentially Suitable
N. Pike Spawning
Habitat

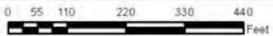
Potentially Suitable
N. Pike Spawning
Habitat

0 62.5 125 250 375 500
Feet

Wisconsin Coastal Management - Ozaukee County PLRM Department
Sucker Creek - Sheet 12

Scale = 1:3,000





APPENDIX H

TRINITY CREEK SUMMARY – BARRIERS AND HABITAT

TRINITY CREEK SUMMARY – BARRIERS AND HABITAT

General Description

Trinity Creek (the Creek) has two branches that converge at the Trinity Creek wetland habitat area in Mequon, Wisconsin to form the main branch (the Main Branch) that flows to the Milwaukee River east of North Cedarburg Road. The south branch of Trinity Creek (the South Branch) passes through a largely agricultural (active or fallow) area; has a low channel gradient (0.003 ft/ft); and a bed made of silt, clay, and other fine particles. Much of the north branch of Trinity Creek (the North Branch) flows through land that has been developed for residential or commercial uses. The North Branch has a moderately low gradient (0.005 ft/ft) that is only slightly steeper than that of the South Branch. The North Branch channel is channelized and/or entrenched in many places and the bed is made of silt and other fine-particle materials like those of the South Branch. The general riparian land uses and channelization observed during this study were also documented in the Wisconsin Conservation Department's 1963 publication *Surface Water Resources of Ozaukee County*.

“...a small, slow moving drainage stream flowing eastward into the Milwaukee River. It flows through an urban area in the lower region. The stream channel is straightened and agricultural drainage is its major use. No sport fish are known to be present.”

Flowing water was observed in the perennial Main Branch between the Trinity Creek wetland habitat area and the Milwaukee River during field investigations of September 25 and 26, 2006. Although flowing, this water had a very foul odor, suggesting high organic loading and decomposition. Standing water was observed in the Trinity Creek Wetland Habitat Area ponds was also observed. The North and South Branches have intermittent flow. By inspecting high-resolution aerial photographs, 25 potential sites were identified. During field inspections, three additional potential sites were identified.

Suspected Barriers

Of the 28 potential sites identified, twelve were classified as suspected barriers following field inspection and two more were inaccessible, and therefore considered suspected barriers. The eleven suspected barriers most likely to fragment the Creek include:

- ▲ Riprap fill blocking the inlet to one of the two culverts under North Cedarburg Road (TC PB2; Photograph 1)
- ▲ Railroad ballast, riprap, and ingrown vegetation that partially constricts the channel (TC PB3)
- ▲ Steel grates, stop logs, riprap channel lining, and channel constriction at three concrete dams in the Trinity Creek wetland habitat area (TC PB3A, PB3B, and PB5, Photograph 2)
- ▲ A series of three road crossings where the channel was artificially widened to accommodate large corrugated metal culverts and densely ingrown vegetation (TC PB8, PB9, and PB10), sediment aggradation (TC PB10), and a debris jam (TC PB9) have formed
- ▲ A relatively large stone cascade formed by riprap stone placed at the inlet of a box culvert (TC PB11; Photograph 3)
- ▲ A farm crossing with two unburied culverts that have less than 6 inches of water depth during bankfull flow events (TC PB21; Photograph 4)
- ▲ A cattail marsh surrounded by sandbar willows where the channel disperses and is lost (TC PB22A)

Along the South Branch, two non-road crossings (TC PB18 and PB19) were inaccessible and a slightly undersized corrugated metal culvert (TC PB20) buried in a dense clay bed channel with no sediment along the culvert bottom also observed. Field inspection of North Branch potential sites was truncated at a large riprap stone cascade north of Donges Bay Road (TC PB11) because flow upstream of there no longer appeared to be channelized and instead flowed through a grassy swale completely ingrown with dense reed canary grass where the potential for juvenile egress appeared extremely unlikely. The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

Two areas where habitat conditions appeared favorable for northern pike spawning were identified. The first is littoral pond habitat in the Trinity Creek wetland habitat area. The close proximity of these ponds to the Milwaukee River, flooded site hydrology, and littoral vegetation are all suitable for northern pike spawning. A second area of potential spawning habitat was found near the South Branch headwater. This shallow cattail and sandbar willow marsh (TC PB22A) north of County Line Road and west of Wauwatosa Road is unlikely passable to fish but under flooded conditions may be suitable for spawning.

Suspected Barrier Photographs



Photograph 1 – Riprap fill blocking inlet to culvert under North Cedarburg Road (TC PB2)



Photograph 2 – Trinity Creek wetland habitat area concrete dam with steel gate (SC PB5)



Photograph 3 – Artificial cascade formed by stone riprap at box culvert inlet (SC PB11)



Photograph 4 – Culverts with low internal water depth during high flow conditions (SC PB21)



Scale = 1:3,000

Wisconsin Coastal Management - Ozaukee County PLRM Department
 Trinity Creek - Sheet 1





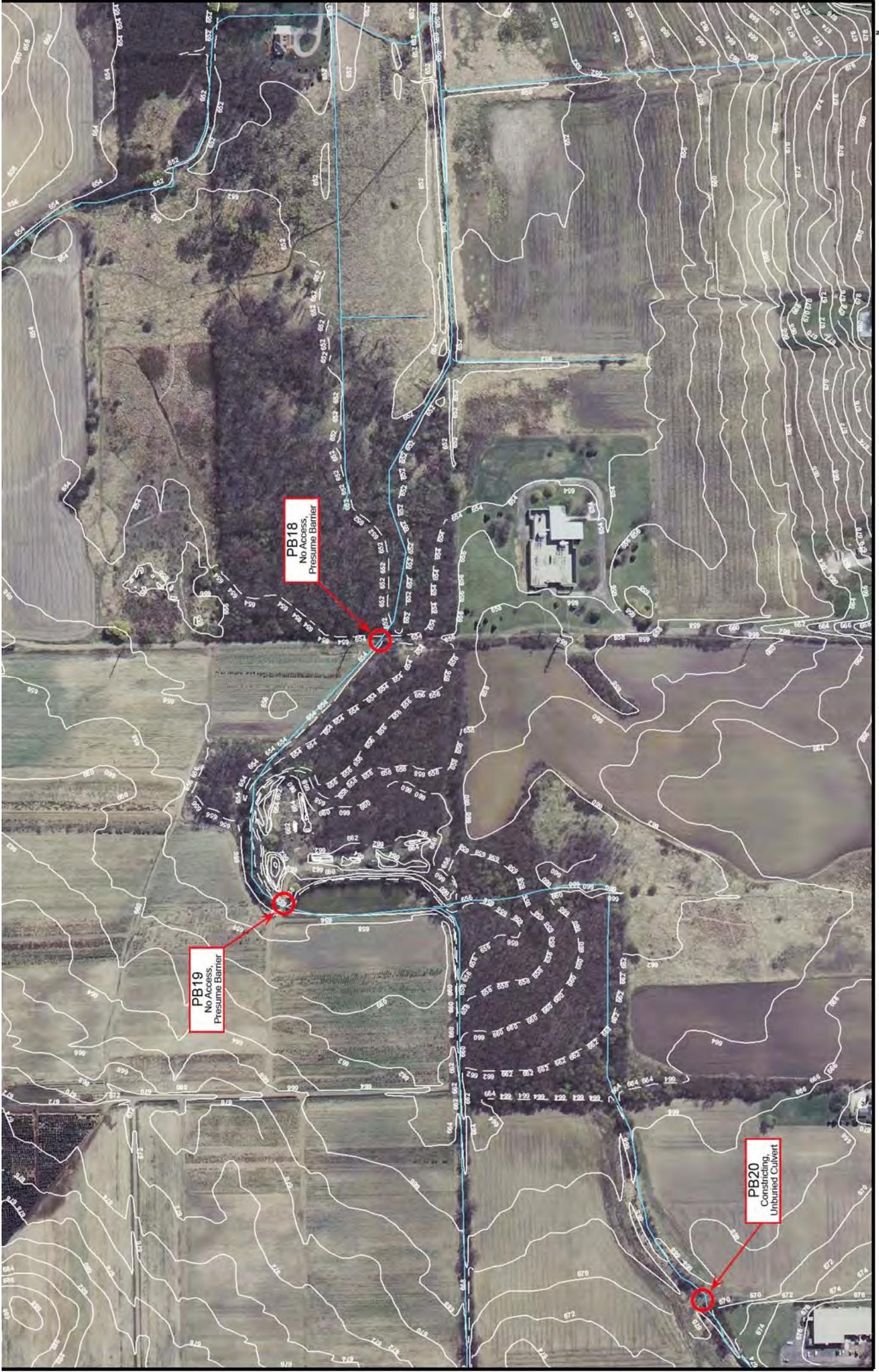
PB8
Channel Widened for
Culverts, Inlet Overgrown
with Vegetation

Potentially Suitable
N. Pike Spawning
Habitat

Potentially Suitable
N. Pike Spawning
Habitat

PB5
Dam with
Gated Spillway

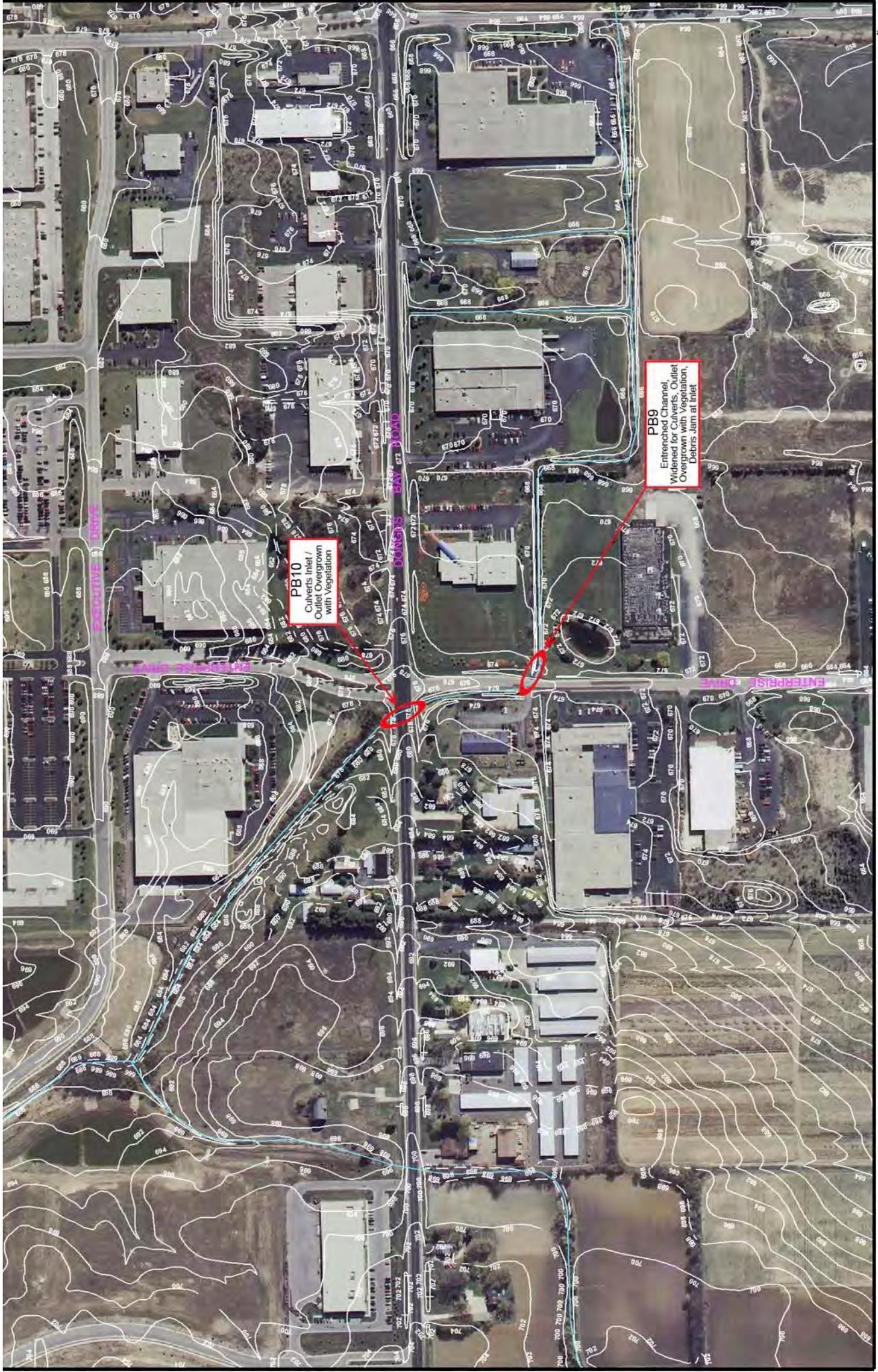




Scale = 1:3,000

Wisconsin Coastal Management - Ozaukee County PLRM Department
Trinity Creek South - Sheet 3







PB11
Riprap Cascade and
Culvert Inlet, Channel
loss, Overgrown grassy
Swale Upstream



Scale = 1:3,000

Wisconsin Coastal Management - Ozaukee County PLRM Department
Trinity Creek North - Sheet 6



APPENDIX I

ULAO CREEK SUMMARY – BARRIERS AND HABITAT

ULAO CREEK SUMMARY – BARRIERS AND HABITAT

General Description

Ulao Creek (the Creek) originates in the Ulao Swamp southwest of Port Washington, Wisconsin and flows southwest to its confluence with the Milwaukee River in Mequon, Wisconsin. It has a fairly low overall gradient (0.001 ft/ft overall), a bed dominated by silt and other fine particles, and an intermittent flow regime with greatly varying discharge as documented in the Wisconsin Conservation Department's 1963 publication *Surface Water Resources of Ozaukee County*.

“...a small drainage stream formed by the joining of three intermittent streams at its head end. Eventually it flows into the Milwaukee River just above Pit Lake. Due to fluctuating water levels, sport fishery value is negligible. Portions of the stream have been straightened for agricultural drainage.”

Historically, spawning northern pike were known to have migrated all the way to Ulao Swamp. Such migrations have not been reported in recent years; however, accumulated large woody debris was manually removed from the channel in Ulao Swamp during recent years to help improve downstream flow and access to northern pike. Also, a woody debris jam located near the mouth has naturally cleared in recent years.

The Creek traverses a variety of riparian land-use types, including forest, fallow and active agriculture, and residential. A hydrologic study of the Creek by the Ulao Creek Partnership and its partners during 1997 found that some reaches of the channel “lose” water to infiltration, an interesting trait that correlates to field observations of an intermittent reach near Arrowhead Road on September 27, 2006.

By inspecting high-resolution aerial photographs, 28 potential sites were identified. In addition, three potential sites were identified during field inspections, and one was identified by an Ozaukee County Planning, Resources and Land Management Department staff member familiar with Ulao Creek.

Suspected Barriers

Following field inspections and landowner interviews on September 26 and 27, 2006, ten of the 32 potential sites were classified as suspected barriers. Of the ten suspected barriers, the seven most likely to fragment the Creek include:

- ▲ A large, vegetated sediment aggradation at the outlet of three box culverts below I-43 just south of Lakefield Road (UC PB10; Photograph 1)
- ▲ A cascade and pool formed by large stone placed to stabilize the channel at a ford (UC PB13)
- ▲ A large natural log jam and sediment aggradation that chokes most of the bankfull channel (UC PB14A; Photograph 2)
- ▲ Steel flumes stabilized with rock and soil fill that obstruct and constrict the channel (UC PB9A and PB19; Photograph 3)
- ▲ Stone ballast accumulated in the channel below a railroad bridge that reduces the channel cross section by about half (UC PB21)
- ▲ Infiltration to groundwater causes channel loss in a wetland complex near the east end of Arrowhead Road (UC PB22; Photograph 4)

Other identified suspected barriers included a woody debris jam at inlets to corrugated metal under a small farm-access road (UC PB4); a pair of long, unburied, and partially aggraded box culverts (UC PB20); and a small farm-access crossing that is presumed to be a barrier but could not be inspected because of the great distance between it and the nearest access point. The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

The three areas most indicative of northern pike spawning habitat are Ulao Swamp, an open forested floodplain near the Milwaukee River Confluence, and a reed canary grass dominated wetland southwest of the Bonniwell Road and Oriole Lane intersection. These areas have forested swamp floodplains and good channel connectivity (i.e., a non-entrenched channel) and appear to regularly flood for considerable periods of time. According to an interviewed landowner, removing excessive large woody debris from the channel in Ulao Swamp has reduced flood elevations there and helped restore downstream flow. Reed canary grass has begun to invade the channel in Ulao Swamp though and is now densely ingrown in some reaches.

A third area of potential northern pike spawning habitat is the infiltrating wetland complex (UC PB22) near the east end of Arrowhead Road. Although flow here is lost to infiltration during low-flow conditions, spring flooding wetland vegetation here may make it suitable for spawning.

Suspected Barrier Photographs



Photograph 1 – Vegetated sediment bar at outlet of box culverts under I-43 (UC PB10)



Photograph 2 – Large natural log jam with sediment aggradation (UC PB14A)



Photograph 3 – Channel constricted by steel flume stabilized with stone and soil fill (UC PB19)



Photograph 4 – Channel lost to infiltration in a reed canary grass-dominated wetland (UC PB22)



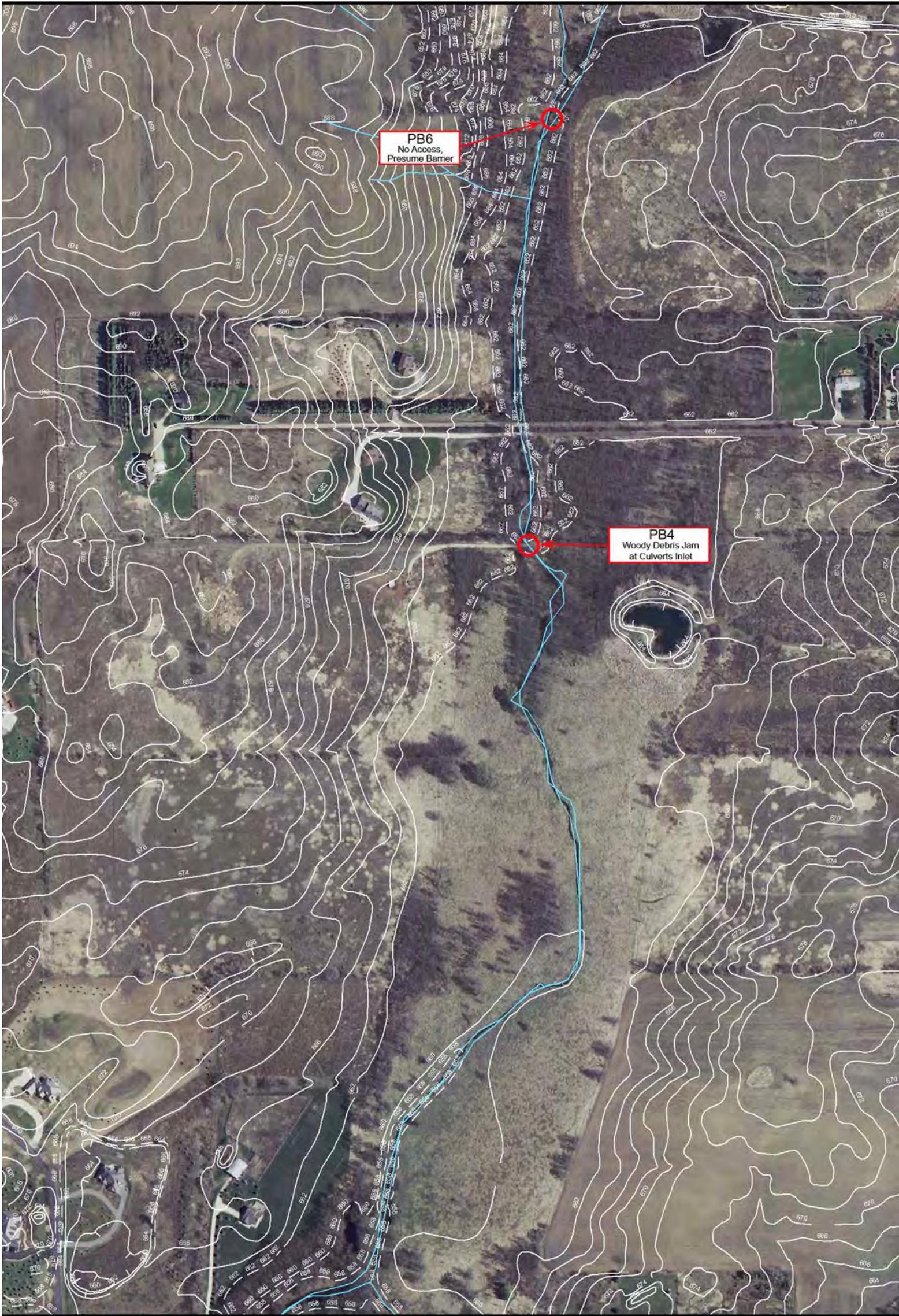


0 62.5 125 250 375 500
Feet

Wisconsin Coastal Management - Ozaukee County PLRM Department
Ulao Creek - Sheet 2

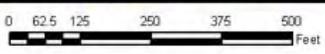
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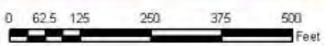
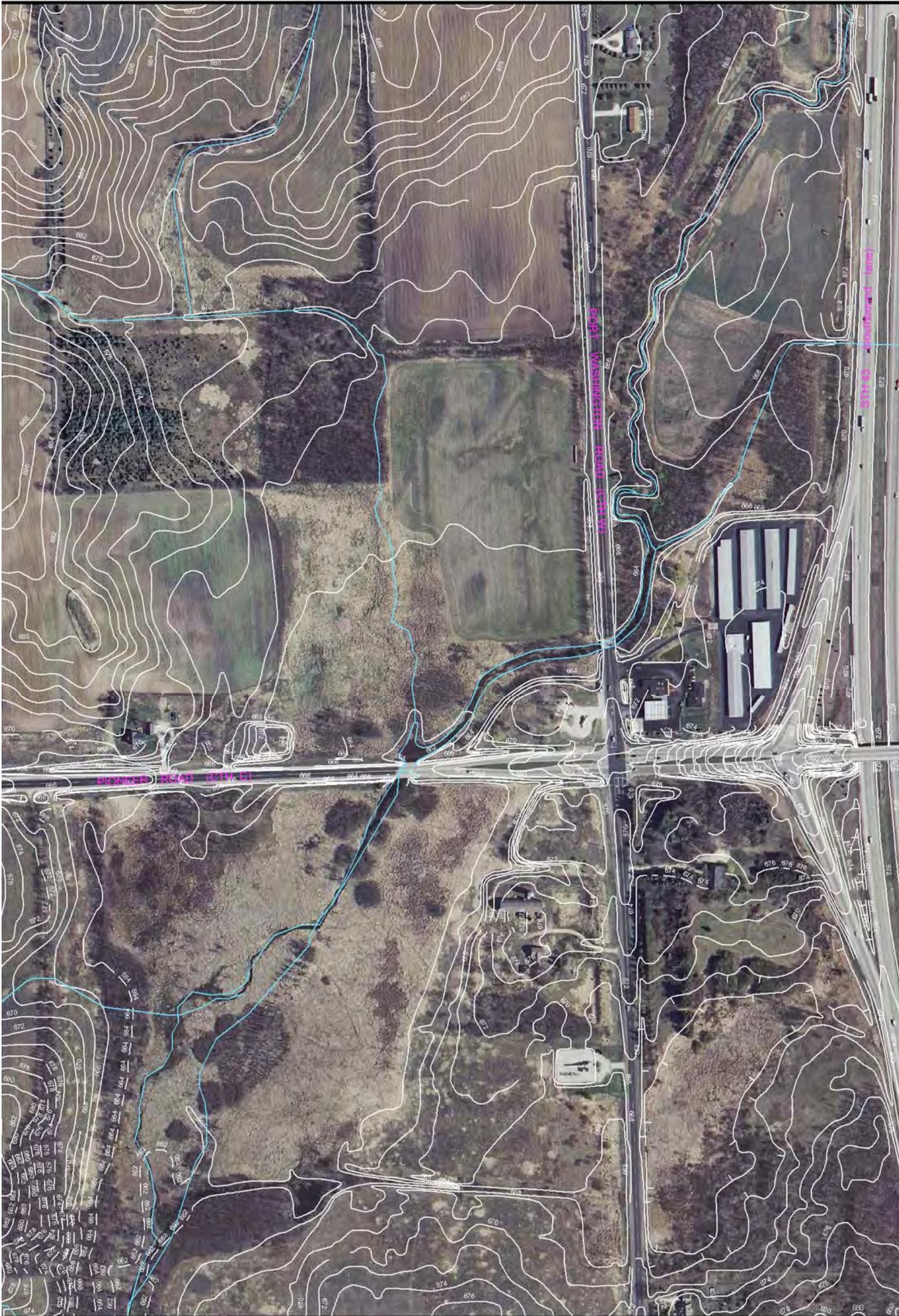




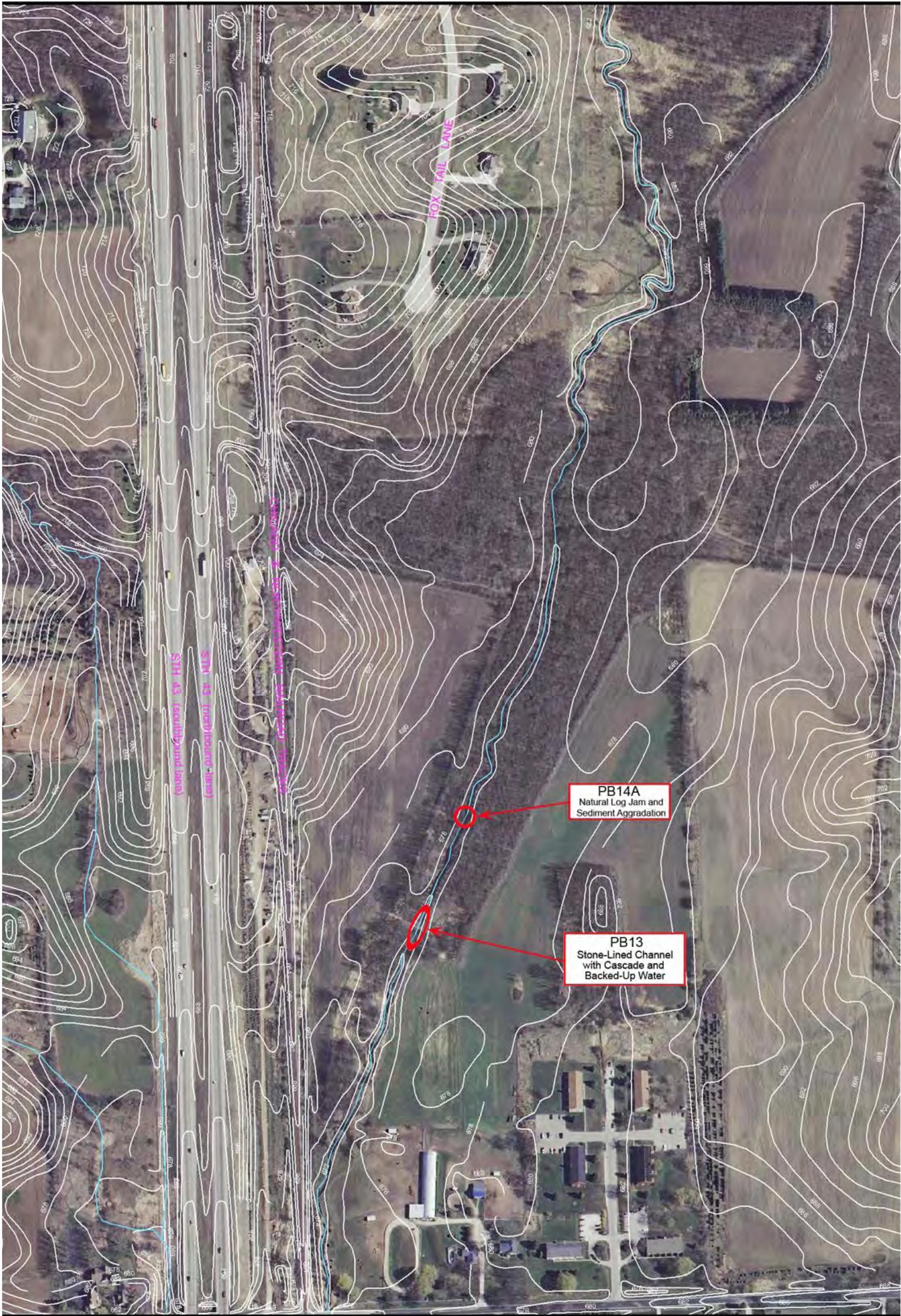
PB6
No Access,
Presume Barrier

PB4
Woody Debris Jam
at Culverts Inlet









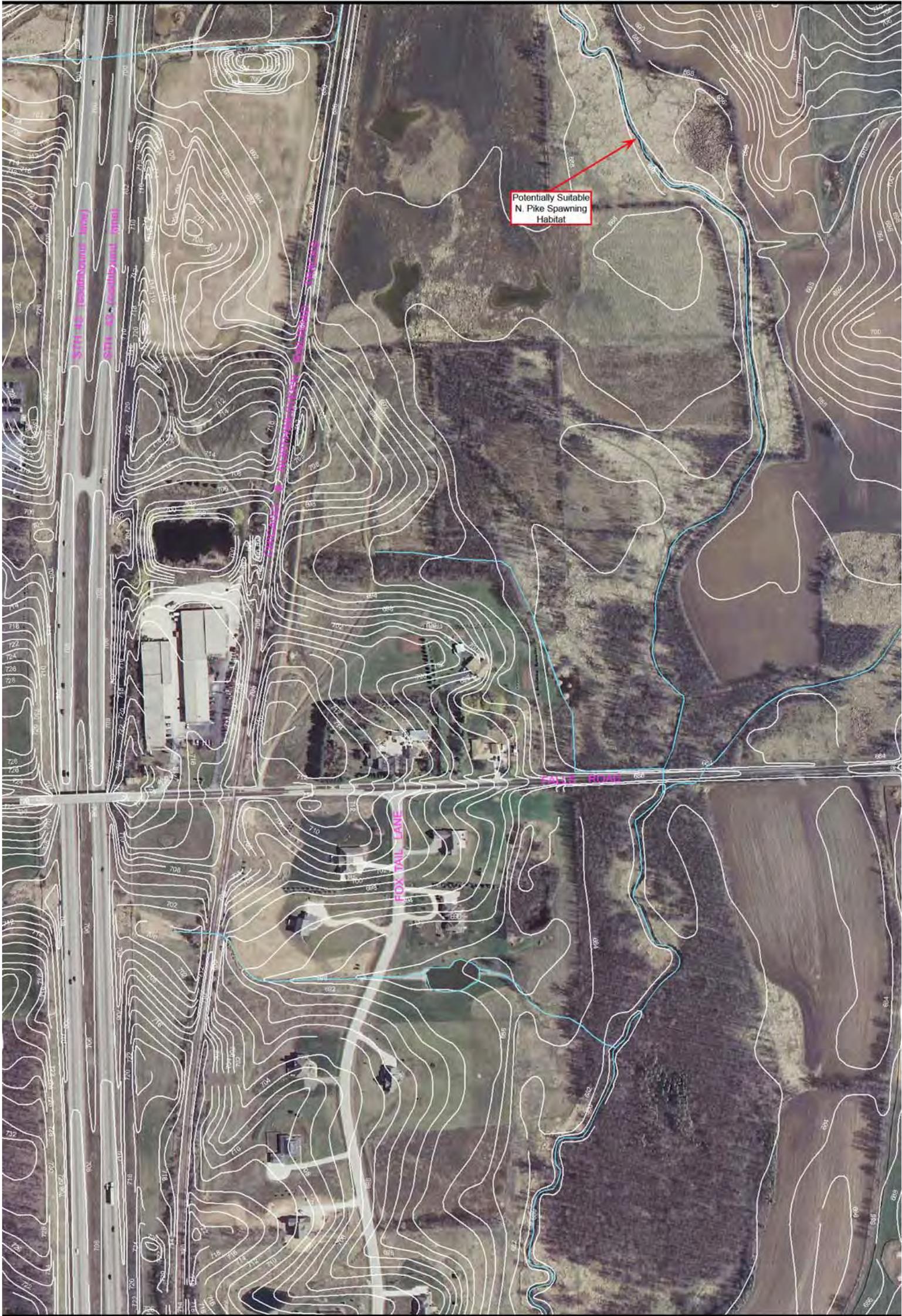
STRAIGHTENED CHANNEL
 (see plan view) 50' HWS
 (see plan view) 50' HWS

FOX TAIL LAKE

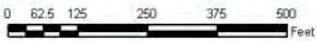
PB14A
 Natural Log Jam and
 Sediment Aggradation

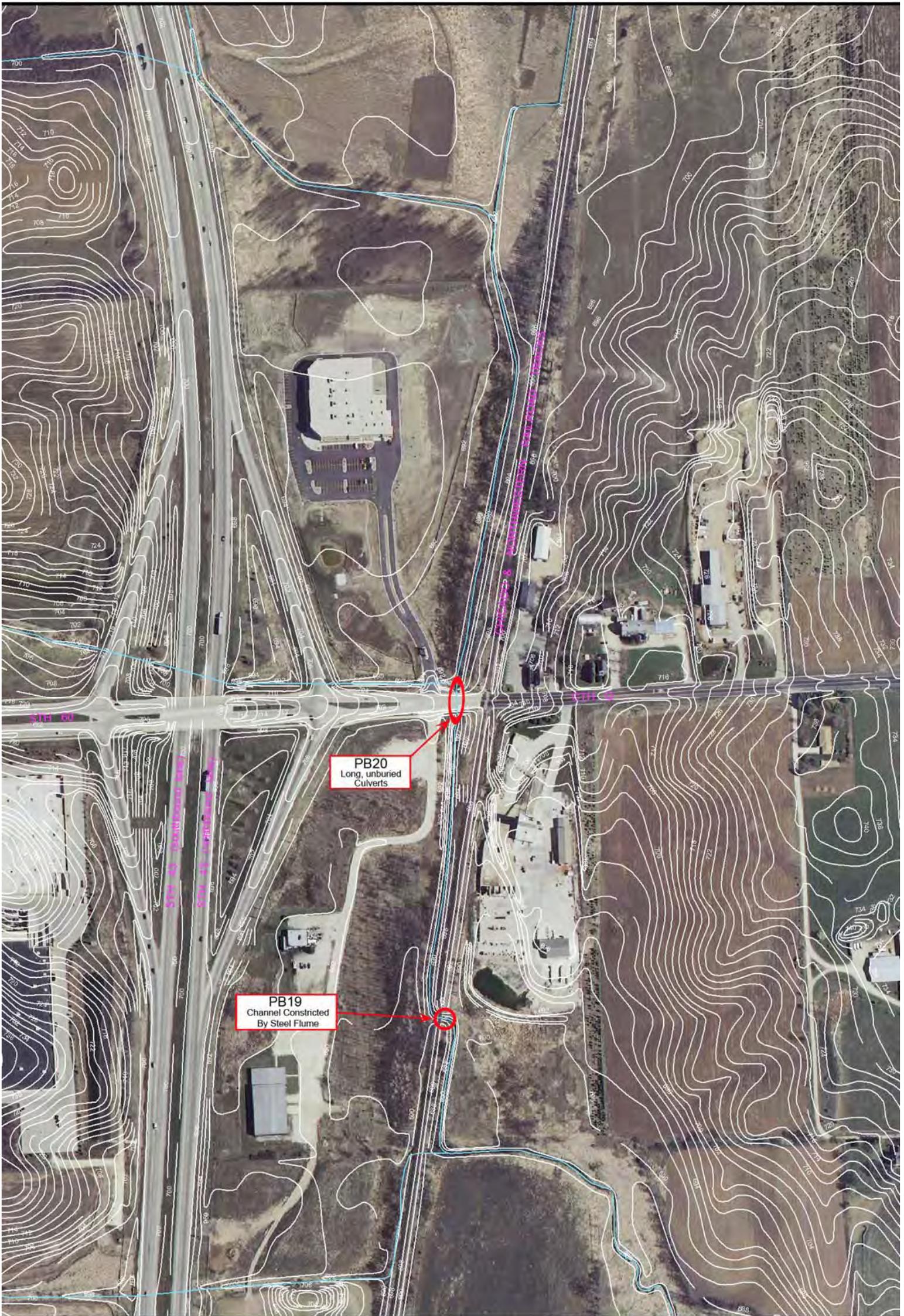
PB13
 Stone-Lined Channel
 with Cascade and
 Backed-Up Water

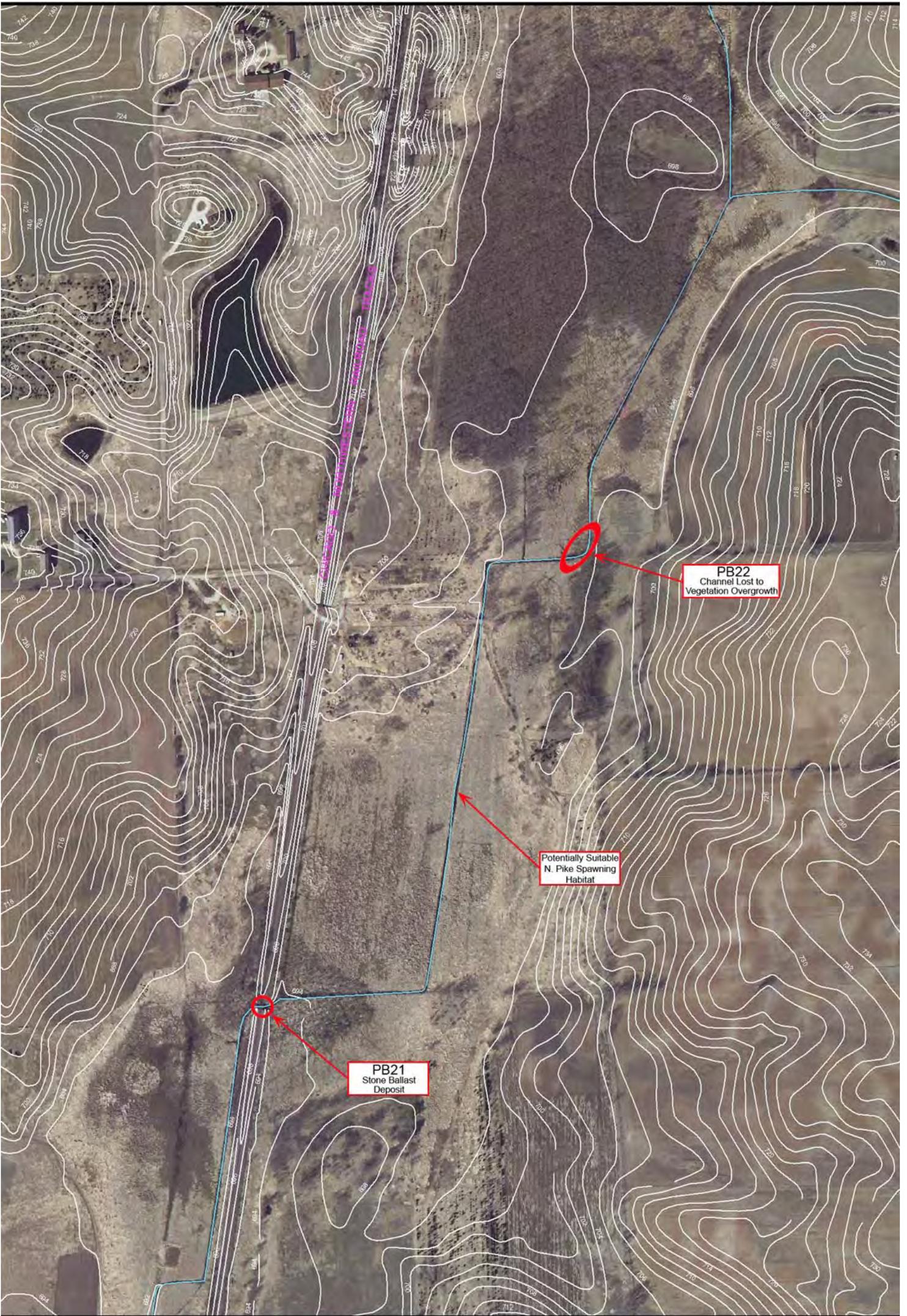


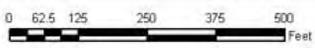
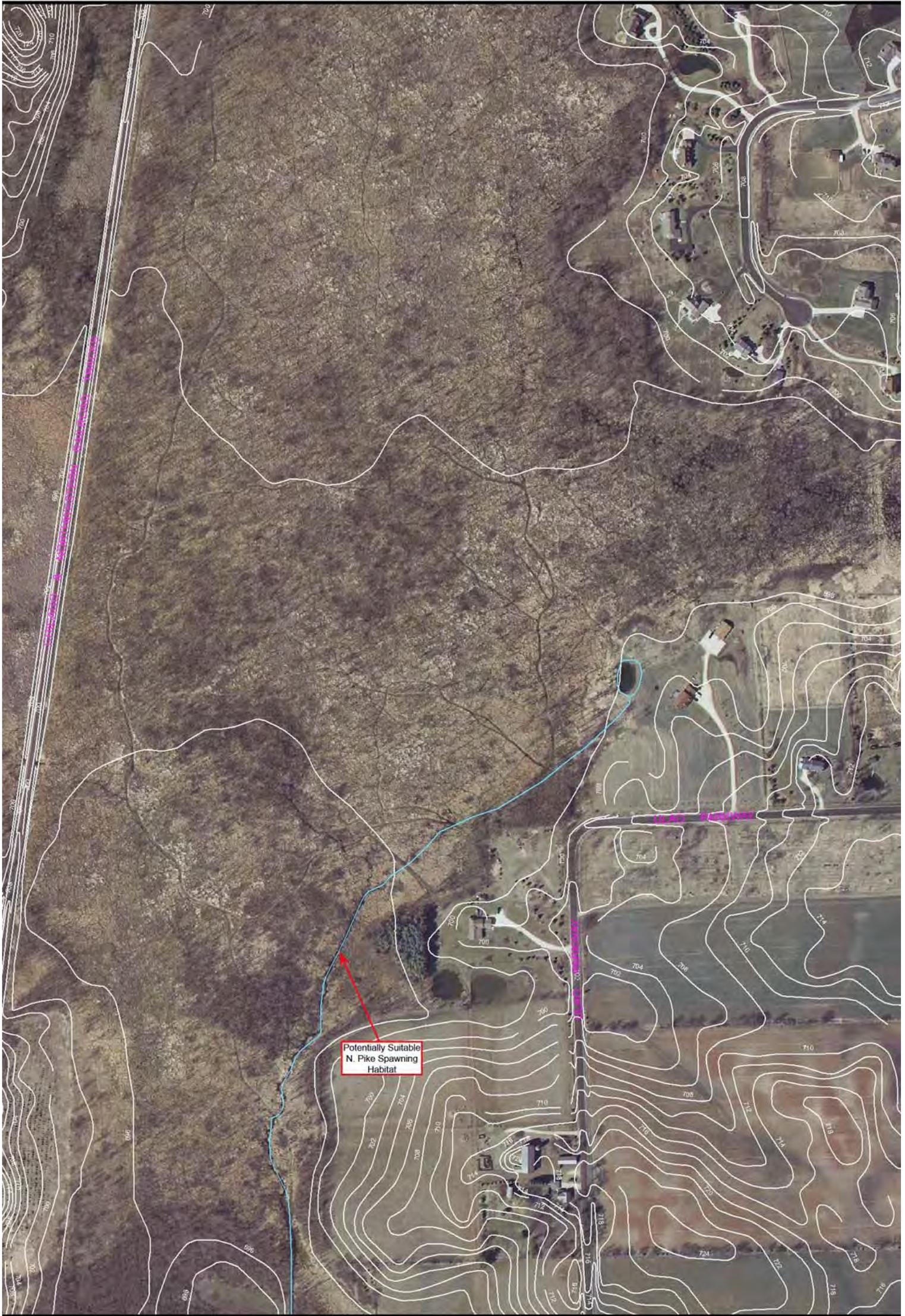


Potentially Suitable
N. Pike Spawning
Habitat









APPENDIX J

UNNAMED CREEK 1 SUMMARY – BARRIERS AND HABITAT

UNNAMED CREEK 1 SUMMARY – BARRIERS AND HABITAT

General Description

Unnamed Creek 1 (the Creek) originates from a small pond (the Pond) west of County Highway I northwest of Grafton, Wisconsin. The Creek flows intermittently and no flowing or standing water was observed during a September 6, 2006 field investigation. It traverses a relatively short distance before emptying into Cedar Creek, has a moderately-low overall gradient (0.008 ft/ft), a relatively flatter reach in floodplain wetland near its outlet, and fine silt and muck bed materials. Most of the Creek is channelized and passes through active or fallow agricultural land. Areas adjacent to the Pond and Creek (i.e., west of County Highway I) appear to be undergoing residential or commercial development (e.g., storm-water detention ponds, asphalt path, etc.). No evidence of impending development was observed along downstream reaches (i.e., east of County Highway I) where riparian areas remain forested or fallow and natural channel loss due to braiding and overgrown vegetation was observed in two reaches.

Inspecting high-resolution aerial photographs revealed two potential sites, and two additional potential sites were identified during site inspections.

Suspected Barriers

All four of the potential sites were classified as suspected barriers to aquatic life passage following the September 6, 2006 site inspections. They included:

- ▲ Natural channel loss within a large floodplain wetland that extends from the Cedar Creek confluence upstream approximately 1000 feet (UC1 PB4; Photograph 1)
- ▲ Natural channel loss to braiding and overgrown vegetation in a very-low gradient reach approximately 1500 feet upstream from the Cedar Creek Confluence (UC1 PB3; Photograph 2)
- ▲ Dual 75-foot long corrugated metal culverts under County Highway I do not constrict the channel or alter local channel morphology but may be a barrier due to their considerable length (UC1 PB1)
- ▲ A narrow culvert under a small pedestrian crossing blocked that constricts the channel, alters local channel morphology, and has pervious debris jamming the inlet (UC1 PB2; Photograph 3)

The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

Four areas of desirable northern pike-spawning habitat were observed during field inspection. The first is a large floodplain wetland extending from the Cedar Creek confluence upstream approximately 1000 feet. The Creek channel disperses upon reaching the upstream boundary of this wetland and the wetland likely isolates the Creek during all but very high flow events. It is forested but relatively open with a dense herbaceous layer dominated by reed-canary grass. Watermarks on mature trees indicate that water depths slightly less than 6 inches are common.

Two smaller wetlands were also observed. The first is connected to the Creek via a small tributary located east of County Highway I where the Creek takes a 90-degree bend. The second is located just west of the County Highway I crossing.

Finally, the littoral zone of the Pond is densely vegetated by cattails and appears to have many desirable pike-spawning habitat characteristics. The Pond outlet is also inhabited by a variety of other hydrophytic species (Photograph 4).

Suspected Barrier Photographs



Photograph 1 – Channel lost to dispersion in forested floodplain wetland (UC1 PB4)



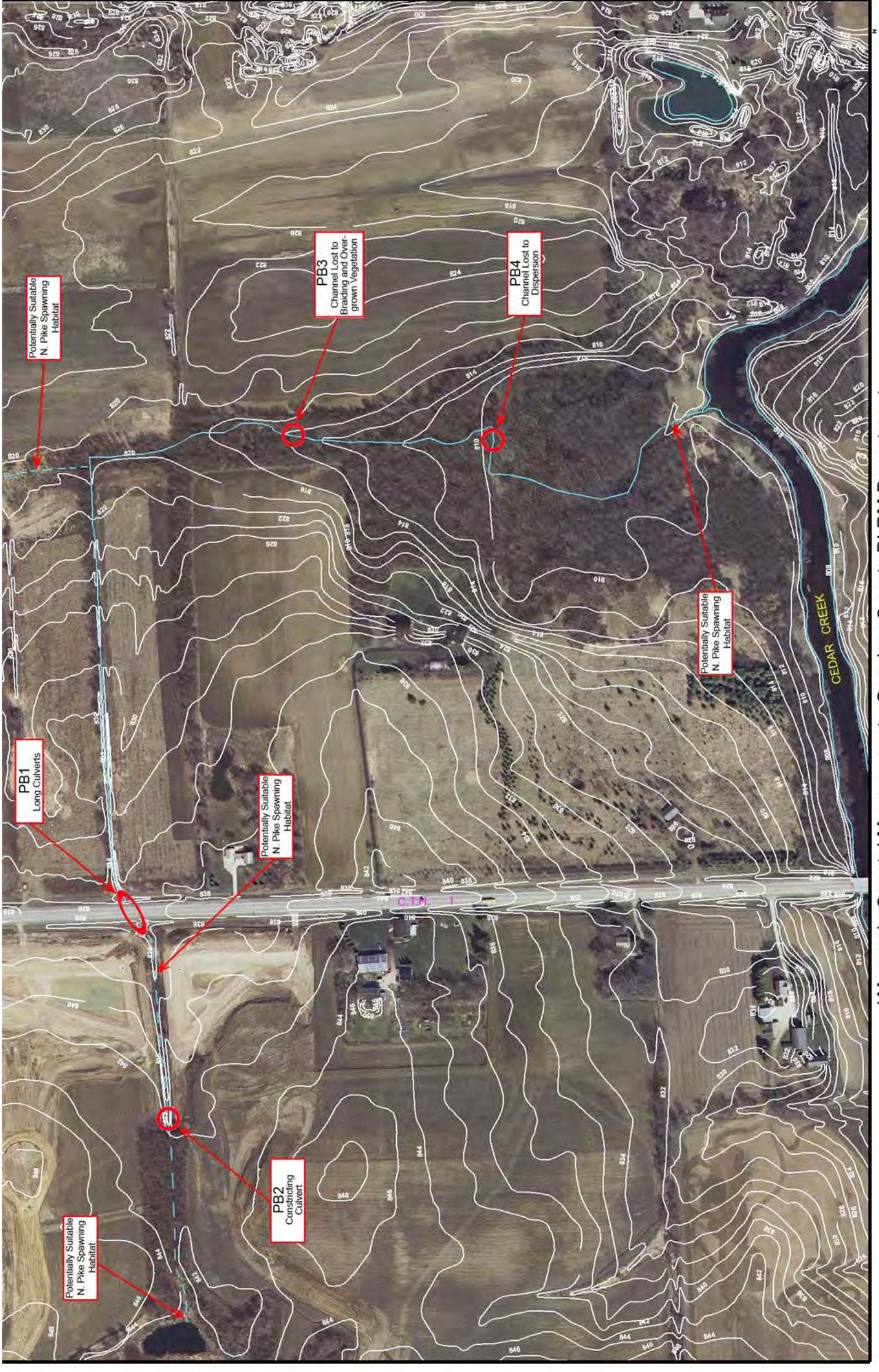
Photograph 2 – Channel lost to braiding and ingrown vegetation (UC1 PB3)



Photograph 3 – Channel constricted and scoured by a narrow culvert that has a pervious debris jam at its inlet (UC1 PB2)

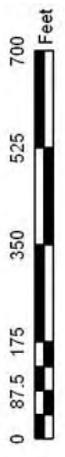


Photograph 4 – Dense vegetation along channel banks of the Pond outlet



Scale = 1:3,000

Wisconsin Coastal Management - Ozaukee County PLRM Department
 Unnamed Creek - Sheet 1



APPENDIX K

UNNAMED CREEK 2 SUMMARY – BARRIERS AND HABITAT

UNNAMED CREEK 2 SUMMARY – BARRIERS AND HABITAT

General Description

Unnamed Creek 2 (the Creek), also referred to as “Highway W Creek,” originates from agricultural fields northeast of the State Highway 57 and Meadow Lark Road intersection and flows south and west to its confluence with the Milwaukee River north of Saukville, Wisconsin. Anecdotal historical accounts of northern pike migrating up the Creek as far north as Hawthorne Drive exist, although a current long-time riparian landowner reported that only common carp now enter the creek during spring floods, and they only remain in the Creek for a few days before out migrating.

The Creek has a low overall gradient (0.002 ft/ft), a bed dominated by silt and other fine-particle materials, a channel that was historically dredged in some reaches, remains almost completely sediment-filled in others, and is ingrown by reed canary grass, sandbar willow, or cattails in many places. Sluggishly flowing water was observed on September 28, 2006 in reaches from the Milwaukee River confluence upstream to Hawthorne Road. The volume of flowing water diminished to only a small trickle at Hawthorne Road and reaches of channel filled with agricultural sediment had no visible flow during the field inspection. By inspecting high-resolution aerial photographs, nine potential sites were identified. During field inspections, one additional potential site was identified.

Suspected Barriers

Of the ten potential sites identified, six were classified as suspected barriers following field inspections and landowner interviews on September 28, 2006. Of those six suspected barriers, the five most likely to fragment the Creek include:

- ▲ Sediment aggradations and dense ingrown vegetation at the pairs of box culverts under State Highway 57 and the short frontage road immediately west of State Highway 57 (UC2 PB2 & PB3; Photograph 1)
- ▲ Channel loss due to excessive sedimentation upstream of Willow Road and densely ingrown vegetation downstream of Willow Road (UC2 PB4B; Photographs 2 and 3)
- ▲ A woody debris jam and sediment aggradation downstream of the undersized and unburied box culvert under Hawthorne Road and adjacent to reaches ingrown with sandbar willow and reed canary grass (UC2 PB7; Photograph 4)

One other suspected barrier is a farm-crossing south of Meadow Lark Road that was inaccessible (landowner unavailable to grant access) and based on the aerial photographs is likely a culvert. This crossing is presumed to be a barrier since it was inaccessible and could not be field inspected. The identified suspected barriers included both the type that can impede adult northern pike access to upstream habitats during high flow and the type that can impede juvenile egress during lower-flow conditions.

Habitat

Anecdotal historical accounts of spring northern pike migrations up the Creek indicate that both northern pike and common carp congregated in flooded agricultural fields north of Hawthorne Road and east of County Highway KK. This area is now beyond the upstream extent of recent common carp runs and is actively farmed. The only area appearing suitable for northern pike spawning habitat downstream of Hawthorne Road is a reach of open channel with dense reed canary grass-covered banks immediately east of State Highway 57 (UC2 PB3). A small pond upstream of Hawthorne Road also appears suitable for

spawning; however, its littoral zone is completely grown in with a dense cattail stand that would likely preclude adult pike access if they could reach the pond. Overall, suitable northern pike-spawning habitat is very scarce in the Creek.

Suspected Barrier Photographs



Photograph 1 – Box culverts with sediment aggradations and densely ingrown vegetation (UC2 PB2)



Photograph 2 – Channel lost to densely ingrown vegetation (UC2 PB4B)

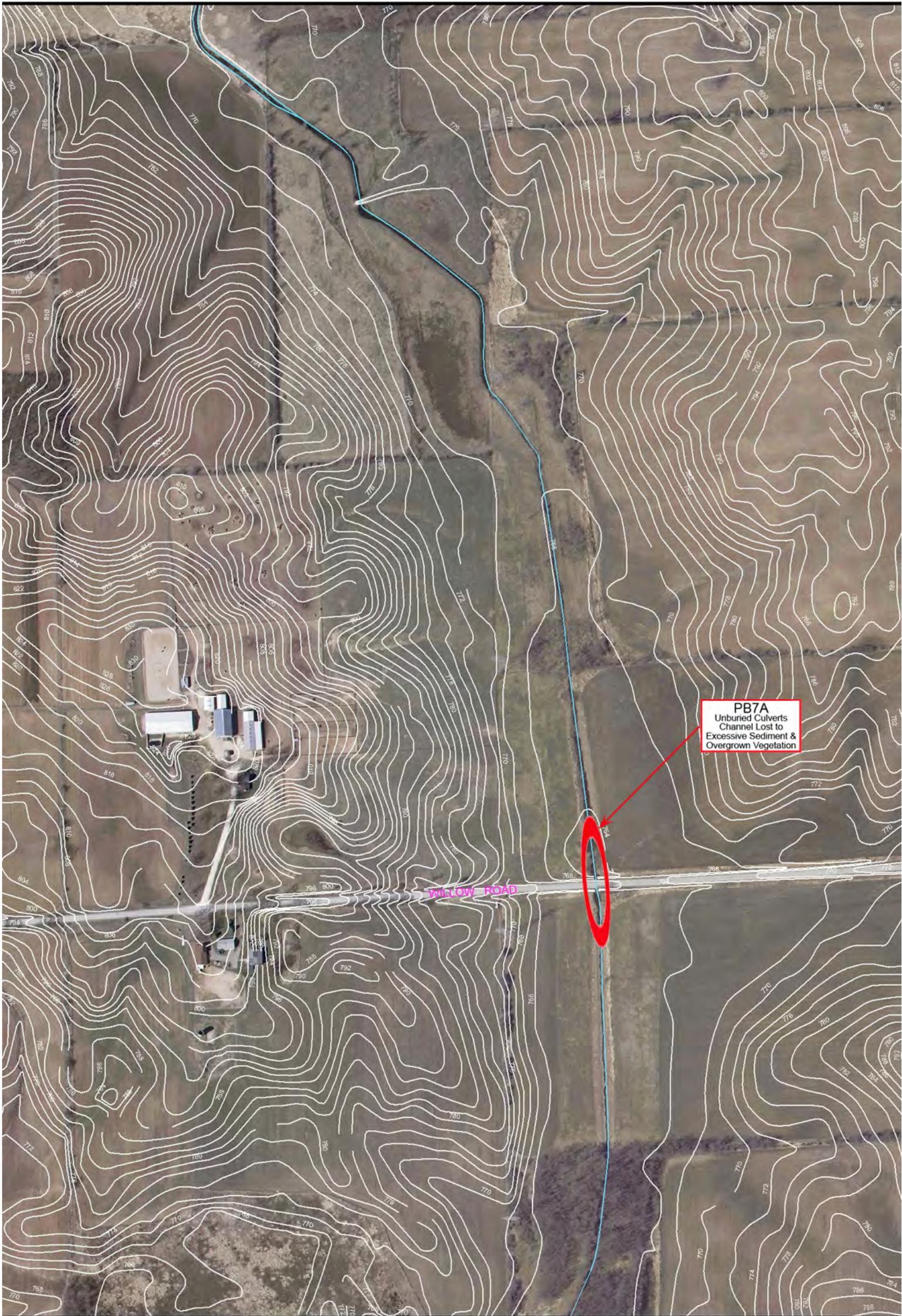


Photograph 3 – Channel lost to excessive sedimentation (UC1 PB4B)



Photograph 4 – Densely ingrown sandbar willow (UC2 PB7)

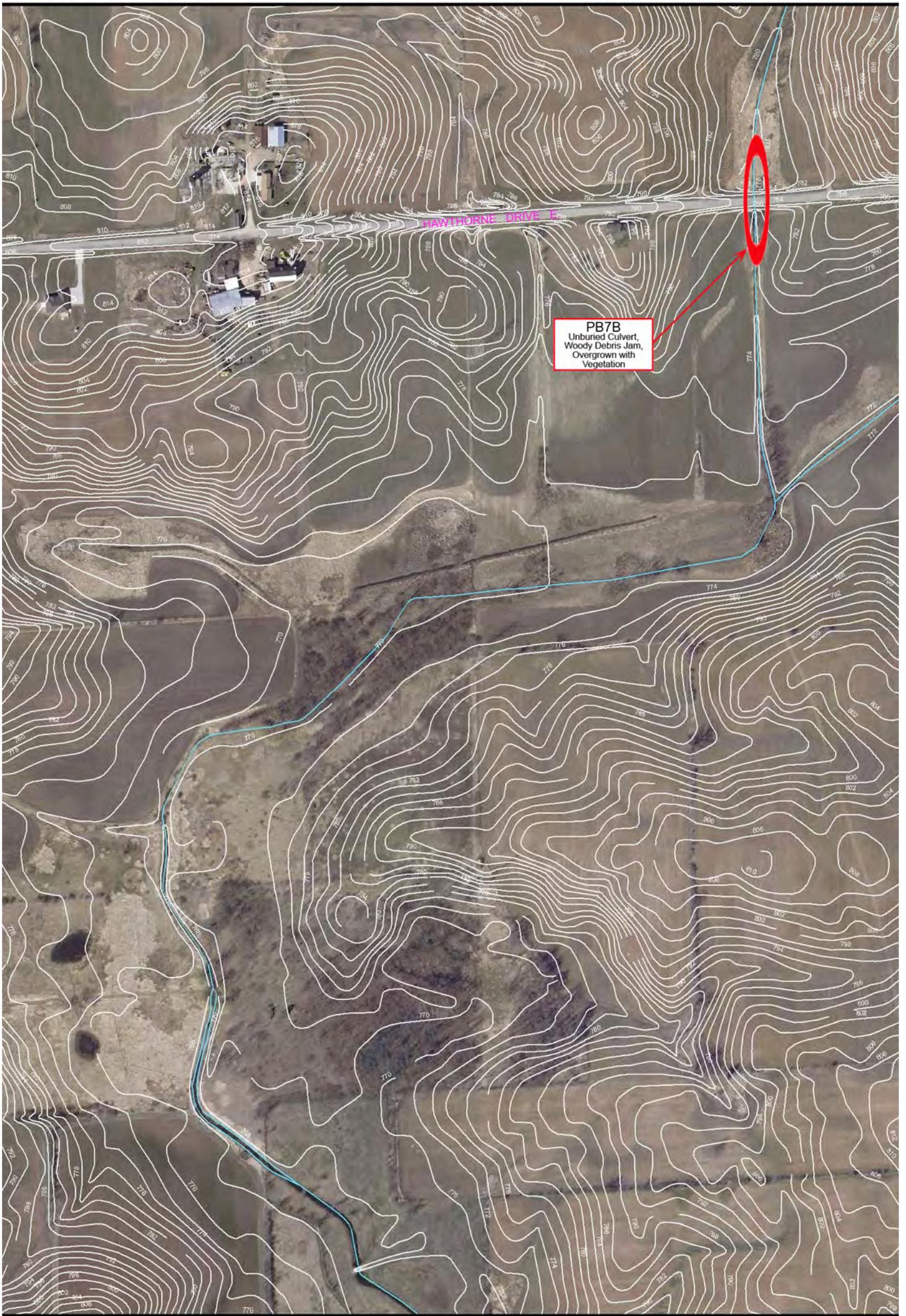




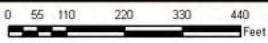
PB7A
Unburned Culverts
Channel Lost to
Excessive Sediment &
Overgrown Vegetation

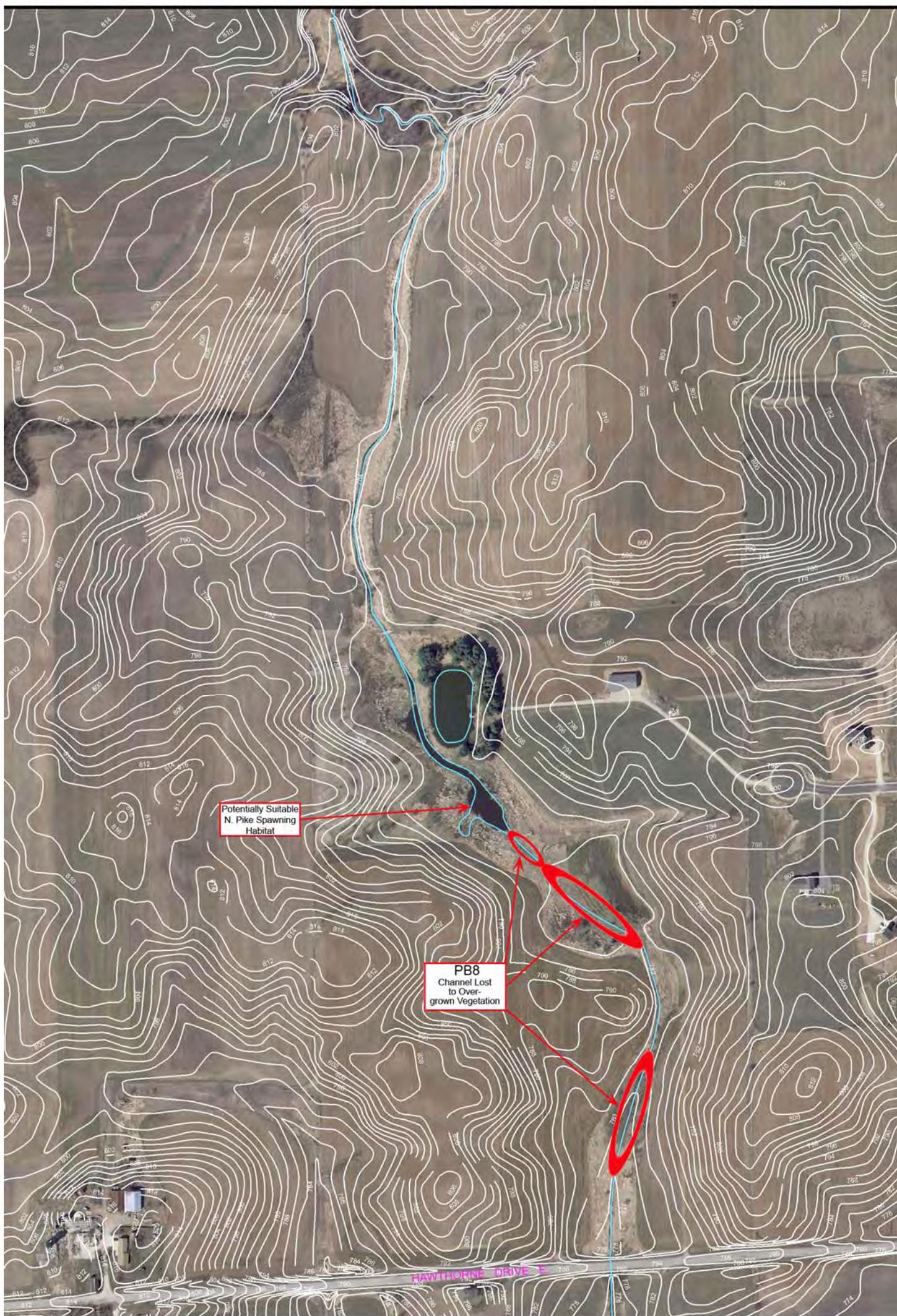
7th LOW ROAD





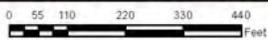
PB7B
Unburied Culvert,
Woody Debris Jam,
Overgrown with
Vegetation

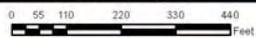
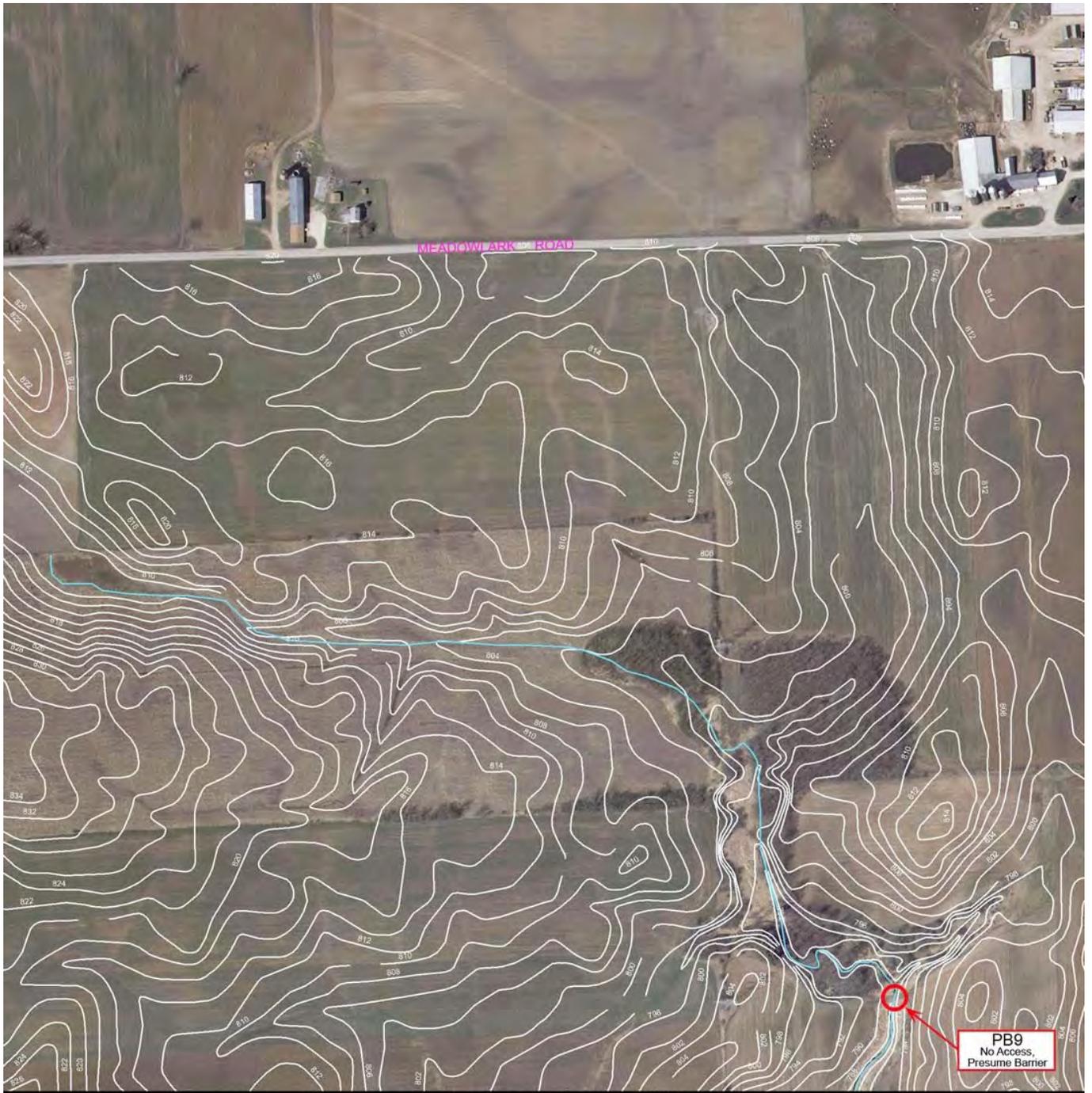




Potentially Suitable
N. Pike Spawning
Habitat

PB8
Channel Lost
to Over-
grown Vegetation





Wisconsin Coastal Management - Ozaukee County PLRM Department
Unnamed Creek #2- Sheet 5

Scale = 1:3,000

