

CONSERVATION RESOURCE ALLIANCE

Little Manistee River Eroding Stream Bank Assessment

Carrieville (Kings Highway) Bridge to Old Stronach Rd. Bridge



Nate Winkler, Biologist

Brandon Glowacki, Project Manager Assistant

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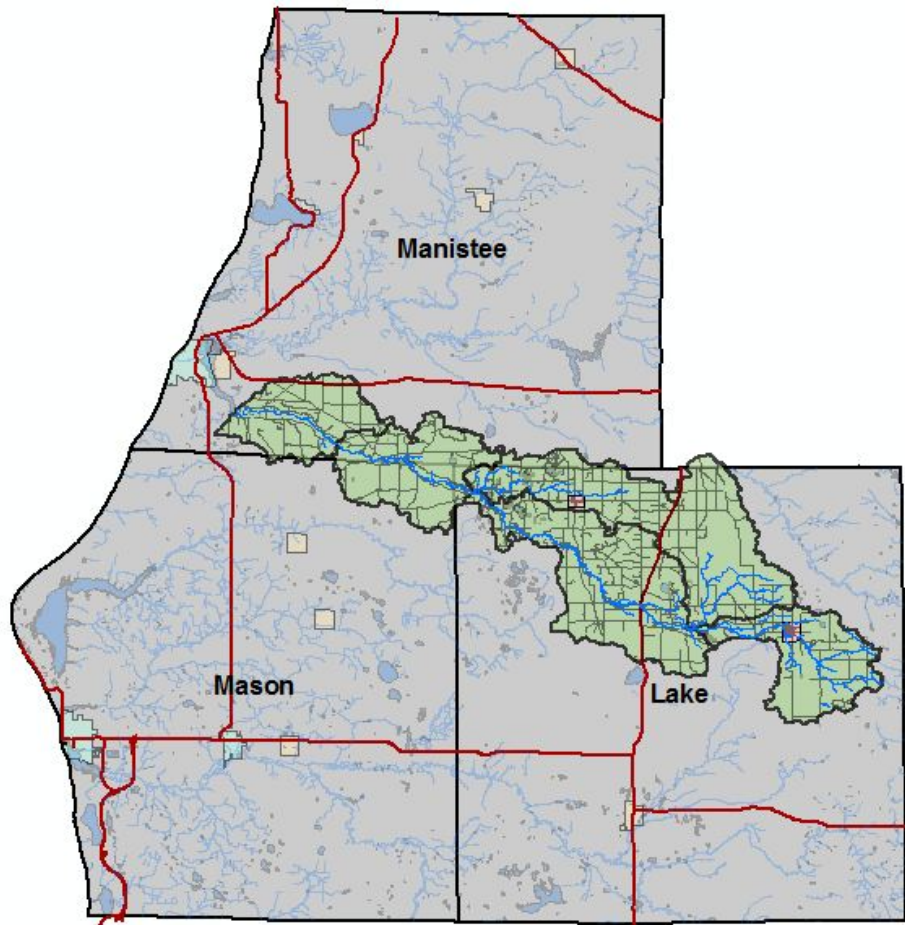


Table of Contents

Introduction and Discussion	Pg. 3
Sites: Carrieville to M-37	Pg. 9
Sites: M-37 to Johnson's Bridge	Pg. 28
Sites: Johnson's Bridge to Bear Track	Pg. 37
Sites: Bear Track to 9 Mile Bridge	Pg. 49
Sites: 9 Mile Bridge to 6 Mile Bridge	Pg. 57
Sites: 6 Mile Bridge to MDNR Weir	No sites
Sites: MDNR Weir to Old Stronach Road Bridge	Pg. 87
Sites: Old Stronach Road Bridge	No sites
Table of Sites According to Severity	Pg. 90
Overview Mapping	Appendices

Introduction

This report describes the effort undertaken between 2011 and 2014 to update and re-evaluate the “Little Manistee River Streambank Erosion Inventory” first released in 1998 with a follow up evaluation and subsequent report released in 2002.

Little Manistee Watershed Restoration Partnership

Since its formation in 1996, the Little Manistee Watershed Restoration Partnership (here after referred to as the “partnership”) has worked together to compile an impressive roster of accomplishments with regard to implementing best management practices to stabilize eroding stream banks, installing fish cover, and replacing undersized and perched culverts.

Members of the partnership include representatives from the following agencies and organizations:

- Little Manistee River Watershed Conservation Council
- US Forest Service
- Michigan Department of Natural Resources
- Michigan Department of Environmental Quality
- Lake County Road Commission
- Conservation Resource Alliance

While these outfits are the primary and consistent participants in meetings held during any given year, anyone with an interest in the Little Manistee River watershed is welcome to participate.

Methods

1998:

(Need to locate)

2002:

The river was inventoried beginning at M-37 in Lake County to the MDNR Weir in Manistee County. Six discrete sections were parsed out as follows:

- M-37 (near the USFS “Old Grade” campground) to Indian Bridge
- Indian Bridge to Dewitt’s Bridge
- Dewitt’s Bridge to 18 Mile Bridge
- 18 Mile Bridge to 9 Mile Bridge
- 9 Mile Bridge to 6 Mile Bridge
- 6 Mile Bridge to the MDNR Weir

Volunteers from the Little Manistee River Watershed Conservation Council (LMRWCC) floated through each of these sections to identify eroding stream banks; the procedure involved providing each site a numeric identifier, recording the location (lat. /long.), taking photographs, and provided a score by

means of evaluating site specific metrics documented on a data sheet. Additionally, treatment recommendations were made on site and recorded on the data sheet.

2011-2014:

Over the course of four field seasons, a biologist from Conservation Resource Alliance with assistance from members of the LMRWCC paddled and waded the river from the Carrieville Bridge (Kings Highway) to the outlet at Manistee Lake. The addition of the sections from Carrieville Bridge to M-37 and the MDNR weir to the outlet was added at the behest of the LMRWCC to get a more comprehensive assessment of the state of the river.

The assessment made of each site was based on that of the procedures employed in 2002. Additionally, field notes were recorded including ambient air and water temperatures, wildlife and fish sightings, channel morphology anomalies, aquatic and terrestrial vegetation, dearth of large wood and poor riparian maintenance practices by private landowners.

Results and Discussion

2002:

(The text below is taken directly from the 2002 survey)

“The Little Manistee River is mostly in good condition in terms of water quality. Shifting sand is the most common substrate in both the upper and lower stretches, while gravel bottom is present in the many riffle areas in the river’s middle stretches where the gradient is the highest. Compared to the 1998 inventory, nineteen fewer sites were found. Site 69, the furthest site downstream, was addressed after the inventory field work was completed but before the inventory was compiled. Of the remaining 68 sites, 26 were minor, 30 were moderate, and just 12 ranked severe. This breakdown indicates that the efforts of the partnership are resulting in fewer erosion sites present, a reduced severity of erosion at remaining sites. While past efforts are paying off, continued efforts to address existing sites and new sites that may develop will be important in the future.

One problem worthy of note is the site numbering system used in the inventories. Sites are numbered from upstream to down, so severe sites with the lowest site numbers tend to be addressed first. When inventories are updated, stabilized sites not needing attention are skipped over in the numbering. This leads to existing sites possibly having two different numbers, depending upon which inventory is being consulted. For example, Site 85 in the 1998 inventory is Site 69 in the 2002 inventory. To alleviate this problem, GPS coordinates were taken at each site and can be used to locate and reference the sites even if confusion exists regarding its number. In addition, a prefix of '98 or '02 could be added the site numbers to clarify which year inventory the site number corresponds to. Finally, it is important to note the fish cover in terms of large woody debris is a continued priority for the quality of the fishery in the Little Manistee. While sediment reduction and removal will continue to improve the quality of the fishery, the addition of cover structures and large woody debris as funding allows is also a goal of the partnership.”

2011-2014:

The most recent permutation of the survey has not proven to be significantly divergent with regard to observations of erosion from that of the prior surveys. A breakdown of the river into the following sections determined by channel and topographic features will help describe the results to follow:

- Carrieville (Kings Highway) to M-37 Bridge
- Old Grade (M-37) to Johnson's Bridge
- Johnson's Bridge to Bear Track Campground
- Bear Track Campground to 9 Mile Bridge
- 9 Mile Bridge to 6 Mile Bridge
- 6 Mile Bridge to MDNR Weir (no section necessitated evaluation)
- MDNR Weir to Old Stronach Rd. Bridge

Carrieville (Kings Highway) to M-37 Bridge

This section was evaluated by both wading and paddling, necessitated by the difficulty posed by accumulations of coarse, medium, and large wood in the channel and the tunnel-like growths of tag alder extending into the stream channel.

This section was found to have **19** eroding stream banks (sites 1-19) which necessitated evaluation. In general terms, this section was low gradient, primarily sandy bottomed, with few current-bearing banks excessively eroding. A random depth of refusal measurement was taken in the channel with depths of sand over gravel being measured at 2 ½'.

Old Grade (M-37) to Johnson's Bridge

This section was evaluated via canoe and was found to have **9** eroding stream banks (sites 20-28) which necessitated evaluation.

Johnson's Bridge to Bear Track Campground

This section was evaluated via canoe and was found to have **12** eroding stream banks (sites 29-41) which necessitated evaluation.

Bear Track Campground to 9 Mile Bridge

This section was evaluated via canoe and was found to have **8** eroding stream banks (sites 42-49) which necessitated evaluation.

In the entire survey, the segment from "Trapper Dan's Landing" to the settlement in the vicinity of Pomeroy Springs exhibited a dearth of large wood more striking than that of the rest of the river. In addition, within the segment the channel not only exhibits a glaring dearth of large wood but also exhibits a high width to depth ratio and high volume of sand bed-load.

Tall, eroding bluffs and banks were documented during the survey but the most striking resource issue is the lack of channel complexity equating to large wood and log jams coupled with the amount of sand bed load. It's important to recognize that the gradient through this section is low which can at least partially explain the channel bed conditions.

Many of the sub-segments in this section that would benefit from treatment are on U.S. Forest Service managed lands and therefore any wood installation and channel narrowing efforts are subject to analysis under the National Environmental Policy Act ("NEPA"). This can be a lengthy process when compared with requirements for analysis for projects on private and State owned lands.

A recommended approach is as follows:

1) Initiate NEPA by compiling sub-segments impacting Forest Service lands onto a list, identify the sub-segments and wood installation locations on a map, and generate a plan describing the proposed scope of work; this material would be then be submitted to the Forest Service for their consideration and analysis.

In the meantime while the NEPA process is in the works,

2) Identify sites on private and State land with subsequent inquiries made to respective landowners as to whether or not they would be interested in having work done on their property. Once project locations are identified and access agreements are acquired, permit applications may be made and subsequently work may be undertaken. And as Federal lands are deemed available for treatment through NEPA, federal sites could be taken on as well.

Ideally, large wood placement and channel narrowing efforts should occur on extensive, contiguous sections of river regardless of ownership to provide for more efficiency in constructing the project which ultimately lends a greater benefit to the river.

Large contiguously owned segments of river in this section are (with few exceptions in private ownership) those administered by the U.S. Forest Service. Access and authorization to install wood and construct jams on these segments would be ideal given the continuity of ownership and the need for treatment.

Most of the remaining land consists of very small privately-owned parcels clustered immediately upstream of the 9 Mile Bridge. To provide the greatest benefit on the river bordering several privately owned parcels, a number of landowners would have to agree to have wood installation and jam construction in the river adjacent to their property; a single access agreement would be signed on to by all parties.

Private landowners with larger holdings of river frontage in this section do occur and would provide an efficient and less costly alternative to the above option. The logistics of working with one landowner are much more amenable to such a project which makes limited project funds go farther.

Given that the entire segment would benefit from bank stabilization, channel narrowing, wood installation, and jam construction the eventual involvement of all riparian owners will occur.

9 Mile Bridge to 6 Mile Bridge

This section was evaluated via canoe and was found to have **30** eroding stream banks (sites 50-79) which necessitated evaluation.

This high gradient section is where the majority of the high, sandy and severely eroding banks are located. The current-bearing banks on the outside of the meander bends are exposed to a high amount of energy; this coupled with the sand dominated geology provides a terrific volume of sediment to the channel. Because the river drops in elevation at a very high rate, the material is transported downstream to a point where the hydraulic competency lessens (approximately the 6 Mile Bridge) and the sediment drops out. As a result the gravel bed channel gradually becomes laden with sand bed-load.

Many of the banks requiring stabilization in this section are on U.S. Forest Service managed lands and therefore any stabilization efforts are subject to analysis under NEPA.

The recommended approach to work in this section is similar to that described in the discussion above;

1) Initiate NEPA by compiling all eroding bank sites (with recommended treatments described) on Forest Service lands onto a list, identify the sites on a map, and generate a plan describing the proposed scope of work; this material would be then submitted to the Forest Service for analysis.

While the NEPA process is occurring,

2) Identify sites on private and State land with subsequent inquiries made to respective landowners as to whether or not they would be interested in having work done on their property. Once project locations are identified and access agreements are acquired, permit applications may be made and subsequently work may be undertaken. As Federal lands are deemed available for treatment through NEPA, federal sites would be taken on as well.

Ideally as in the wood installation, bank stabilization efforts should occur on extensive, contiguous sections of river regardless of ownership to provide for more efficiency in constructing the project which lends a greater benefit to the river.

This section more than any other exhibited the most dramatic change in the extent of erosion observed as compared to the 2002 survey. The erosion sites observed in the rest of the river (and had been surveyed prior) tended to be similar in appearance and severity as in 2002.

6 Mile Bridge to MDNR Weir

This section was evaluated via canoe and was found to have **no** eroding stream banks which necessitated evaluation for treatment.

The gradient is markedly less here than in the prior section and as a result, the hydraulic competency was less and subsequently the observed sand bed load was much higher. High, current bearing banks were not as prevalent.

MDNR Weir to Old Stronach Rd. Bridge

This section was evaluated via canoe and was found to have **3** eroding stream banks (sites 80-82) which necessitated evaluation. The extent to which any eroding banks were encountered was just above the Old Stronach Road Bridge. From this point to the mouth at Manistee Lake the river courses, and braids in several places, through lowlands dominated by tag alders, ultimately yielding to no erosive banks along this final section.

The channel is highly aggraded with sediment in this section and exhibits the remains of wood wing dams constructed during an earlier era in stream restoration.

Acknowledgements

This assessment was generously funded by the Little Manistee River Watershed Conservation Council, a citizen-based advocacy organization with a strong and effective presence in the Little Manistee River watershed.

Mapping assistance was contributed by the United States Forest Service (Cadillac Ranger Station) with additional general consultation provided by both the Forest Service and the Michigan Department of Natural Resources Cadillac District Office.

Little Manistee River Eroding Stream Bank Assessment: Carrieville (Kings Highway) to M-37 Bridge

Site 1

44.03460, -85.72291

Aspect: S

Slope: Vertical

Length: 30'

Height: 4'

Severity: Minor

Ownership: State

River-right

Notes: water depth 2.5-3.0' maximum, substrate sand, some gravel and wood



View straight on (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 2

44.03514, -85.72549

Aspect: SW

Slope: 1:1

Length: 12'

Height: 7'

Severity: Moderate

Ownership: State

River-right

Notes: substrate sand, channel width 16', water depth 2.0-4.0' maximum



View straight on (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 3

44.03531, -85.72869

Aspect: W

Slope: 2:1

Length: 50'

Height: 7'

Severity: Minor

Ownership: State

River-left

Notes: channel width 20', substrate sand, water depth 2.5-3.0' maximum



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 4

44.03443, -85.73084

Aspect: E

Slope: 1.5:1

Length: 12'

Height: 10'

Severity: Minor

Ownership: State

River-left

Notes: water depth 3.0', channel width 12', substrate sand



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 5

44.03493, -85.73140

Aspect: W

Slope: Vertical

Length: 20'

Height: 6'

Severity: Minor

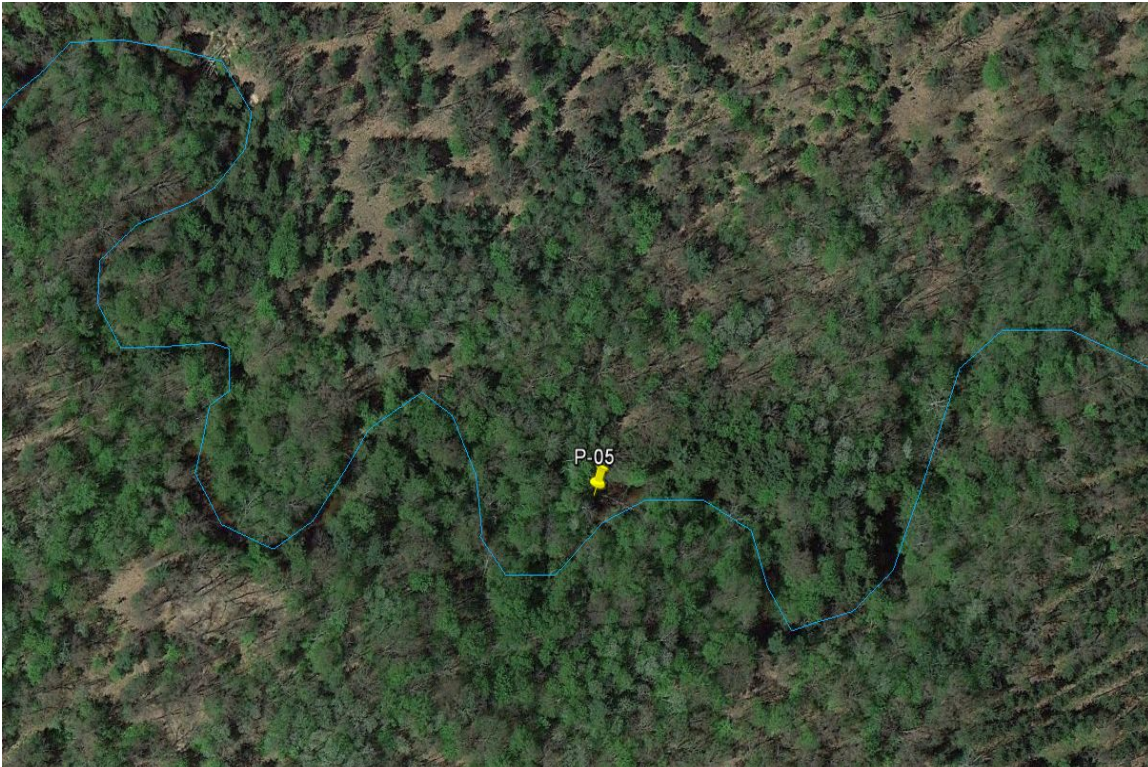
Ownership: State

River-right

Notes: water depth 1'-2.5', substrate sand/some gravel



View downstream and across (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 6

44.03523, -85.73225

Aspect: S

Slope: Vertical

Length: 8'

Height: 5'

Severity: Minor

Ownership: State

River-right

Notes: substrate gravel/some sand, channel width, water depth .5'-1.5'



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 7

44.03511, -85.73254

Aspect: SE

Slope: 1:1

Length: 50'

Height: 5-8'

Severity: Minor

Ownership: State

River-right

Notes: substrate sand/some gravel, water depth 1'-2', channel width 15'



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 8

44.03476, -85.73311

Aspect: SE

Slope: 1:1

Length: 20'

Height: 12-15'

Severity: Minor

Ownership: State

River-left

Notes: channel width 24', water depth .5', substrate sand



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 9

44.03536, -85.73319

Aspect: W

Slope: 1:1

Length: 12'

Height: 5'

Severity: Minor

Ownership: State

River-right

Notes: channel width 20', water depth 1'-2.5', substrate sand/some gravel



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 10

44.03605, -85.73297

Aspect: W

Slope: Vertical

Length: 50'

Height: 20'

Severity: Severe

Ownership: State

River-right

Notes: water depth 4"-2.5', channel width 20', substrate sand



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 11

44.03500, -85.73459

Aspect: ESE

Slope: 1:1

Length: 20'

Height: 15'

Severity: Minor

Ownership: State

River-left

Notes: water depth 1'-2.0', substrate sand/some gravel, channel width 24'



View straight on (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 12

44.03573, -85.73586

Aspect: NW

Slope: Vertical

Length: 40'

Height: 6'

Severity: Moderate

Ownership: State

River-right

Notes: water depth 1'-1.5', substrate sand/some gravel, channel width 24'



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 13

44.03534, -85.73651

Aspect: ENE

Slope: 1:1

Length: 20'

Height: 10'

Severity: Severe

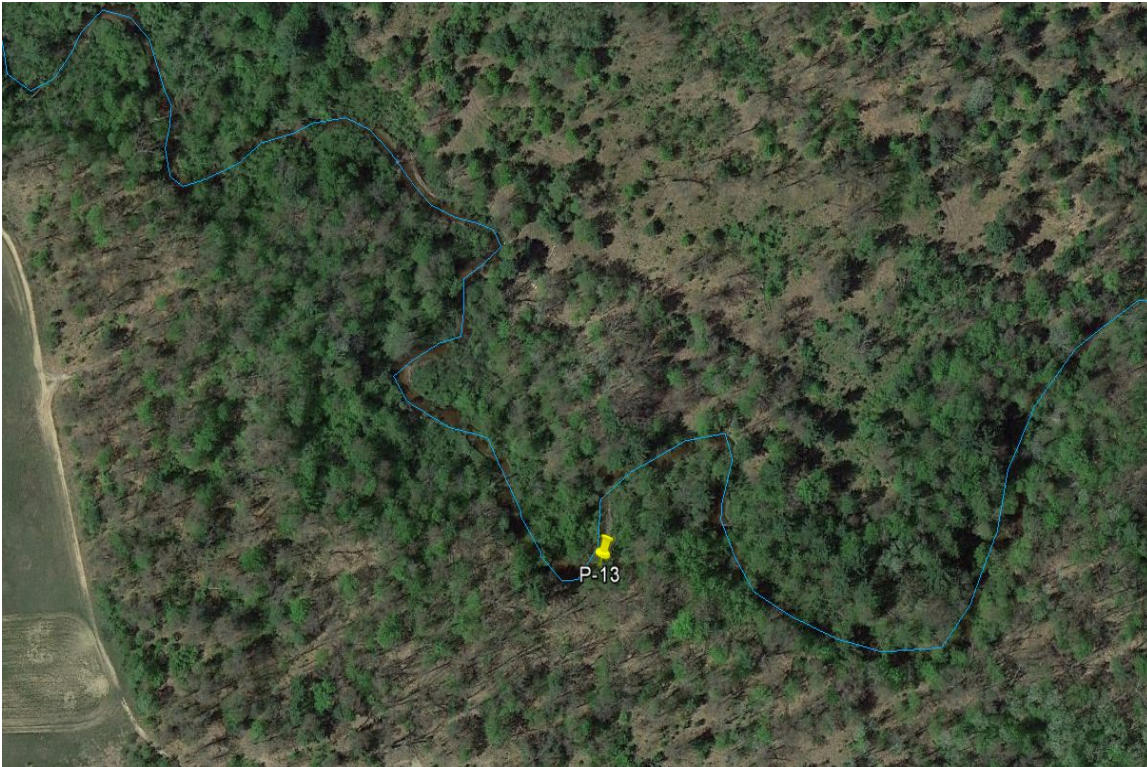
Ownership: State

River-left

Notes: channel width 15', substrate sand, water depth .5'-3.0'



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 14

44.03533, -85.73666

Aspect: ENE

Slope: 1:1

Length: 10'

Height: 7'

Severity: Moderate

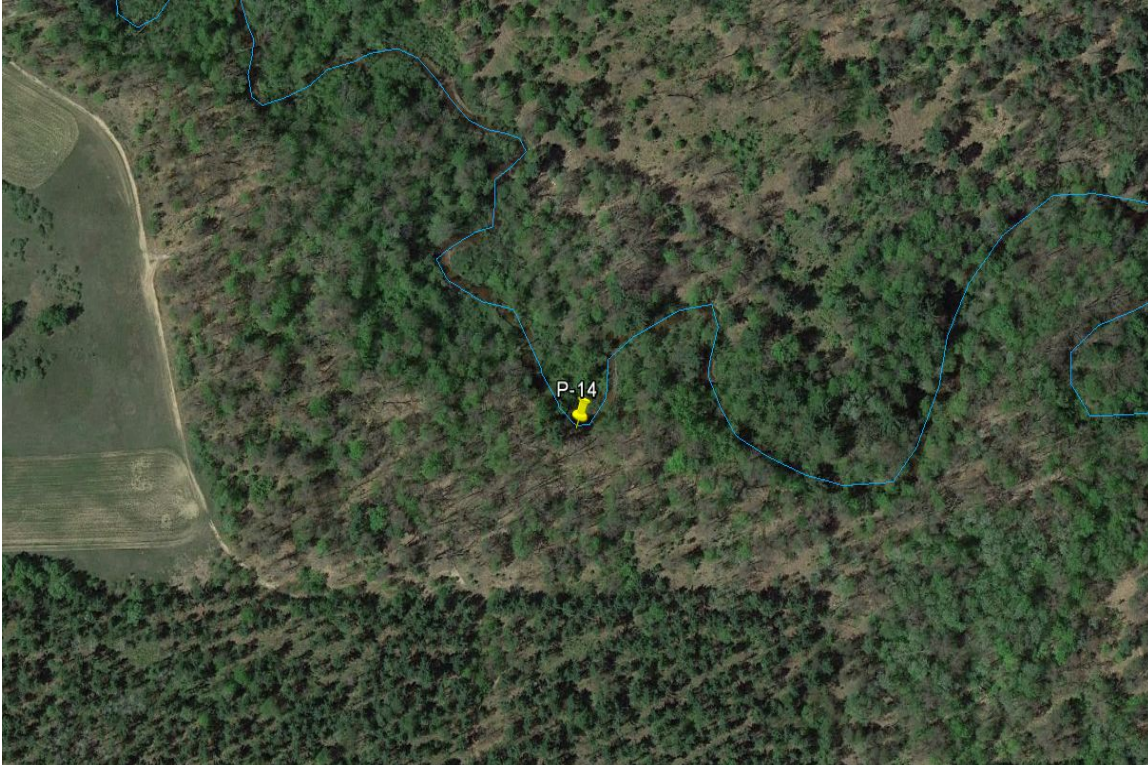
Ownership: State

River-left

Notes: water depth .5'-2.0', substrate sand, channel width 30'



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 15

44.03653, -85.73881

Aspect: N

Slope: 1:1

Length: 70'

Height: 18'

Severity: Moderate

Ownership: State

River-left

Notes: water depth .5'-3.5', channel width 14', substrate sand



View downstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 16

44.03795, -85.73965

Aspect: SE

Slope: 1:1

Length: 8'

Height: 12-15'

Severity: Severe

Ownership: State

River-right

Notes: channel width 30', water depth .5'-2.0', substrate fieldstone/sand



View upstream (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 17

44., -85.

Aspect: WSW

Slope: 1:1

Length: 100'

Height: 15'

Severity: Moderate

Ownership:

River-right

Notes: water depth 2.0'-3.0', substrate sand, channel width 20'



View downstream (2013)

Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 18

44.04644, -85.82390

Aspect: WSW

Slope: 1:1

Length: 20'

Height: 10'

Severity: Moderate

Ownership: State

River-right

Notes: channel width 24', water depth 3.0', substrate sand



View straight on (2013)



Carrieville (Kings Highway) to M-37 Bridge (continued)

Site 19

44.05424, -85.83720

Aspect: WSW

Slope: Vertical

Length: 43'

Height: 2'

Severity: Moderate

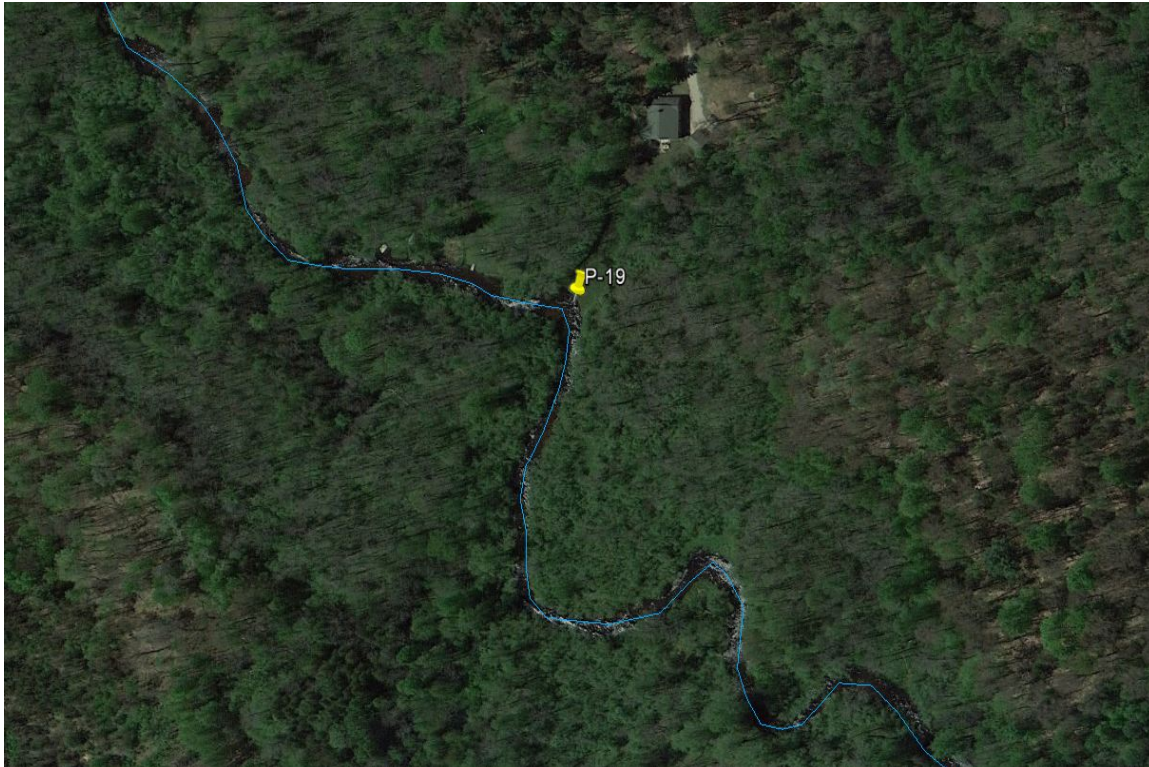
Ownership: Private

River-right

Notes: water depth 4.0'-4.5', substrate sand/some gravel, channel width 43'



View upstream and across (2013)



Little Manistee River Eroding Stream Bank Assessment: Old Grade (M-37) to Johnson's Bridge

Site 20

44.06129, -85.86926

Aspect: S

Slope: 1:1

Length: 50'

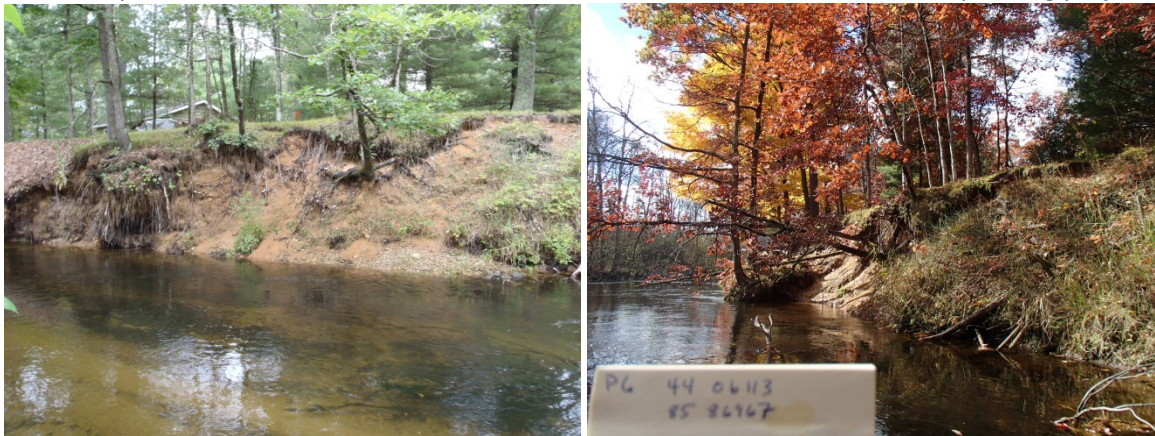
Height: 8'

Severity: Severe

Ownership: Private (VanSingel)

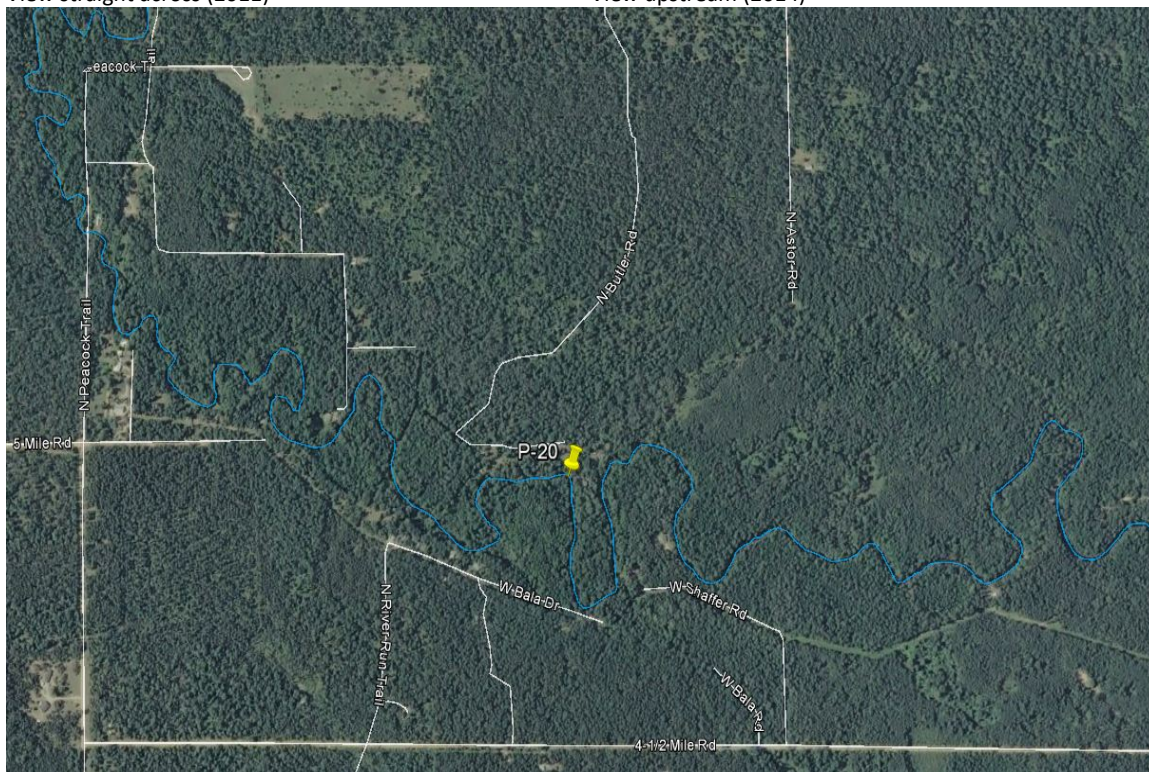
River-right

Notes: depth at toe 2.5', landowner has been in touch with CRA on stabilization-pending project



View straight across (2011)

View upstream (2014)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 21

44.07075, -85.88659

Aspect: E

Slope: 1:1

Length: 60'

Height: 8'

Severity: Minor

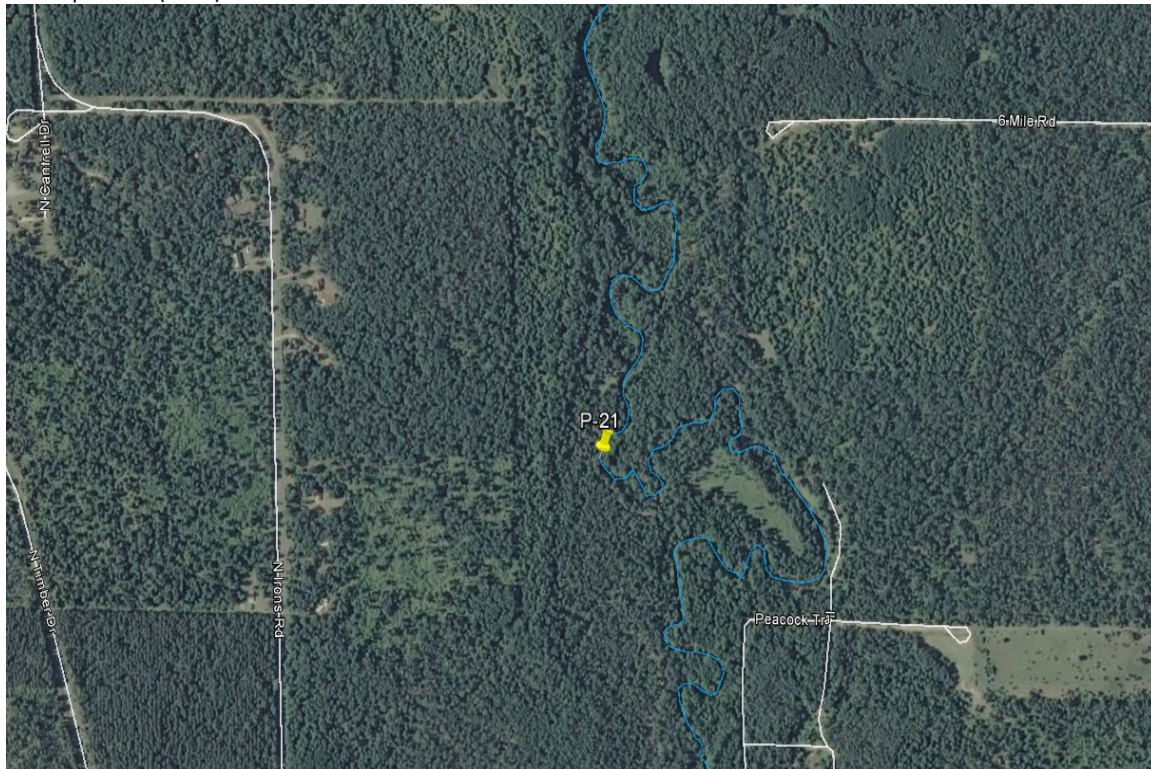
Ownership: Private

River-left

Notes: depth at toe 3'



View upstream (2014)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 22

44.08316, -85.89396

Aspect: S

Slope: 1:1

Length: 15'

Height: 5-8'

Severity: Minor

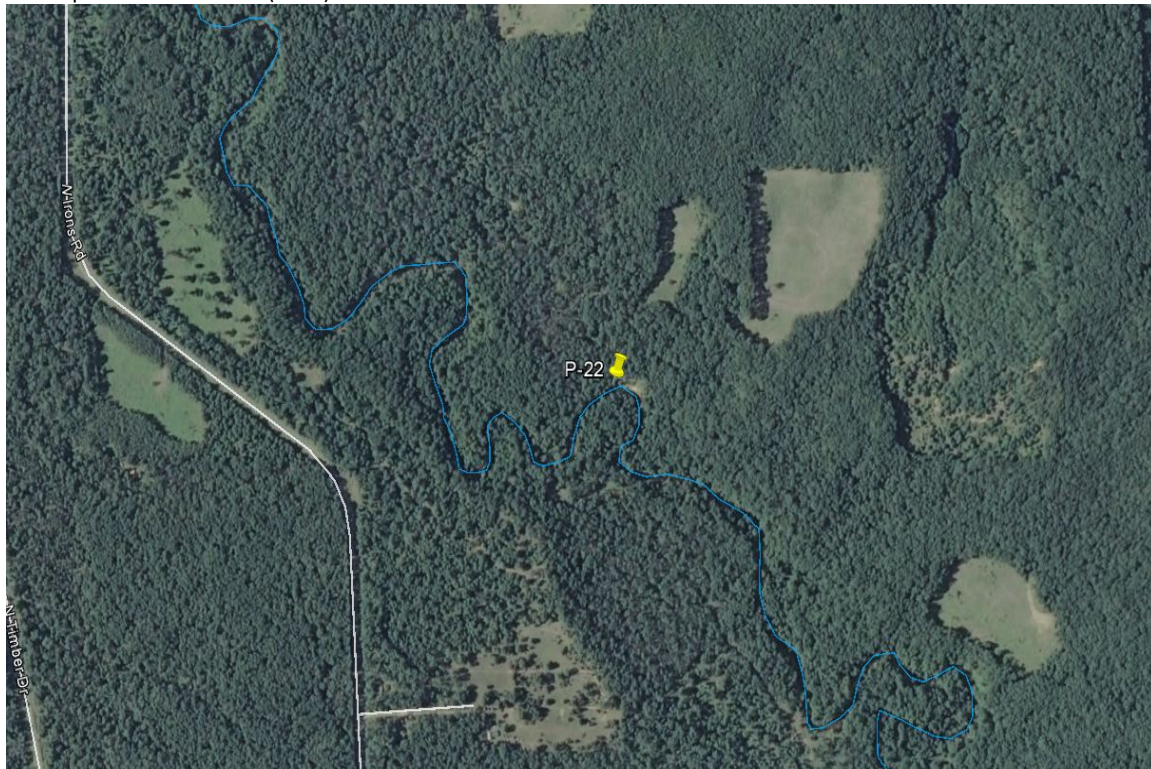
Ownership: Indian Club

River-right

Notes: cold upwelling observed at toe, water at toe 2.5'



View upstream and across (2014)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 23

44.08305, -85.89362

Aspect: S

Slope: 1:1

Length: 15'

Height: 5-8'

Severity: Moderate

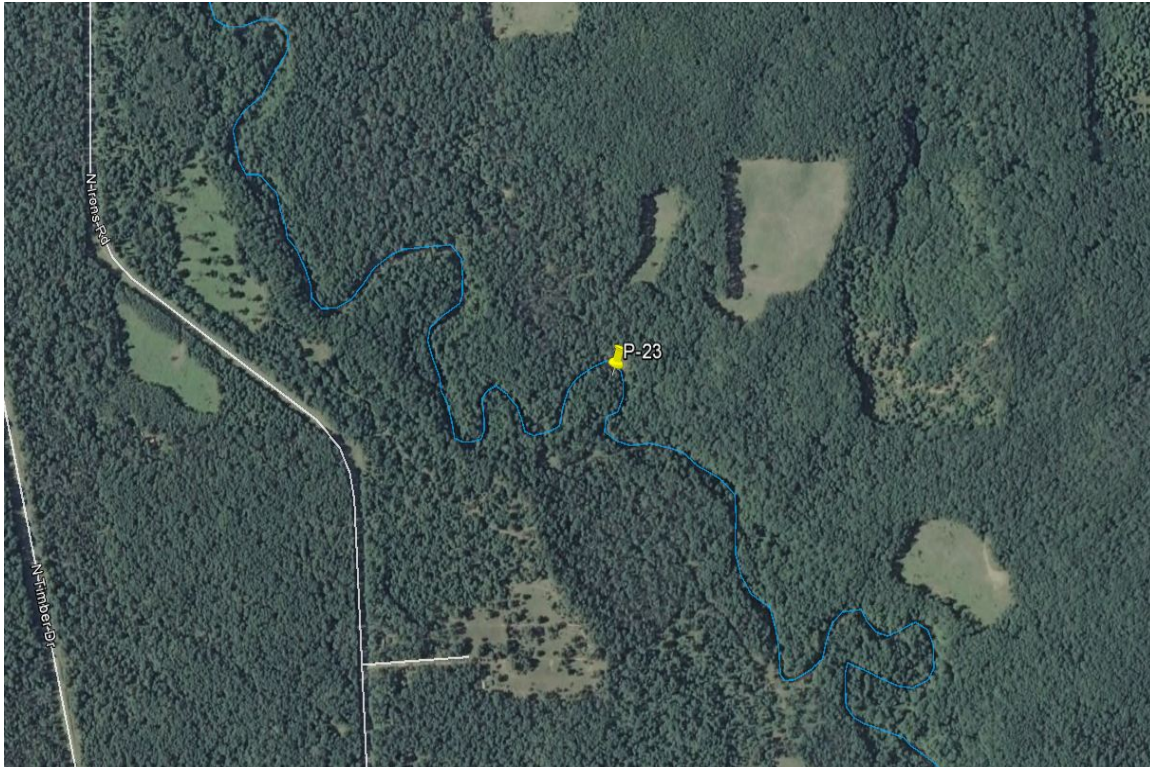
Ownership: Indian Club

River-right

Notes:



View straight across (2014)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 24

44.08778, -85.90224

Aspect: S

Slope: 1:1

Length: 17'

Height: 10'

Severity: Moderate

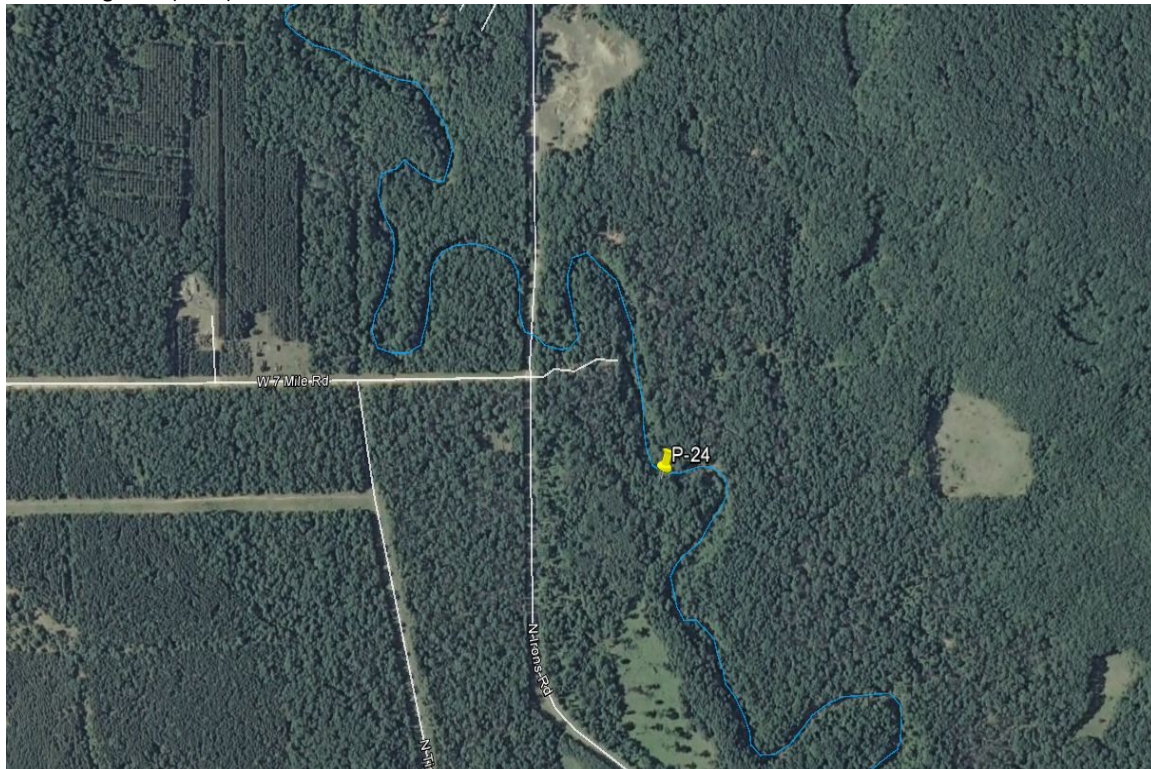
Ownership: Indian Club

River-right

Notes:



View straight on (2011)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 25

44.09072, -85.90729

Aspect: E

Slope: 1:1

Length: 120'

Height: 8-10'

Severity: Minor

Ownership: Indian Club

River-right

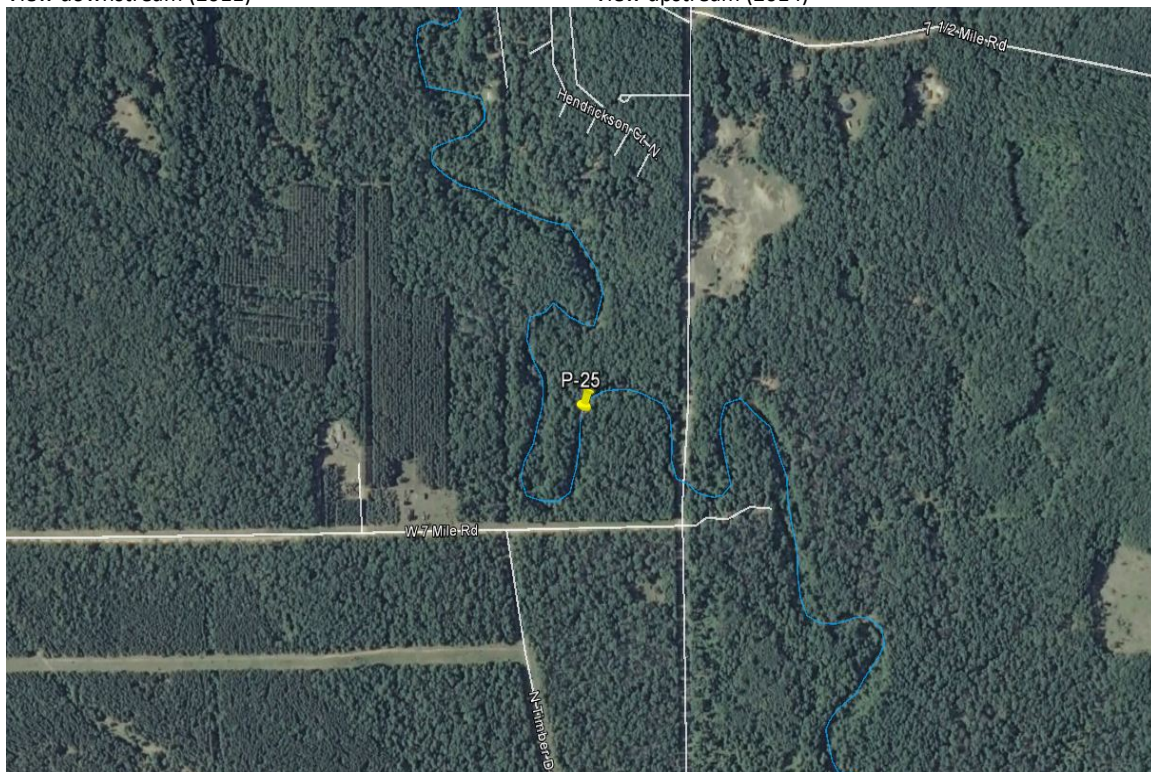
Notes: some clay expressed at toe, water depth 3', (toe is well buffered from current, re-vegetation occurring)



View downstream (2011)



View upstream (2014)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 26

44.09183, -85.90728

Aspect: N

Slope: 1:1

Length: 150'

Height: 10-12'

Severity: Minor (toe is well buffered from current, re-vegetation occurring)

Ownership: Indian Club

River-right

Notes: has had work done prior at the toe



View downstream (2011)



View downstream (2014)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 27

44.10229, -85.91377

Aspect: S

Slope: 1:1

Length: 50'

Height: 20'

Severity: Severe

Ownership: Federal

River-left

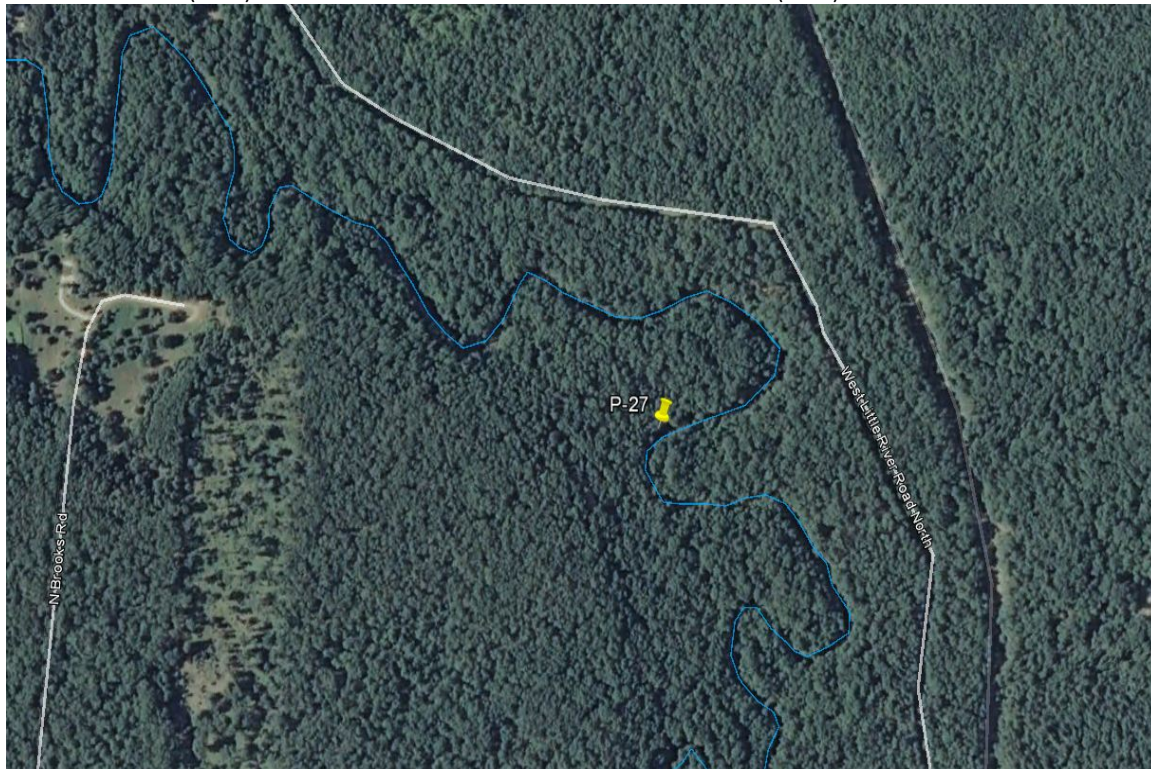
Notes: outside of meander bend, low effort fix would be to secure large wood at toe to buffer flow



View downstream (2011)



View downstream (2014)



Old Grade (M-37) to Johnson's Bridge (continued)

Site 28

44.10368, -85.91600

Aspect: SE

Slope: 1:1 (from 2:1 in 2011)

Length: 17'

Height: 8'

Severity: Severe

Ownership: Federal

River-right

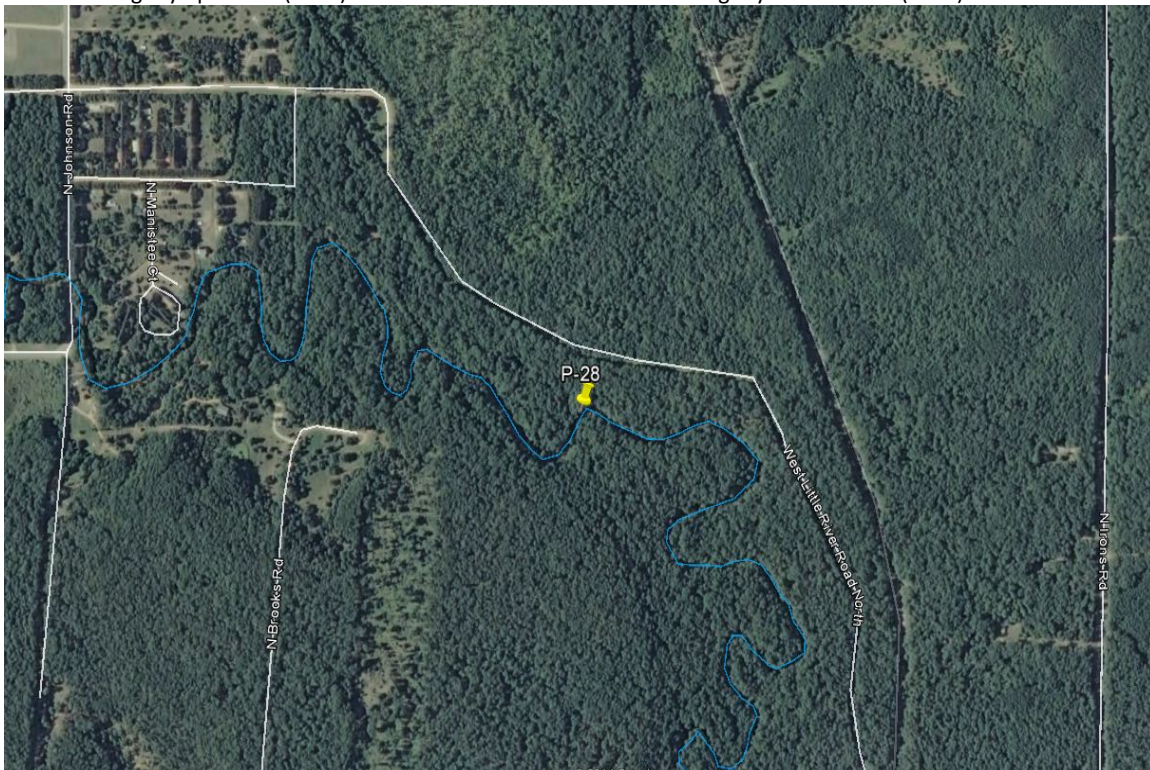
Notes: the site trended from moderate to severe between 2011 and 2014 indicating recreational access may be one of the major influences to pursue on many sites



View from slightly upstream (2011)



View from slightly downstream (2014)



Little Manistee River Eroding Stream Bank Assessment: Johnson's Bridge to Bear Track

Site 29

44.10558, -85.92979

Aspect: N

Slope: 1:1

Length: 65'

Height: 15'

Severity: Severe

Ownership: Private

River-left

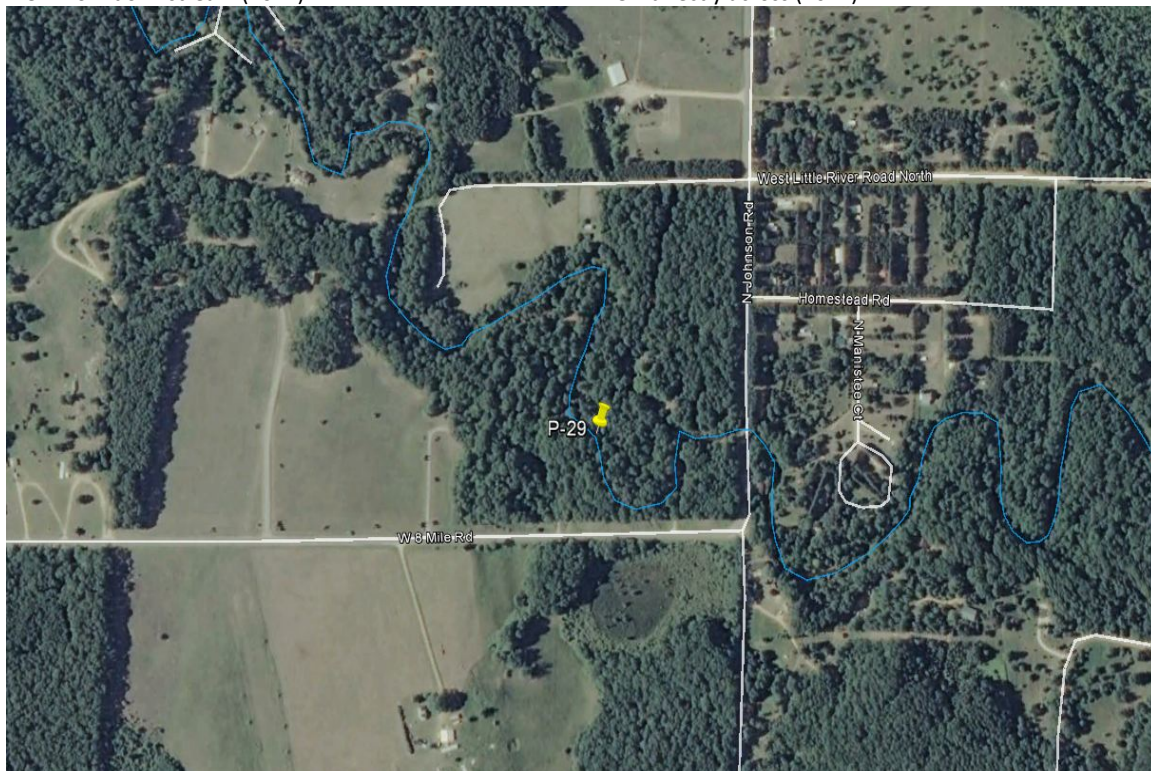
Notes: note 2014 photo top of bluff has slumped to water level and is protecting toe, depth at toe 3.5'



View from downstream (2011)



View directly across (2014)



Johnson's Bridge to Bear Track (continued)

Site 30

44.10704, -85.93314

Aspect: E

Slope: 2:1

Length: 25'

Height: 20'

Severity: Severe

Ownership: Private

River-left

Notes: active bleeding of sediment into stream, obscured by leaf drop in 2014 photo, depth at toe 3.5'



View from upstream (2011)



View straight across (2014)



Johnson's Bridge to Bear Track (continued)

Site 31

44.10852, -85.93373

Aspect: SE

Slope: Vertical

Length: 15'

Height: 5'

Severity: Moderate

Ownership: Private

River-right

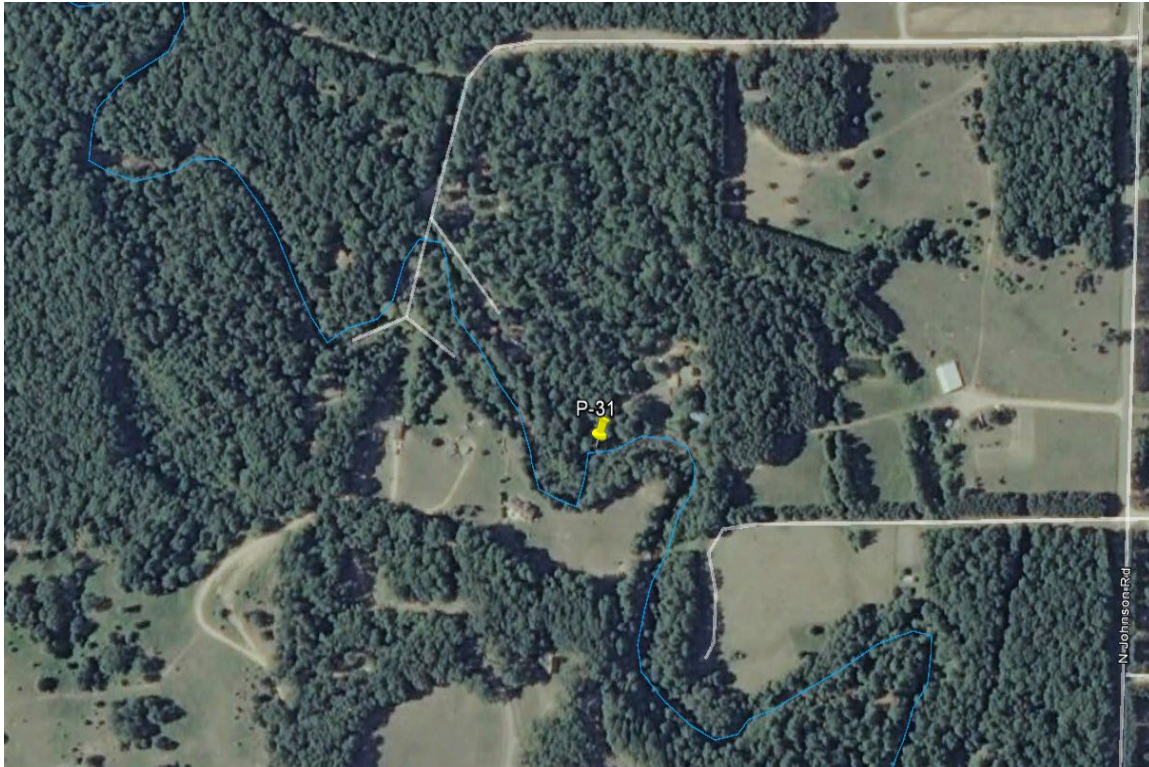
Notes: high clay content in bank material, low rate of sloughing, depth at toe 6'



View straight across (2011)



View straight across (2014)



Johnson's Bridge to Bear Track (continued)

Site 32

44.11152, -85.93974

Aspect: S

Slope: 1:1

Length: 24'

Height: 5'

Severity: Moderate

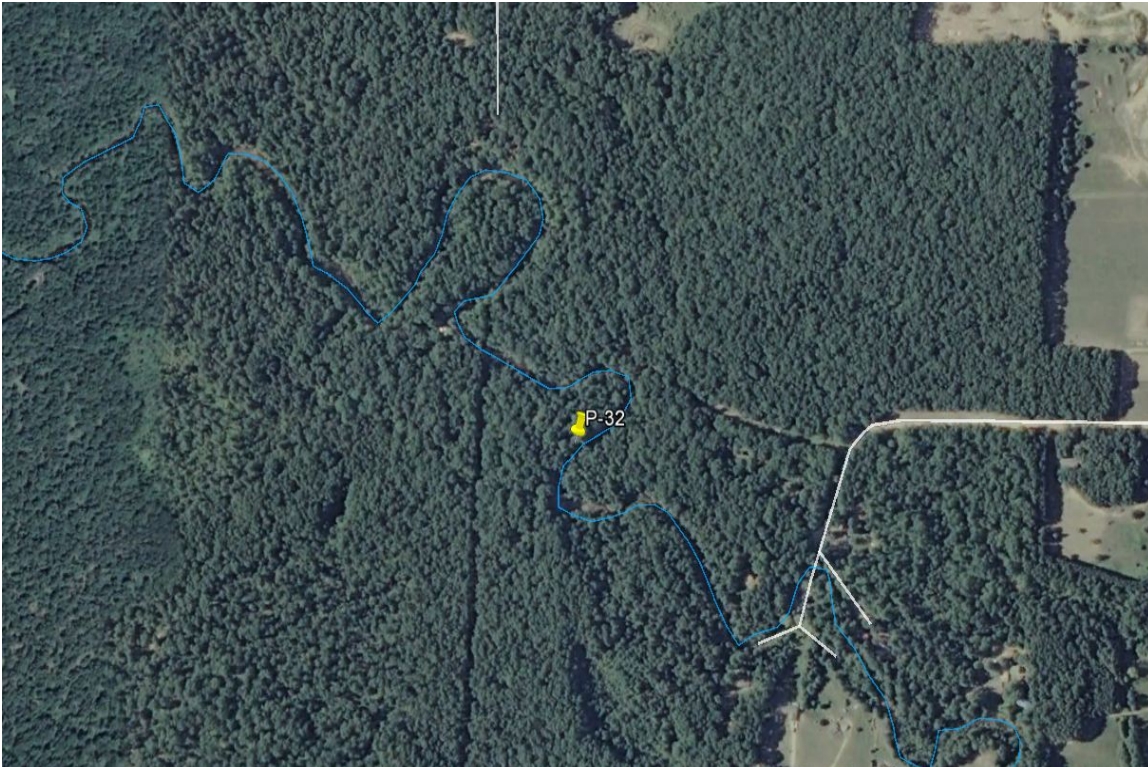
Ownership: Private

River-left

Notes: channel width 43', substrate gravel/sand, depth at toe 2'



View upstream and across (2011)



Johnson's Bridge to Bear Track (continued)

Site 33

44.11264, -85.95417

Aspect: NE

Slope: 1.5:1

Length: 38'

Height: 20'

Severity: Severe

Ownership: Federal

River-left

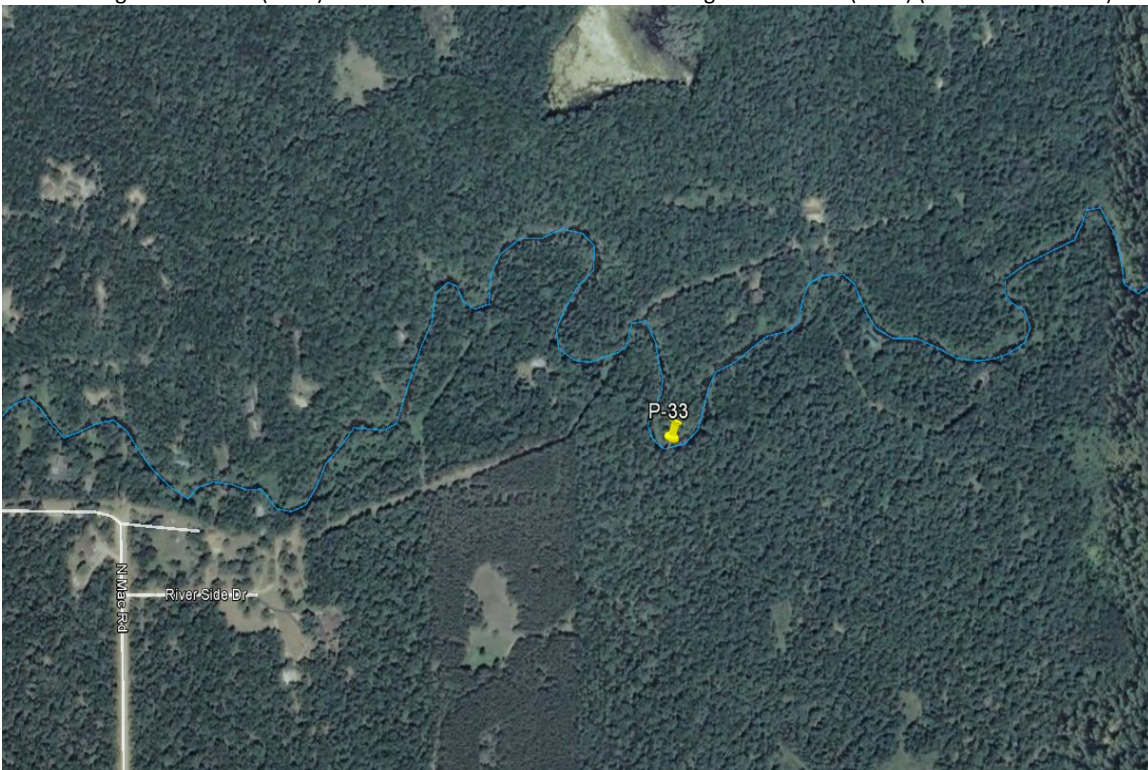
Notes: outside of meander bend, channel width at this location 28', water depth 4', substrate fine sediment/gravel/sand



View looking downstream (2011)



View looking downstream (2014) (note toe stabilized)



Johnson's Bridge to Bear Track (continued)

Site 34

44.11472, -85.95557

Aspect: S

Slope: 2:1

Length: 50'

Height: 9-11'

Severity: Minor (no flow access to toe, re-vegetating on its own)

Ownership: Private

River-right

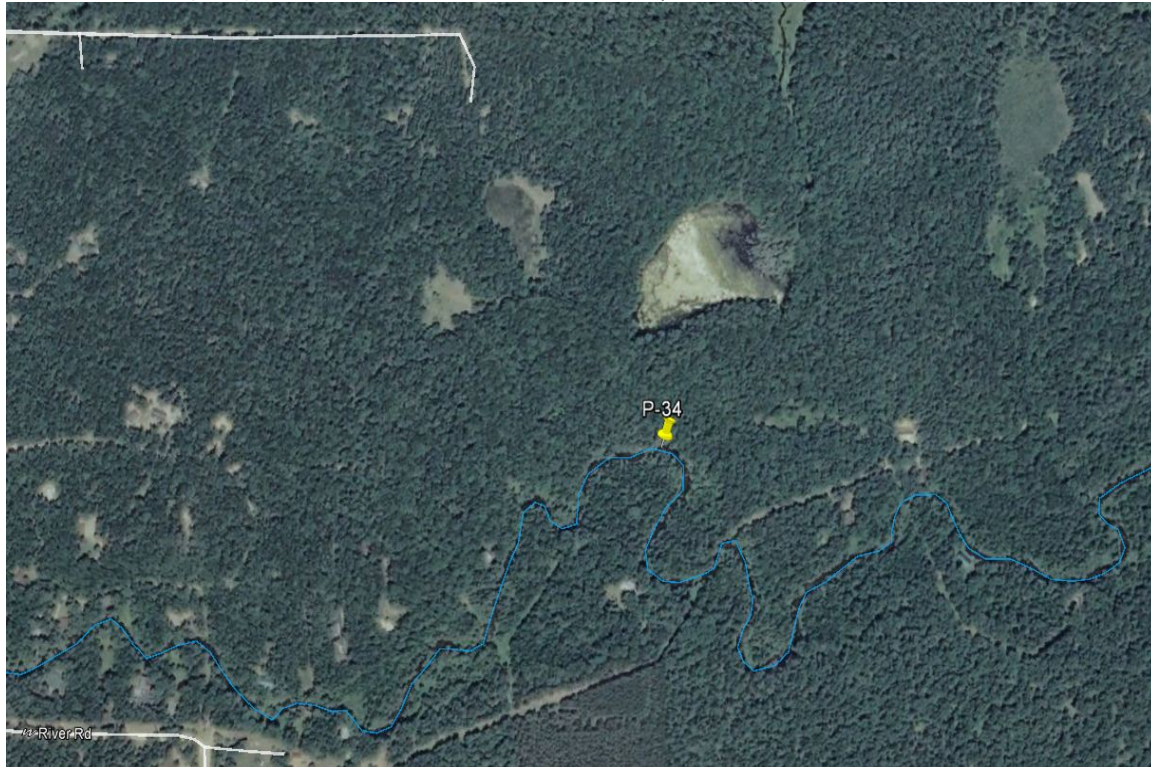
Notes: channel width 30', substrate fine sediment/sand/large wood



View downstream (2011)



View upstream (2014)



Johnson's Bridge to Bear Track (continued)

Site 35

44.11395, -85.95700

Aspect: NE

Slope: 1:1

Length: 18'

Height: 12'

Severity: Moderate (though trending to severe)

Ownership: Private

River-left

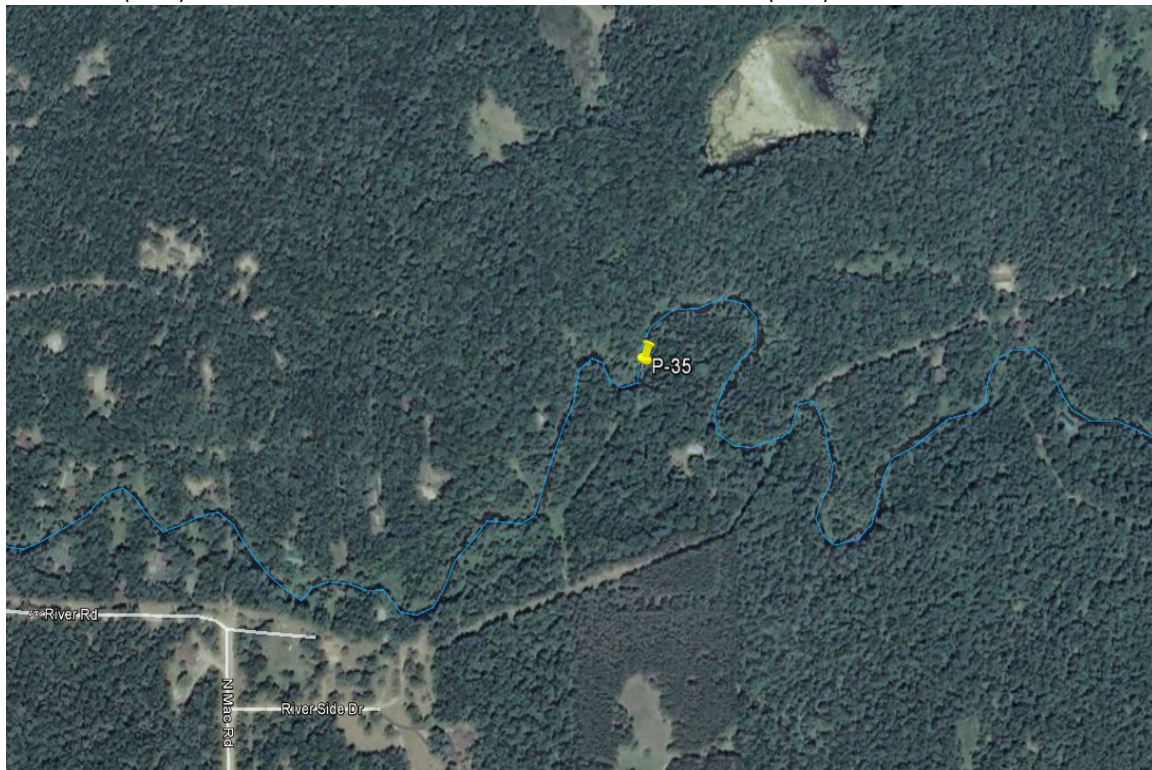
Notes: river width 30-32', water depth at toe 4.5-5', substrate small gravel, sand, large wood, current slow



View at toe (2011)



View from across (2014)



Johnson's Bridge to Bear Track (continued)

Site 36

44.12045, -85.97579

Aspect: SE

Slope: 2:1

Length: 35'

Height: 15'

Severity: Moderate

Ownership: State

River-right

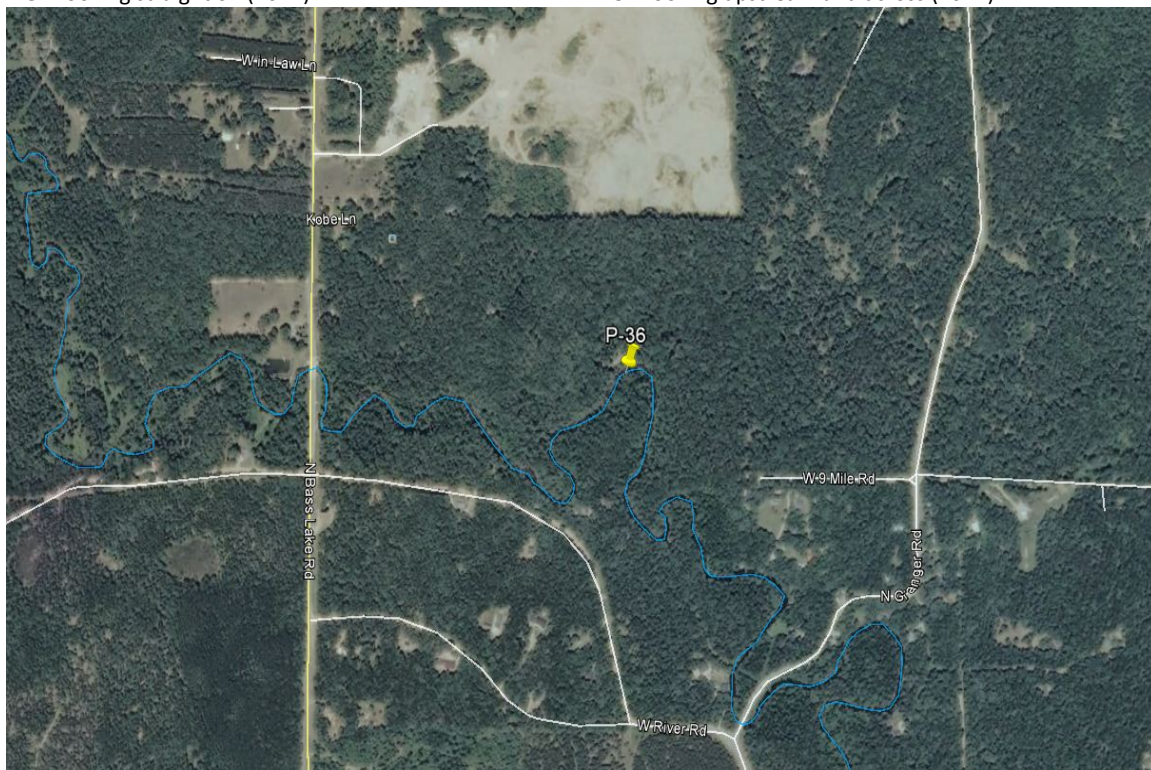
Notes: channel width 46', water depth 1.5', two-track at top of bluff, recreational foot traffic, trail on both sides of river, substrate small gravel/sand/organic material/macrophytes (primarily *naiad*)



View looking straight on (2011)



View looking upstream and across (2014)



Johnson's Bridge to Bear Track (continued)

Site 37

(Immediately downstream of Site 36)

Aspect: SE

Slope: 2:1

Length: 15'

Height: 35'

Severity: Moderate

Ownership: State

River-right

Notes: two-track at top of bluff, recreation foot traffic, trail on both sides of river, channel width 46', substrate small gravel/sand/organic material/macrophytes, depth at toe 1.5'



View straight on (2011)



Johnson's Bridge to Bear Track (continued)

Site 39

44.12311, -85.98900

Aspect: W

Slope: 1:1

Length: 32'

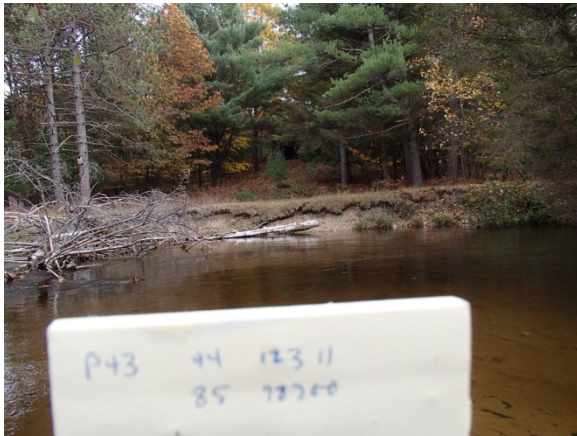
Height: 5'

Severity: Moderate

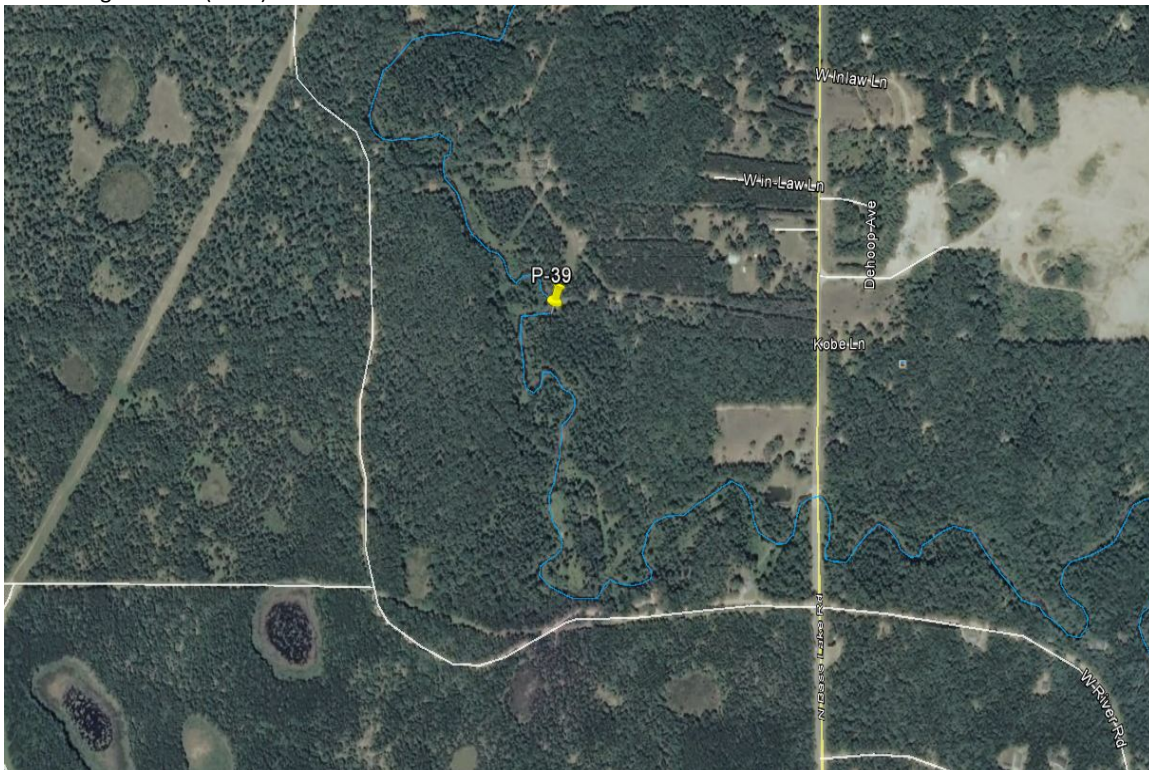
Ownership: Private (red camp located upland from river)

River-right

Notes: toe of bank unstable, channel width 40', water depth 2', substrate gravel and sand, outside of meander bend



View straight across (2014)



Johnson's Bridge to Bear Track (continued)

Site 40

44.14604, -86.02100

Aspect: S

Slope: 1:1

Length: 50'

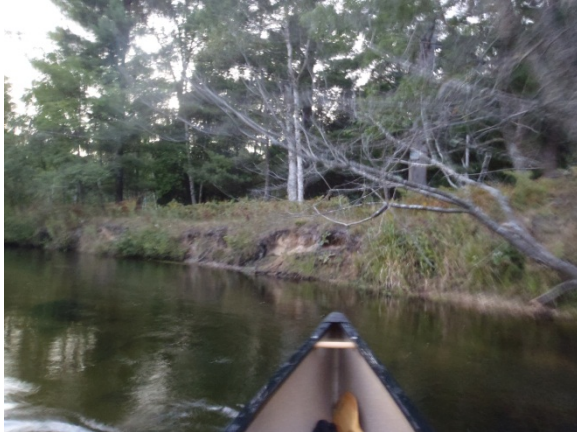
Height: 4'

Severity: Minor

Ownership: Private

River-right

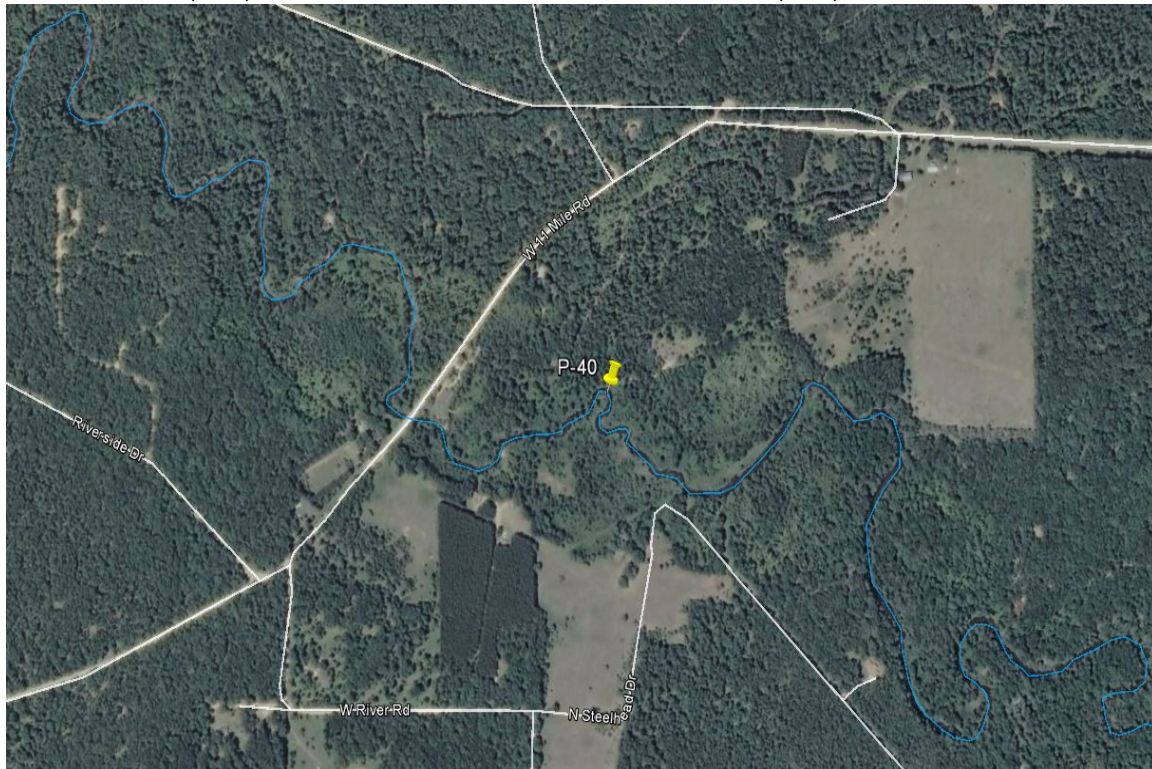
Notes: substrate gravel and macrophytes, channel width 20', depth at toe 1.5'



View downstream (2011)



View downstream (2014)



Johnson's Bridge to Bear Track (continued)

Site 41

44.14946, -86.03151

Aspect: N

Slope: 1.5:1

Length: 18'

Height: 4.5'

Severity: Moderate

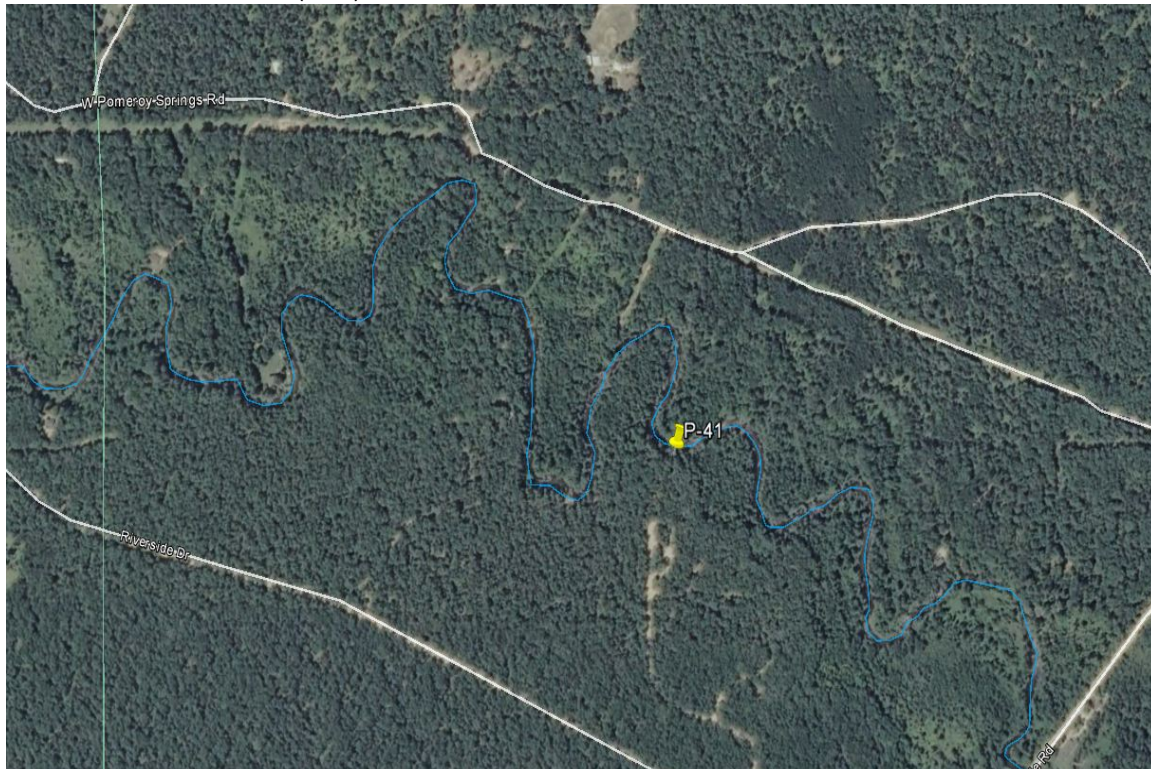
Ownership: Federal

River-left

Notes: access to river at Bear Track Campground



View downstream and across (2011)



Little Manistee River Eroding Stream Bank Assessment: Bear Track to 9 Mile Bridge

Site 42

44.14892, -86.03348

Aspect: N

Slope: 1.5:1

Length: 75'

Height: 37'

Severity: Severe

Ownership: Private

River-left

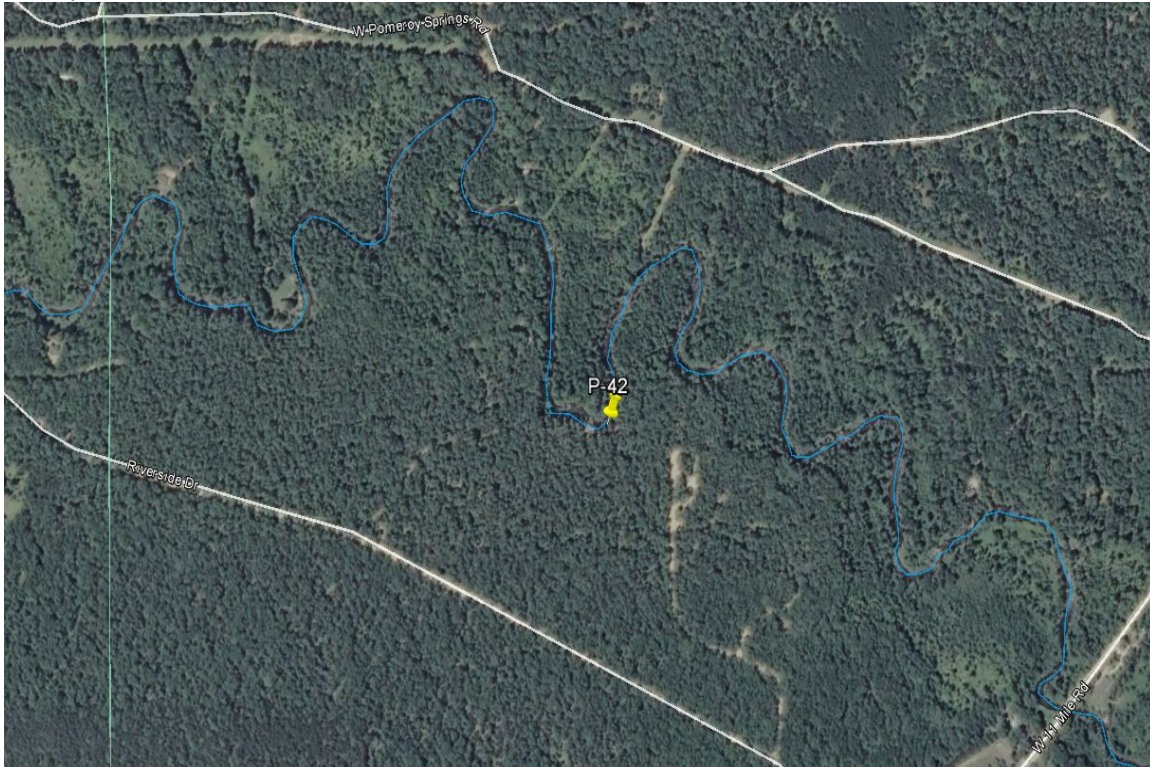
Notes: water depth 3.5' at toe, substrate sand and large wood



View upstream (2011)



View downstream (2014)



Bear Track to 9 Mile Bridge (continued)

Site 43

44.15312, -86.04842

Aspect: NE

Slope: 1.5:1

Length: 20'

Height: 8'

Severity: Minor

Ownership: Federal

River-right

Notes: some clay in bank-stable, substrate silt/sand/macrophytes/some gravel



View downstream and across (2014)



Bear Track to 9 Mile Bridge (continued)

Site 44

44.15501, -86.05926

Aspect: S

Slope: 1:1

Length: 15'

Height: 8'

Severity: Moderate

Ownership: Federal

River-left

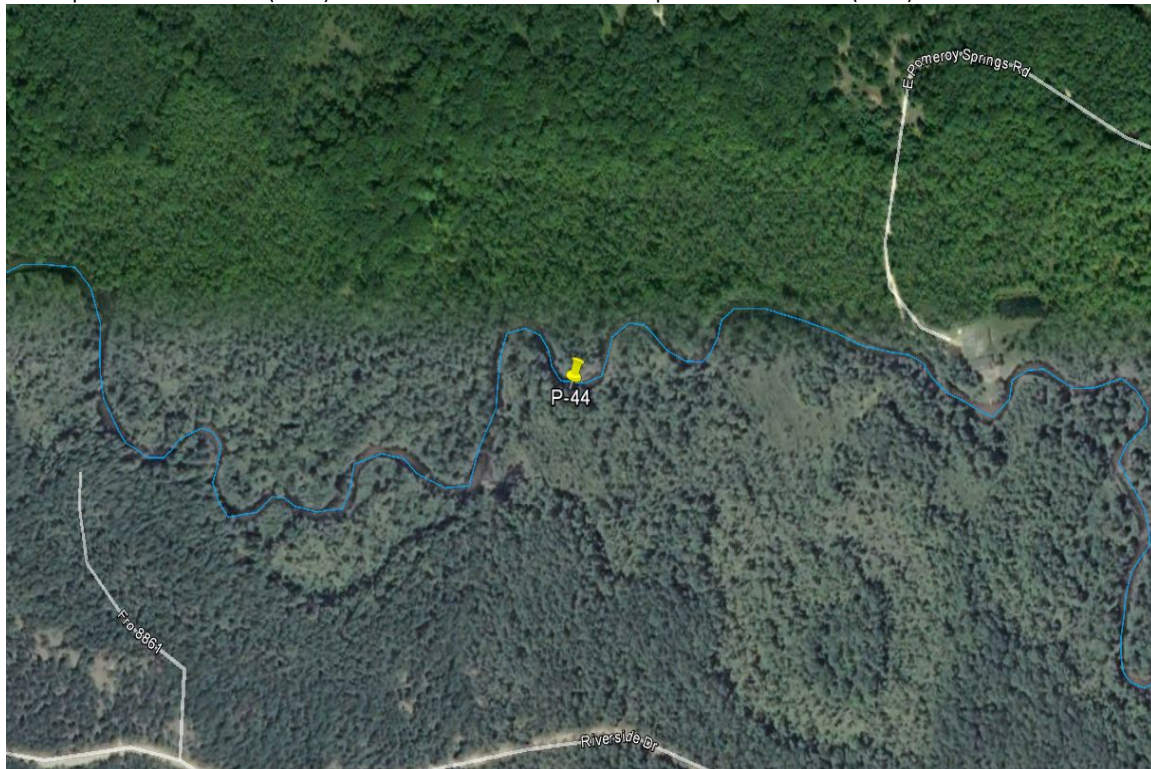
Notes: substrate sand/large wood/small gravel, depth at toe 3', minimal movement of wood in frame



View upstream and across (2011)



View upstream and across (2014)



Bear Track to 9 Mile Bridge (continued)

Site 45

44.15800, -86.06942

Aspect: SW

Slope: 1.5:1

Length: 74'

Height: 36'

Severity: Severe

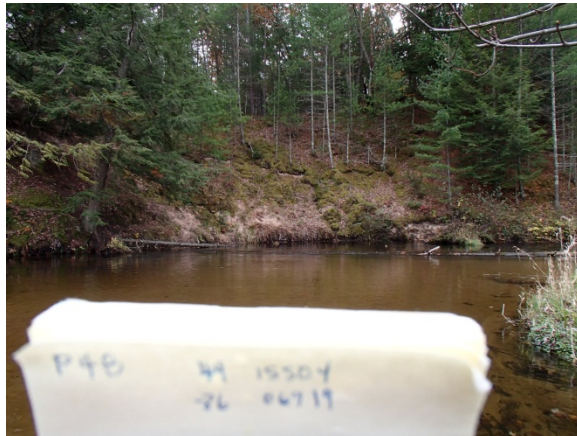
Ownership: Federal

River-left

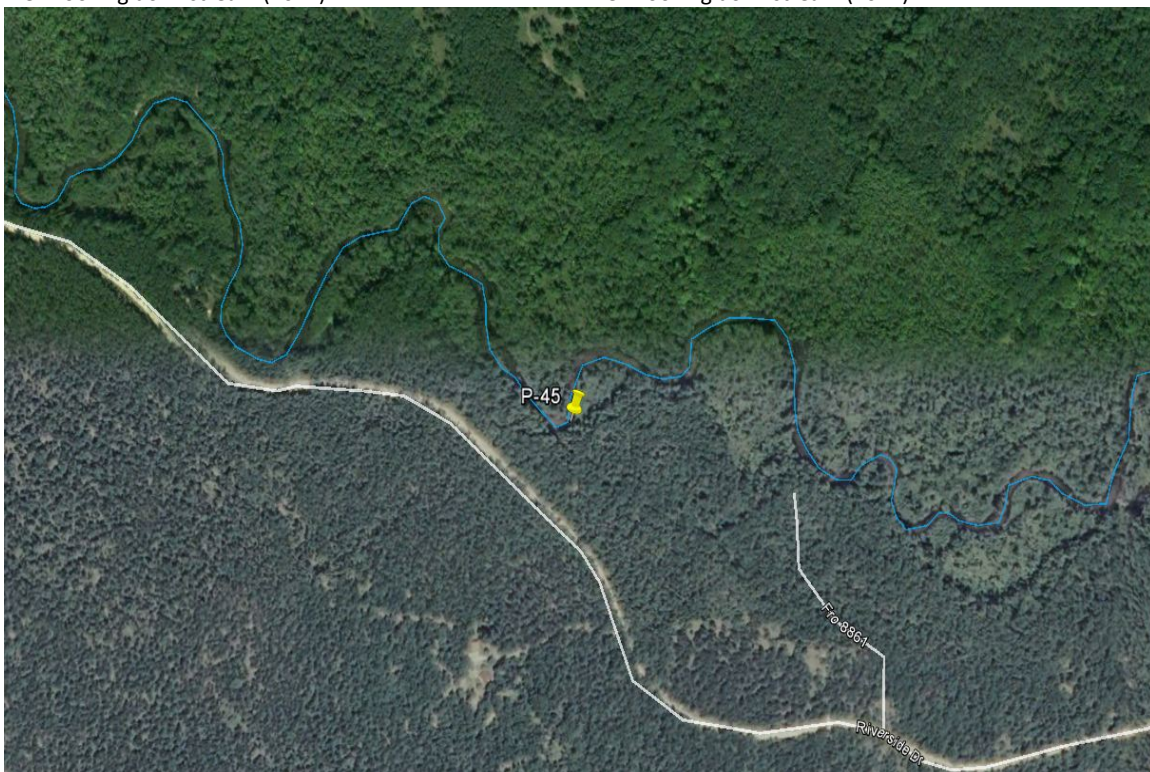
Notes: starting to see number of dead standing cedar in this area, channel extremely wide, depth at toe 4', substrate silt and sand



View looking downstream (2011)



View looking downstream (2014)



Bear Track to 9 Mile Bridge (continued)

Site 46

44.15785, -86.07438

Aspect: SW

Slope: Vertical

Length: 15'

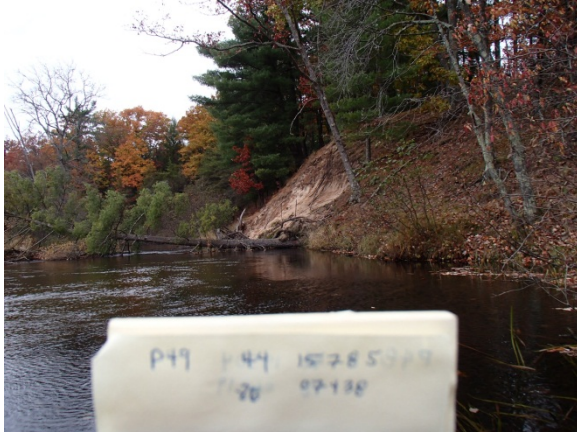
Height: 20'

Severity: Severe

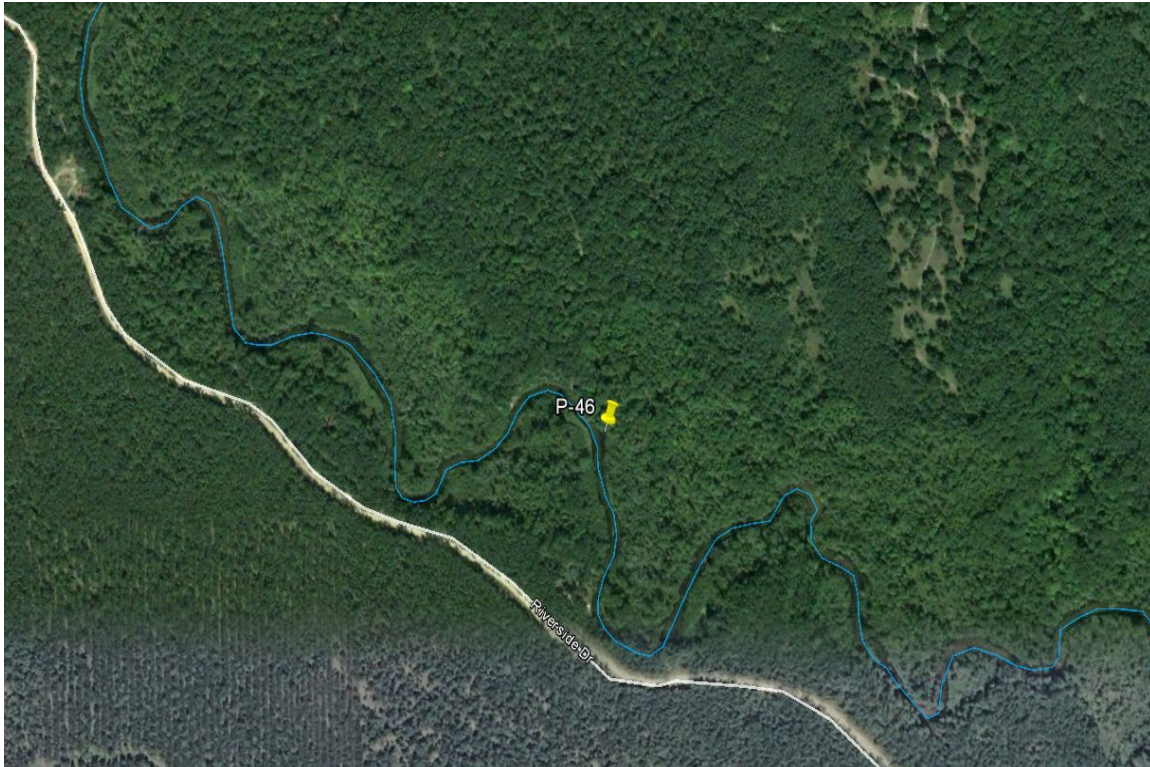
Ownership: Federal

River-right

Notes: new since 2011 survey, white pine snag took bank out



View looking downstream (2014)



Bear Track to 9 Mile Bridge (continued)

Site 47

44.15840, -86.07536

Aspect: SE

Slope: 1.5:1

Length: 40'

Height: 15'

Severity: Moderate

Ownership: Federal

River-right

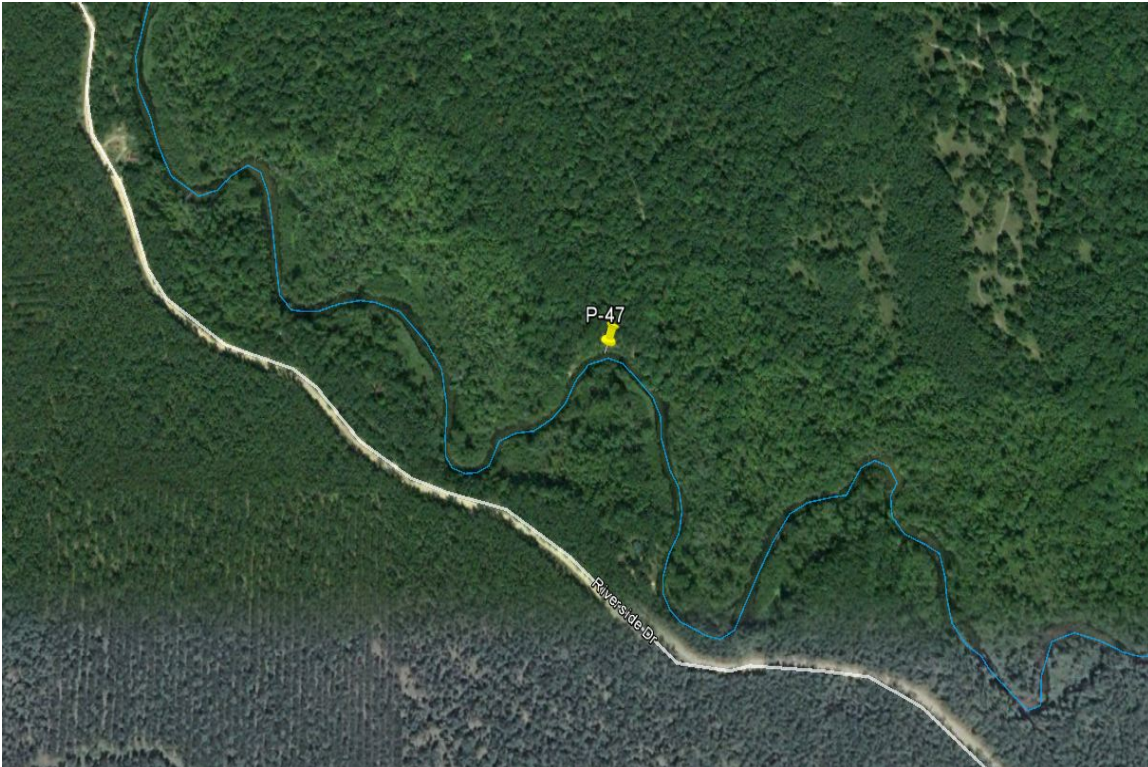
Notes: water depth at toe 5', slow back eddy, substrate sand and silt



View downstream (2011)



View downstream (2014)



Bear Track to 9 Mile Bridge (continued)

Site 48

44.16675, -86.08632

Aspect: SE

Slope: 1.75:1

Length: 120'

Height: 23'

Severity: Moderate

Ownership: Private

River-right

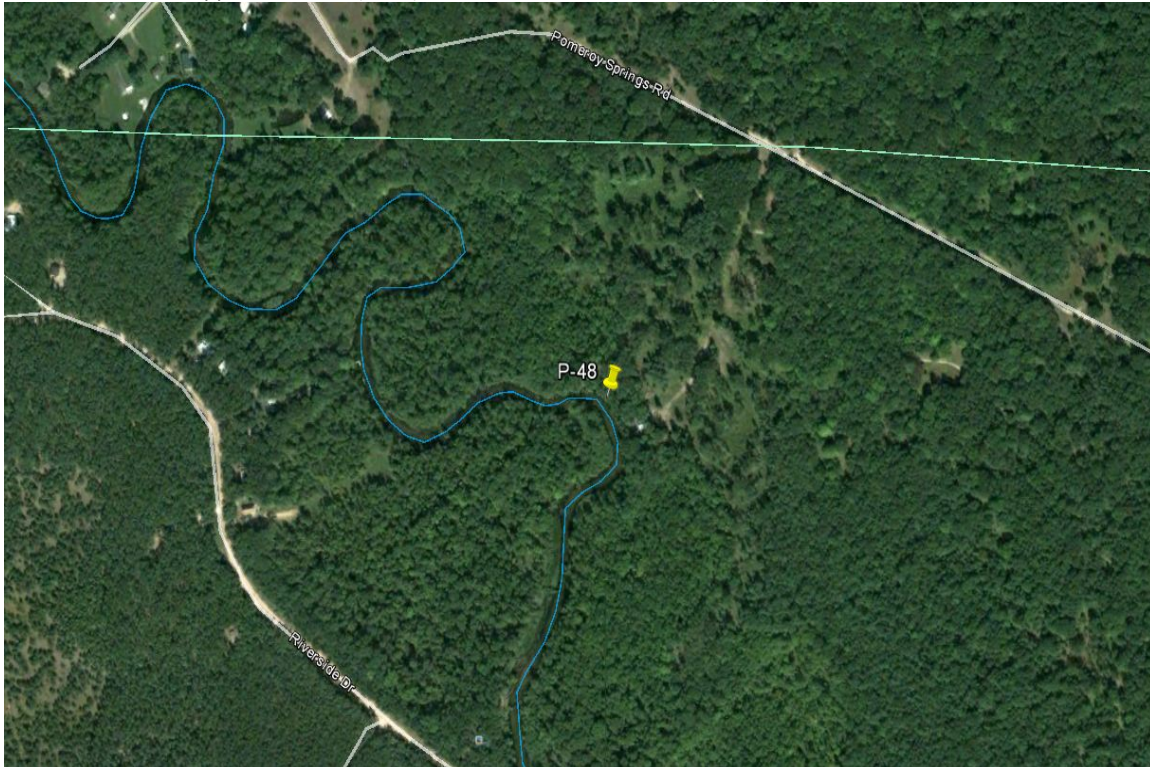
Notes: campsite and associated recreational traffic, substrate silt and sand, depth at toe 3'



View downstream, approach to site (2011)



View across (2014)



Bear Track to 9 Mile Bridge (continued)

Site 49

44.17103, -86.09265

Aspect: W

Slope: Vertical

Length: 50'

Height: 20'

Severity: Minor

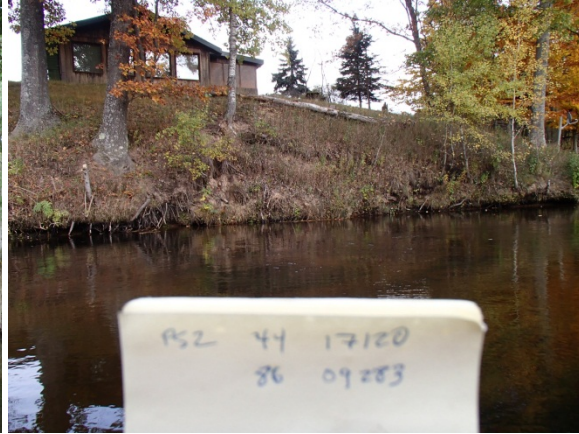
Ownership: Private

River-right

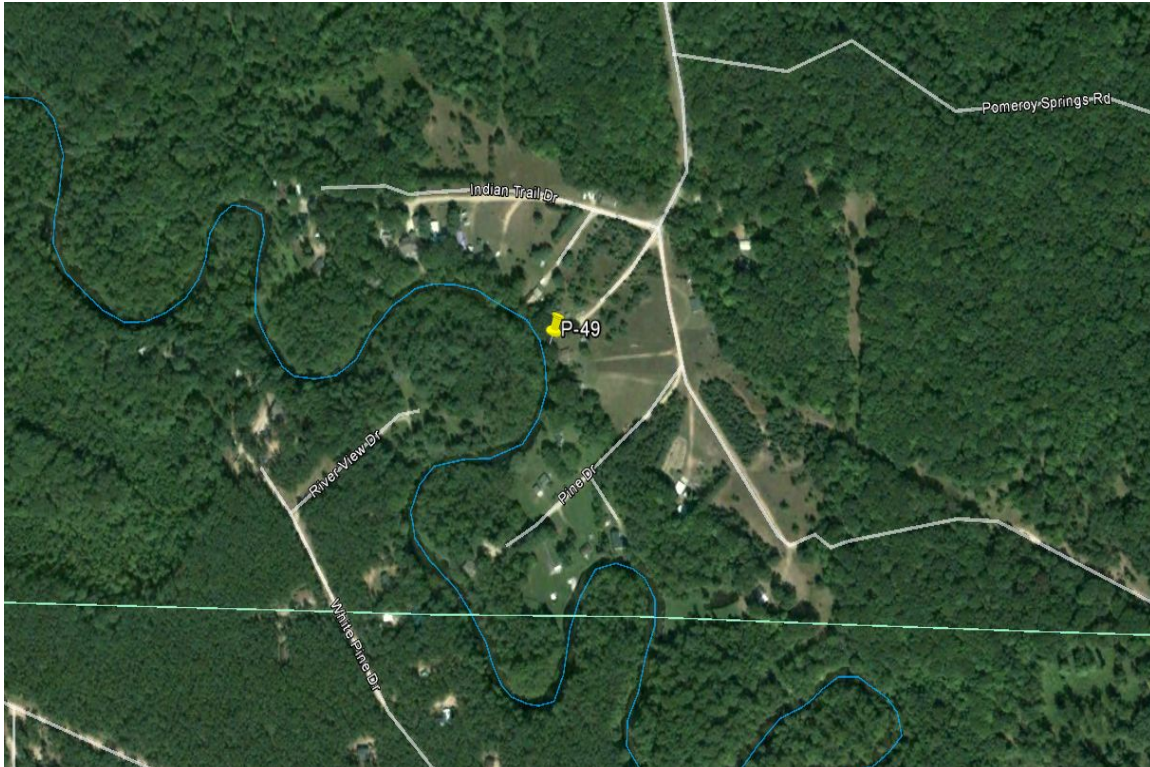
Notes: substrate small and medium gravel, depth at toe 2', Pomeroy Springs/Indian Trail area



View across (2011)



View across (2014)



Little Manistee River Eroding Stream Bank Assessment: 9 Mile Bridge to 6 Mile Bridge

Site 50

44.17063, -86.10652

Aspect: NE

Slope: 2:1

Length: 65'

Height: 20'

Severity: Severe

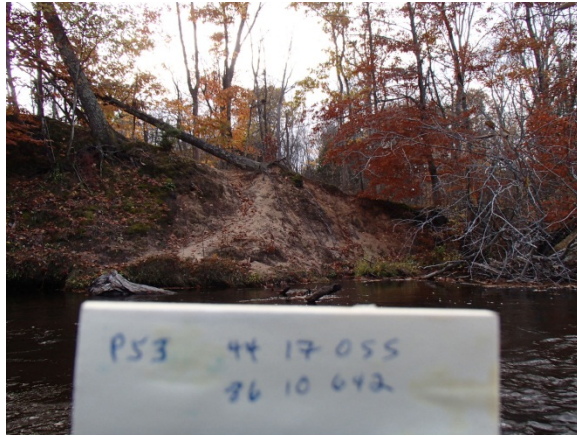
Ownership: Federal

River-left

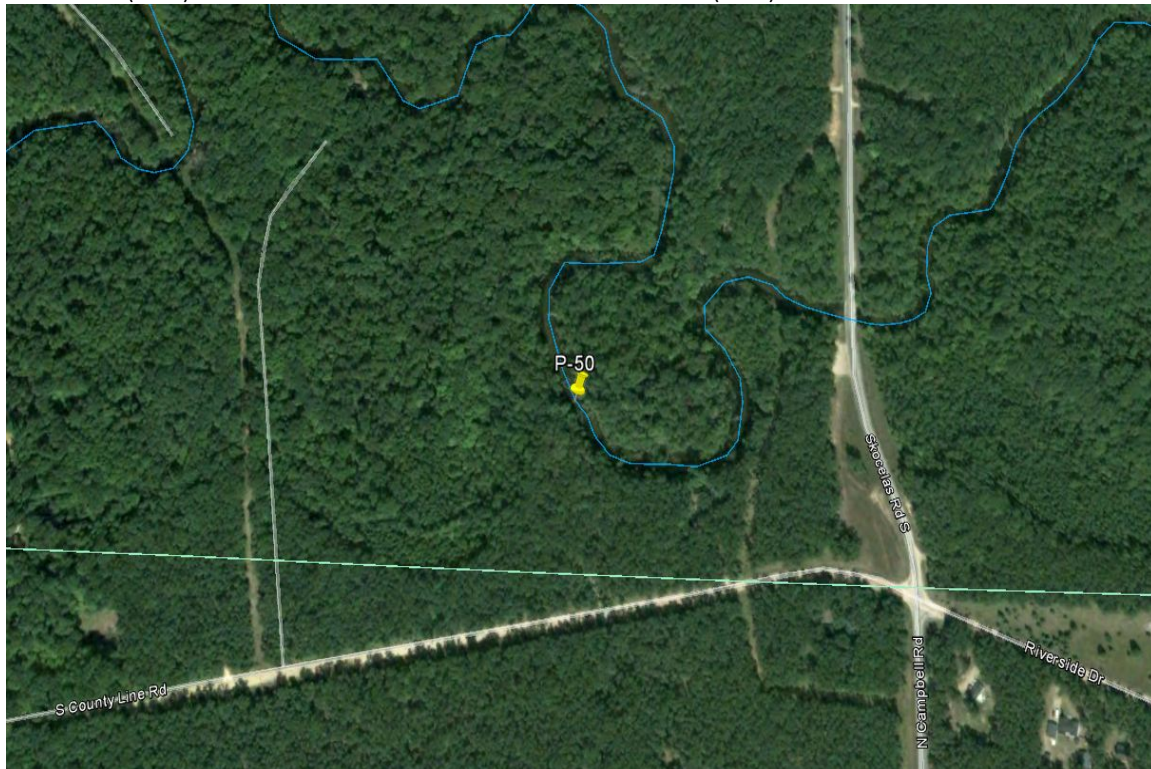
Notes: substrate sand/wood/organic material, depth at toe 5'



View across (2011)



View across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 51

44.17343, -86.11155

Aspect: NE

Slope: 2:1

Length: 18'

Height: 12'

Severity: Moderate

Ownership: Private

River-right

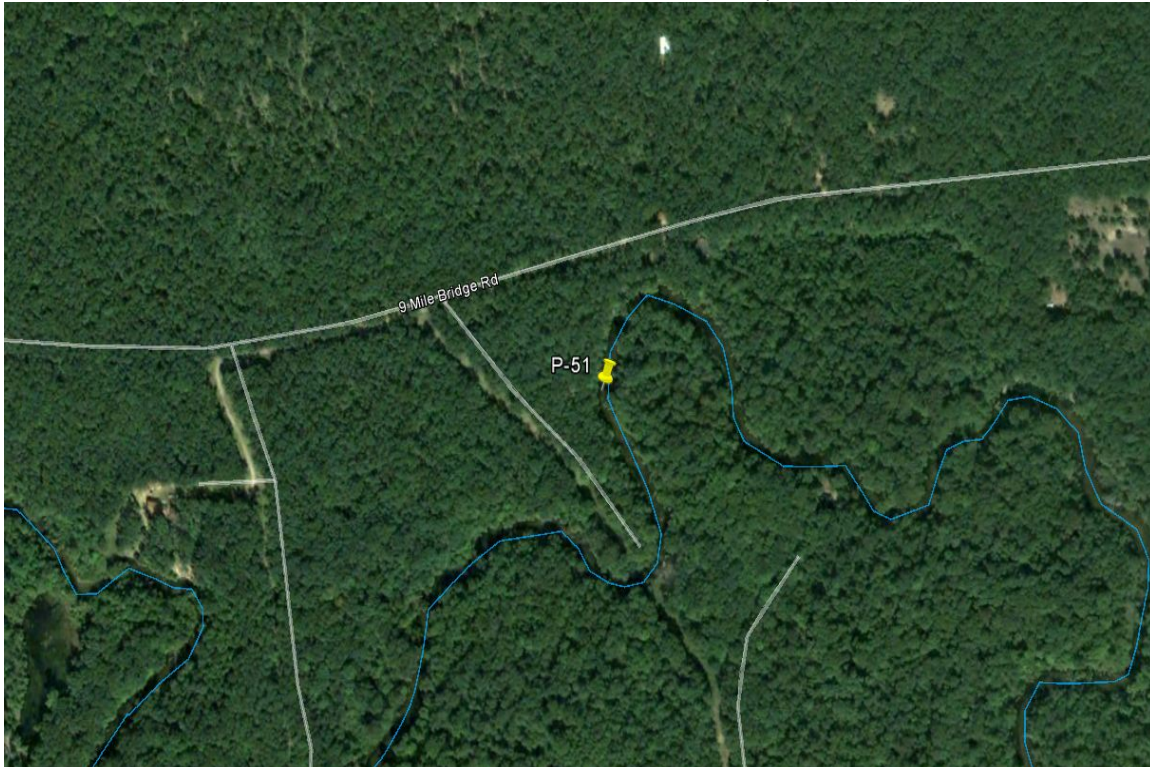
Notes: substrate sand/medium gravel, depth at toe 4'



View across (2011)



View across and upstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 52

44.16944, -86.11571

Aspect: E

Slope: Vertical

Length: 16'

Height: 5'

Severity: Minor

Ownership: Private

River-right

Notes: substrate coarse gravel, depth at toe 1.5', outside of meander, undercut



View downstream and across (2011)



View upstream and across-note maple snag (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 53

44.17276, -86.11858

Aspect: S

Slope: vertical (2011), 2:1 (2014)

Length: 40'

Height: 12' (2011), 18' (2014)

Severity: Severe

Ownership: Private

River-right

Notes: notable change in dimensions between 2011 and 2014, substrate gravel/sand, depth at toe 3'



View downstream (2011)



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 54

(Immediately adjacent downstream of prior site-could be considered one large site)

Aspect: E

Slope: 2:1, 1:1

Length: 125'

Height: 30'

Severity: Severe

Ownership: Private

River-right

Notes: toe-stone had been installed as well as terracing farther up the bluff, recreational traffic at issue, substrate gravel/sand/wood debris



View of midsection of site (2011)



View of downstream end of site (2011)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 55

44.17129, -86.11982

Aspect: SE

Slope: Vertical

Length: 18'

Height: 10'

Severity: Severe

Ownership: Federal

River-right

Notes: substrate small gravel/sand/wood, depth at toe 3.5'



View downstream (2011)



View upstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 56

44.17105, -86.12032

Aspect: NE

Slope: 1.5:1 (2011), 1:1 (2014)

Length: 18'

Height: 12'

Severity: Severe

Ownership: Private

River-left

Notes: clay ledge at toe, part of previously restored bank, substrate sand/small gravel/large wood, depth at toe 2'



View across (2011)



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 57

44.17134, -86.12100

Aspect: NE

Slope: 1.5:1 (2011), 1:1 (2014)

Length: 120'

Height: 12'

Severity: Severe

Ownership: Private

River-left

Notes: clay ledge at toe, severity increased in intervening years



View downstream (2011)



View upstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 58

44.17248, -86.12090

Aspect: W

Slope: 1.5:1

Length: 140'

Height: 40'

Severity: Moderate

Ownership: Federal

River-right

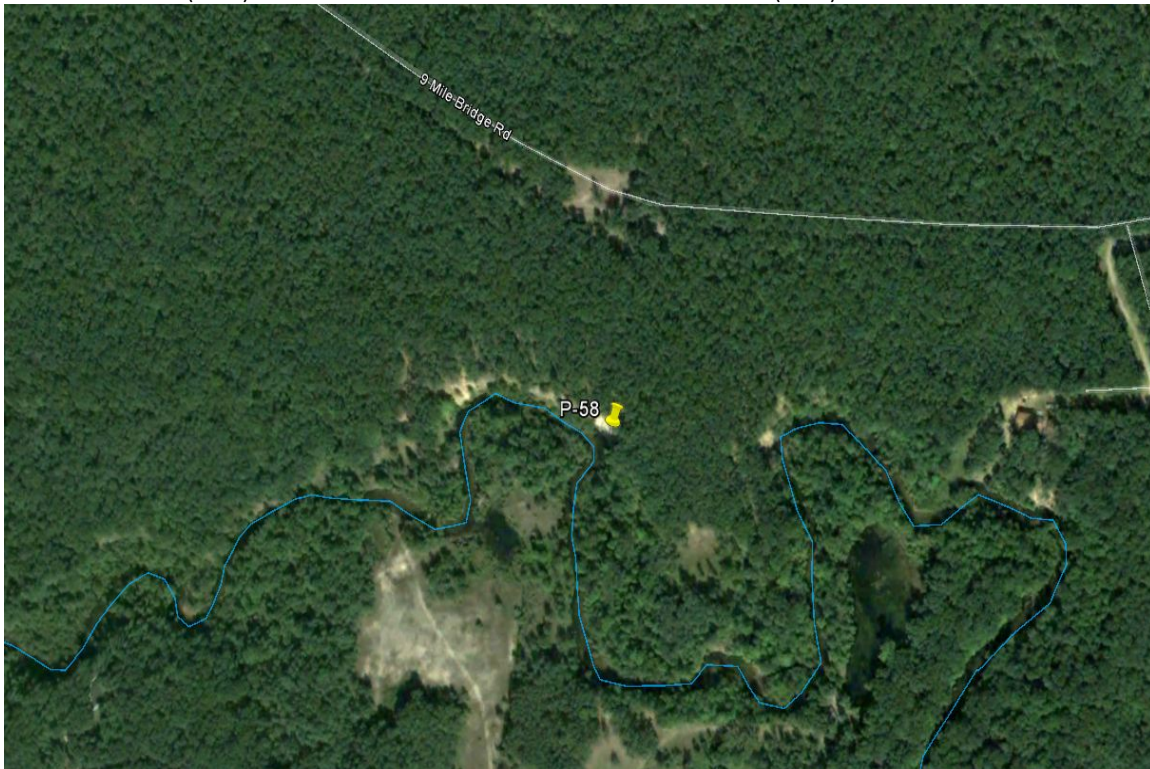
Notes: toe stable, prior work done, spring at toe, depth at toe 3', substrate sand/wood



View downstream (2011)



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 59

44.17273, -86.12226

Aspect: SE

Slope: Vertical

Length: 210'

Height: 12'

Severity: Severe

Ownership: Federal

River-right

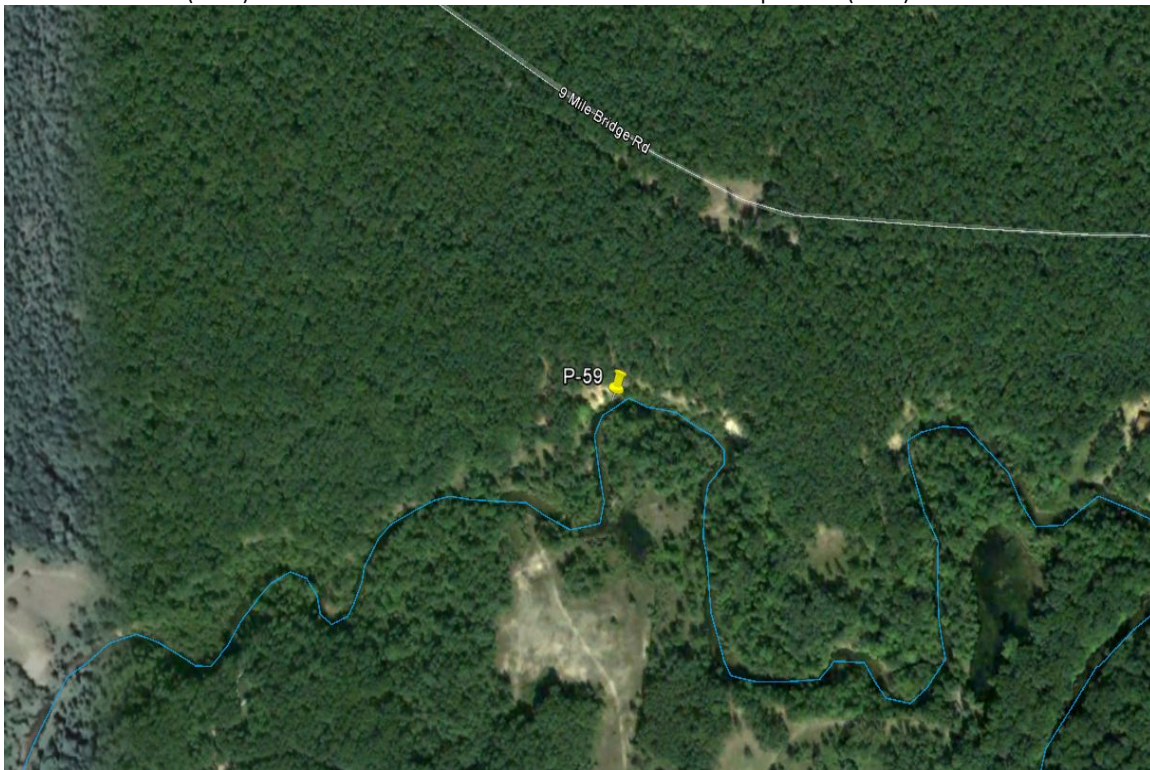
Notes: angler access, continuation of prior site, clay exposed in bank, back eddies caused by debris jam, depth at toe 3'



View downstream (2011)



View across and upstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 60

44.17191, -86.12246

Aspect: S

Slope: 1:1

Length: 80'

Height: 8'

Severity: Severe

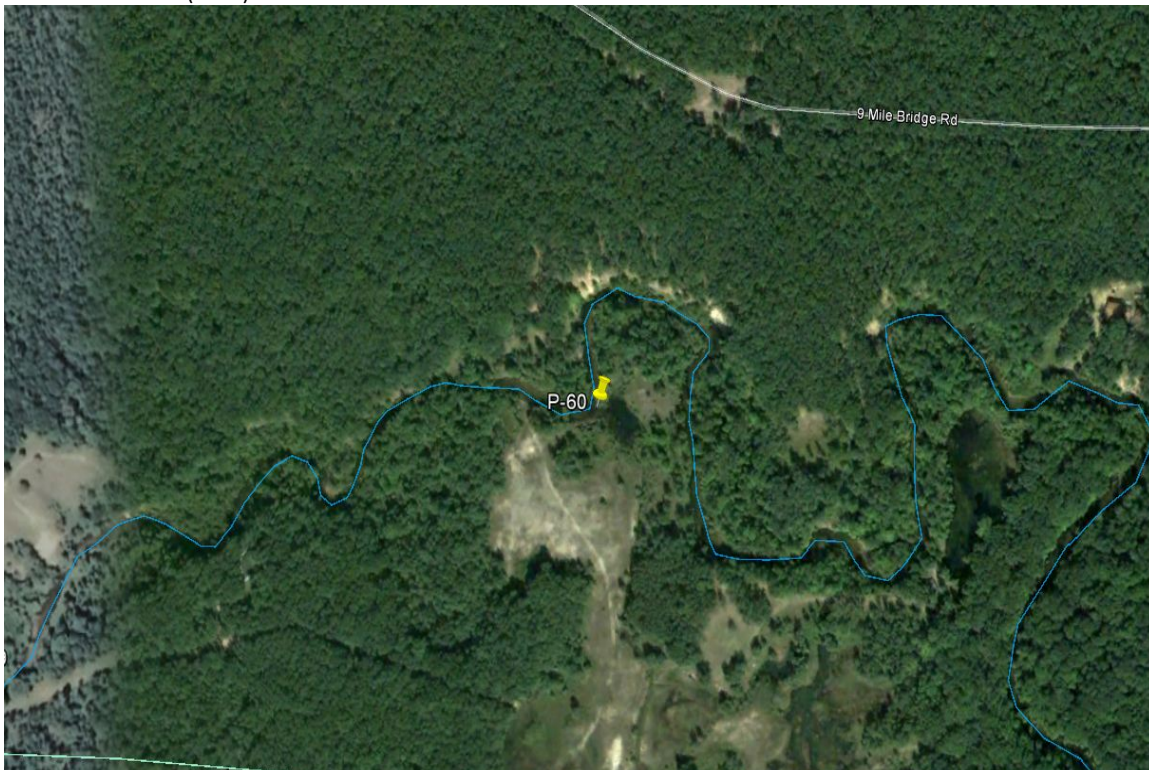
Ownership: Private

River-left

Notes: depth at toe 2', substrate coarse gravel, rapid back eddy, large amount of gravel in bank, partly protected by debris jam



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 61

44.17218, -86.12317

Aspect: SSE

Slope: 1:1

Length: 30'

Height: 8'

Severity: Moderate

Ownership: Federal

River-right

Notes:



View across (2011)



View across (2011)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 62

44.17180, -86.12465

Aspect: S

Slope: 1:1

Length: 30'

Height: 10'

Severity: Moderate

Ownership: Federal

River-right

Notes:



View upstream and across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 63

44.17156, -86.12486

Aspect: N

Slope: 1:1, Vertical

Length: 60'

Height: 12'

Severity: Severe

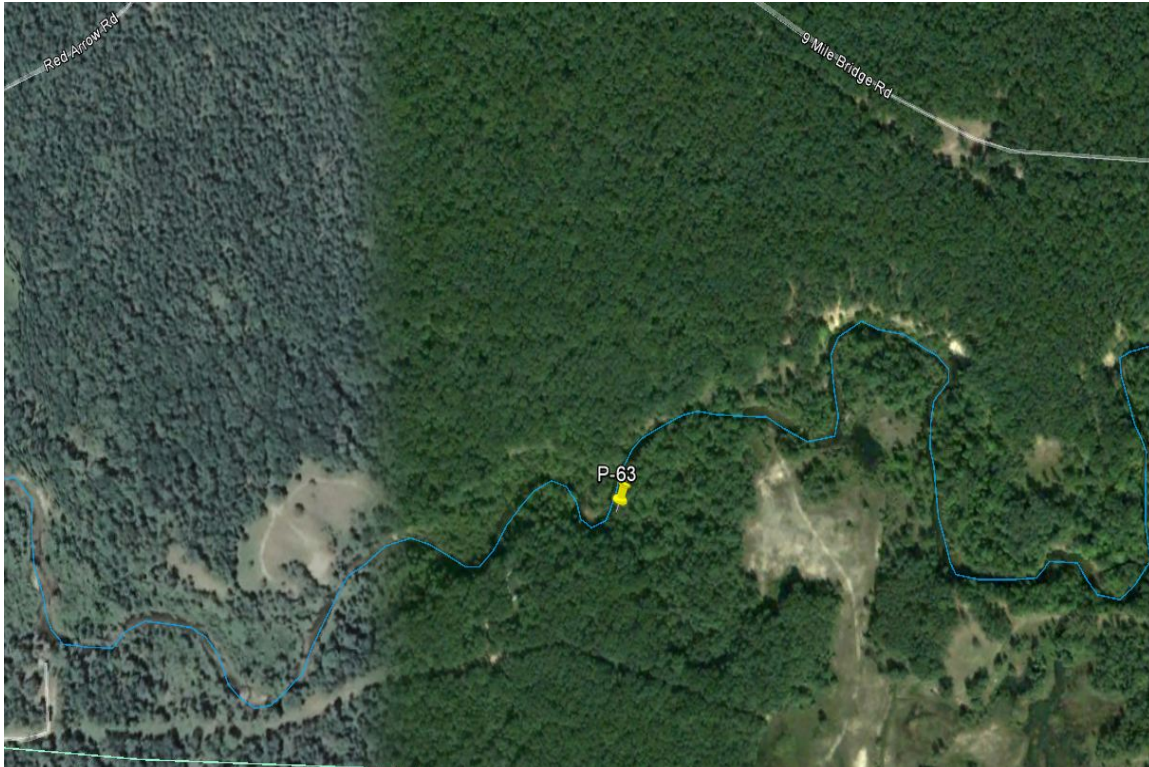
Ownership: Private

River-left

Notes:



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 64

44.17125, -86.12619

Aspect: N

Slope: 1:1

Length: 40'

Height: 12'

Severity: Minor

Ownership: Private

River-left

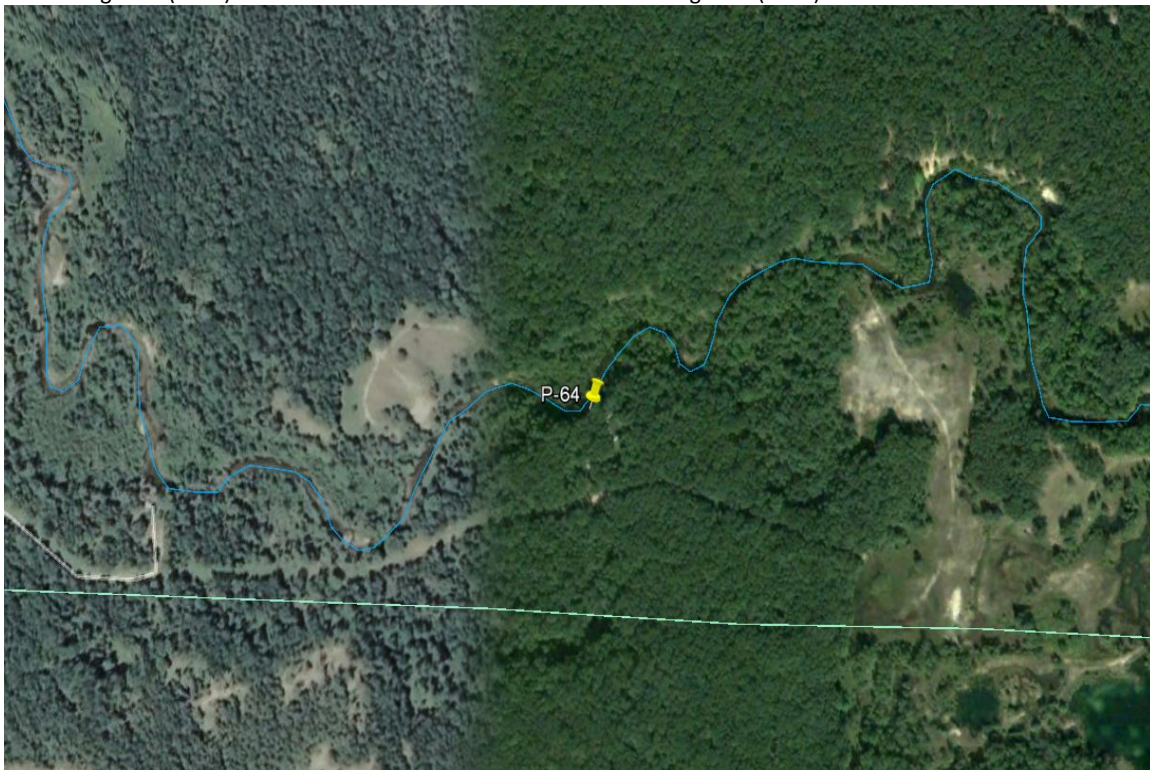
Notes: substrate gravel/sand, depth at toe 3', back-eddy causing toe erosion, landowner dropped trees in 2011 frame and placed at toe for protection



View straight on (2011)



View straight on (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 65

44.17134, -86.12689

Aspect: S

Slope: Vertical

Length: 18'

Height: 20'

Severity: Severe

Ownership: Federal

River-right

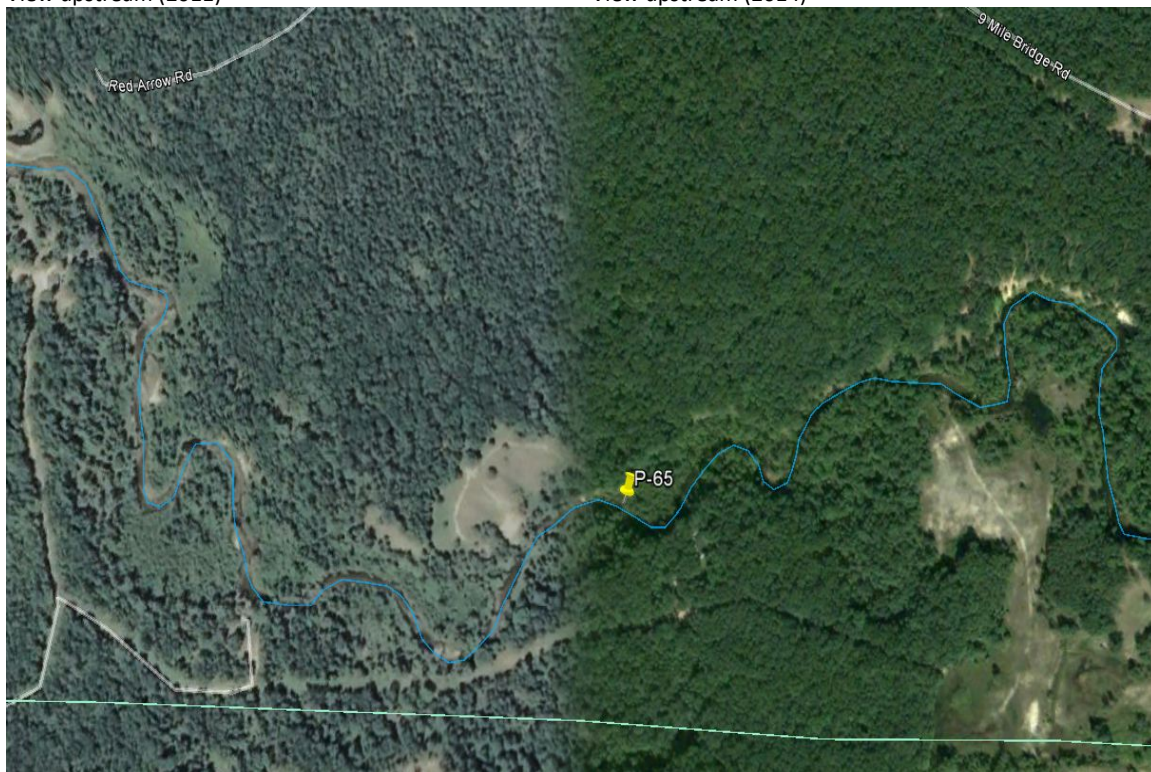
Notes: depth at toe 3', substrate gravel/sand, erosion resulting from boiling and eddying from current deflecting off relic structure into toe



View upstream (2011)



View upstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 66

44.17019, -86.12878

Aspect: NE

Slope: Vertical

Length: 12'

Height: 30'

Severity: Severe

Ownership: Private

River-left

Notes:



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 67

44.17061, -86.13050

Aspect: N

Slope: Vertical

Length: 50'

Height: 8'

Severity: Minor (2011), Severe (2014)

Ownership: Private (Kevin Kops)

River-left

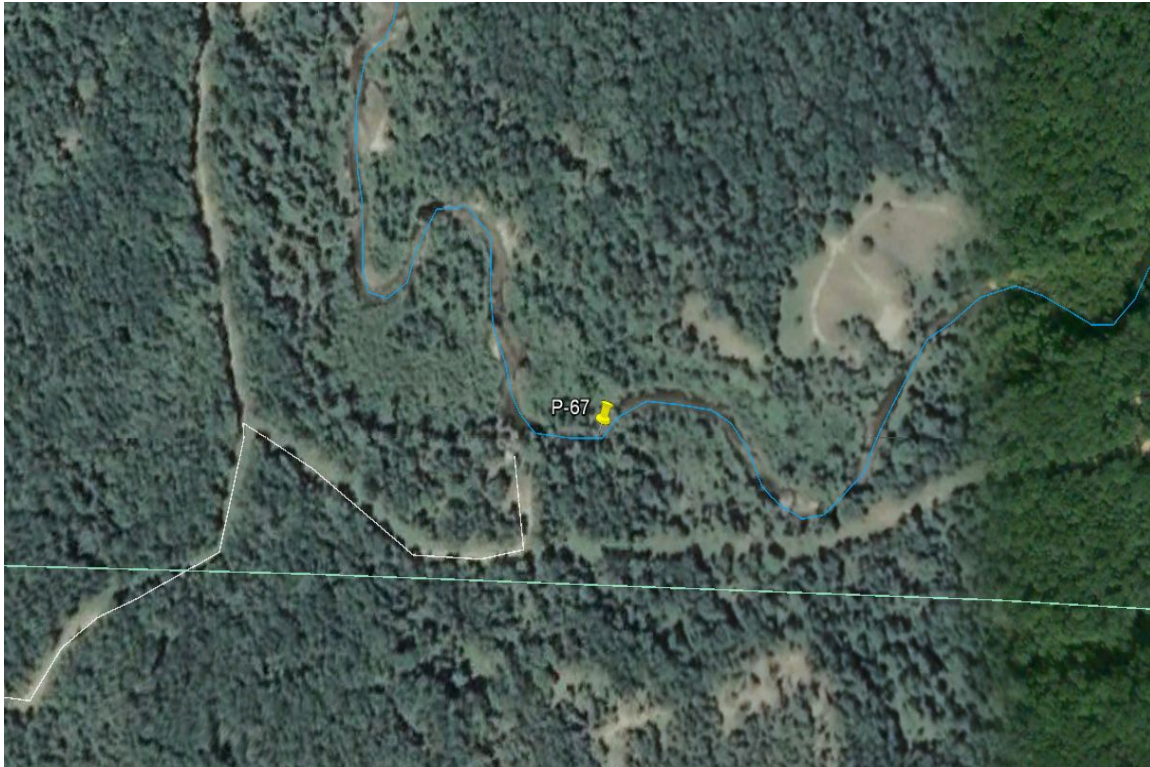
Notes: substantial change in severity in intervening years



View downstream (2011)



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 68

44.17126, -86.13128

Aspect: S

Slope: 1:1, Vertical

Length: 220'

Height: 12-15'

Severity: Severe

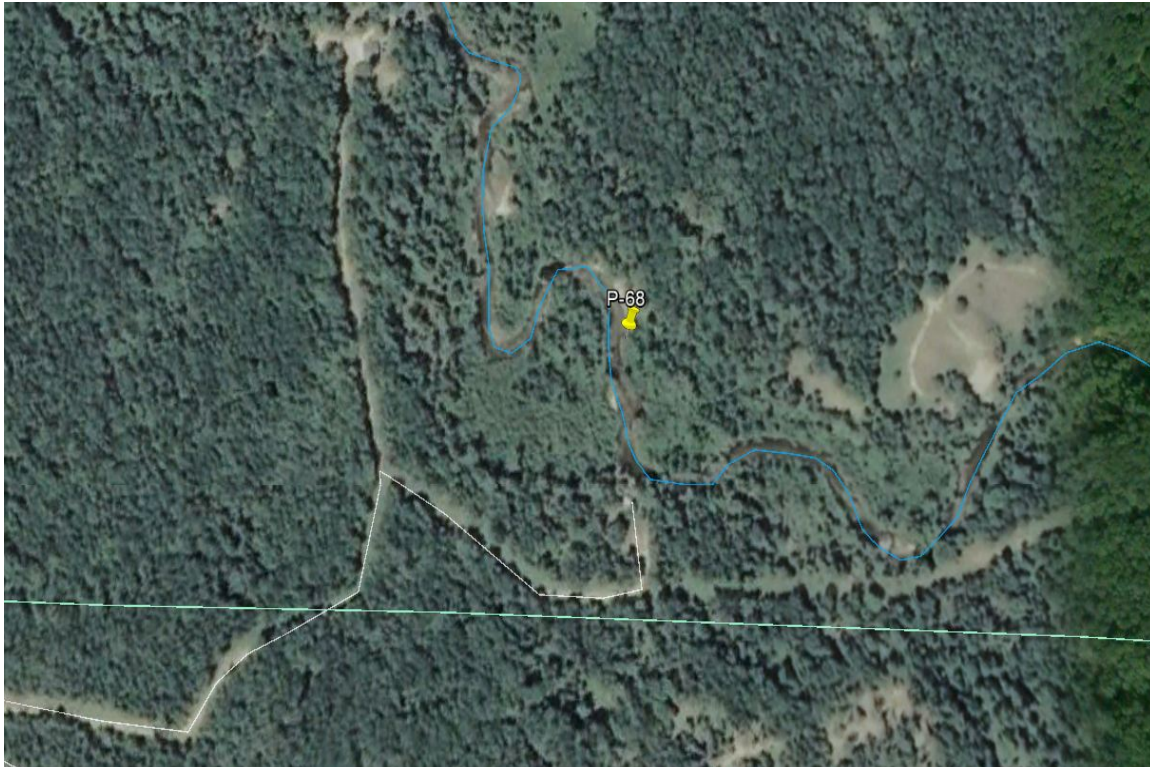
Ownership: Federal

River-right

Notes: new as of 2014 survey



View downstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 69

44.17371, -86.13341

Aspect: S

Slope: Vertical

Length: 12'

Height: 3'

Severity: Minor

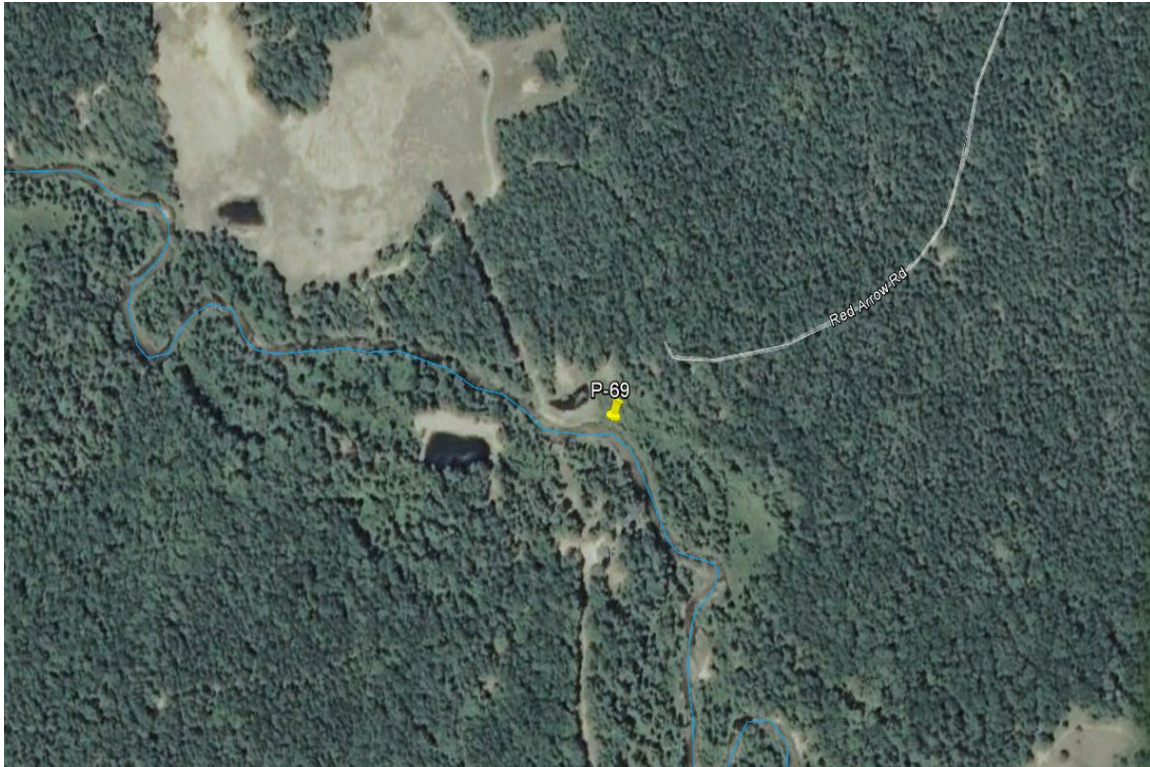
Ownership: Private

River-right

Notes: a pond is located on the up-country side of the bank



View across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 70

44.17403, -86.13457

Aspect: S

Slope: Vertical

Length: 15'

Height: 3'

Severity: Minor

Ownership: Private

River-right

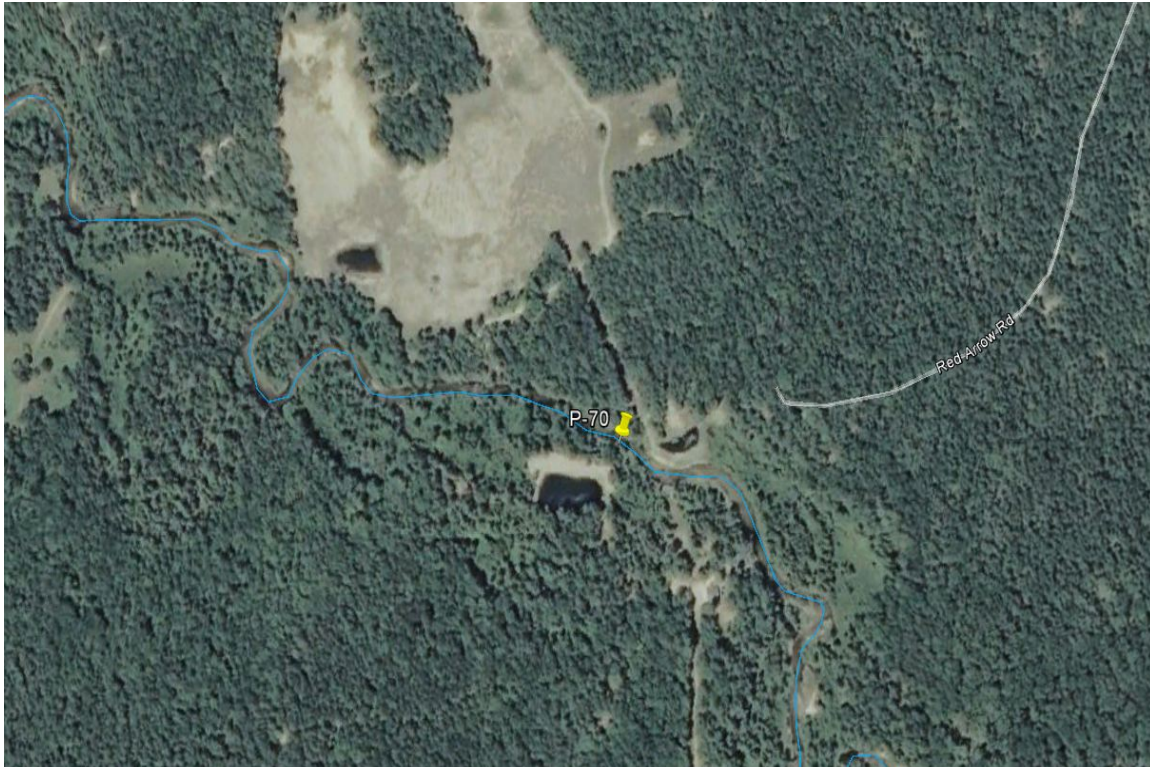
Notes: angler path at top, substrate gravel/clay at toe



View across (2011)



View across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 71

44.17411, -86.13509

Aspect: S

Slope: Vertical

Length: 20'

Height: 5'

Severity: Minor

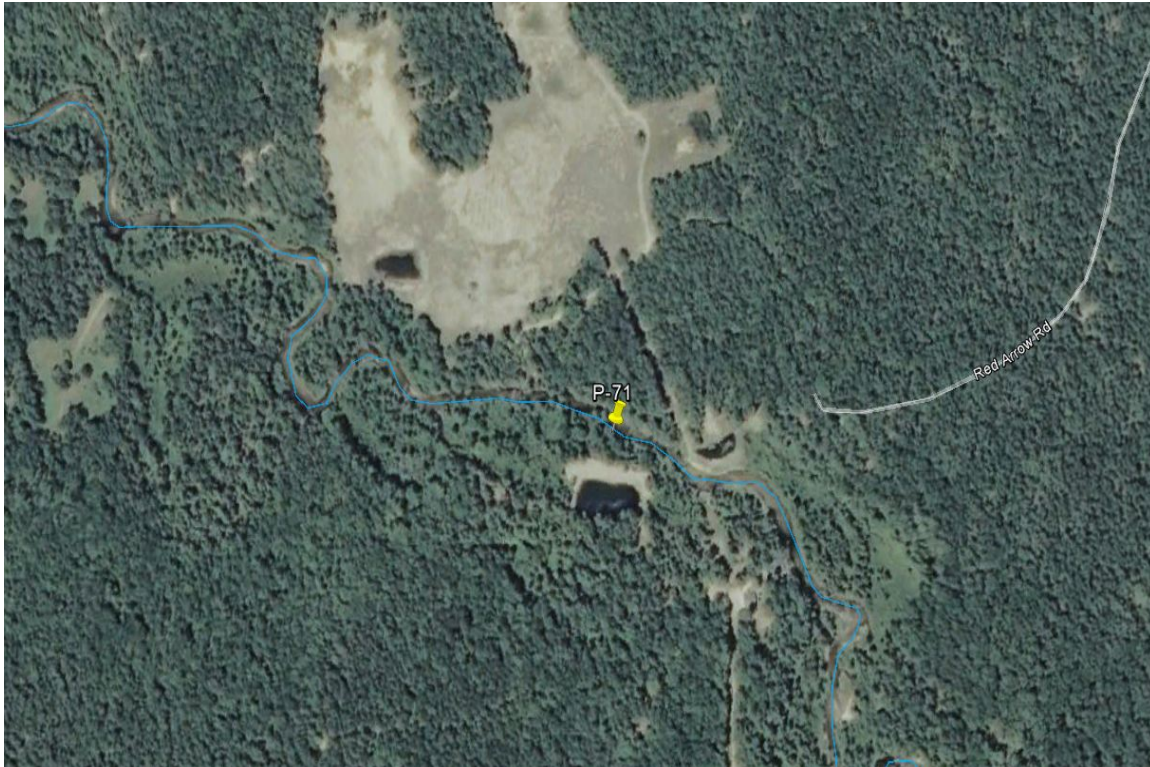
Ownership: Private

River-right

Notes: angler path at top, substrate gravel/clay at toe



View downstream and across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 72

44.17437, -86.13871

Aspect: N

Slope: Vertical

Length: 120'

Height: 10'

Severity: Severe

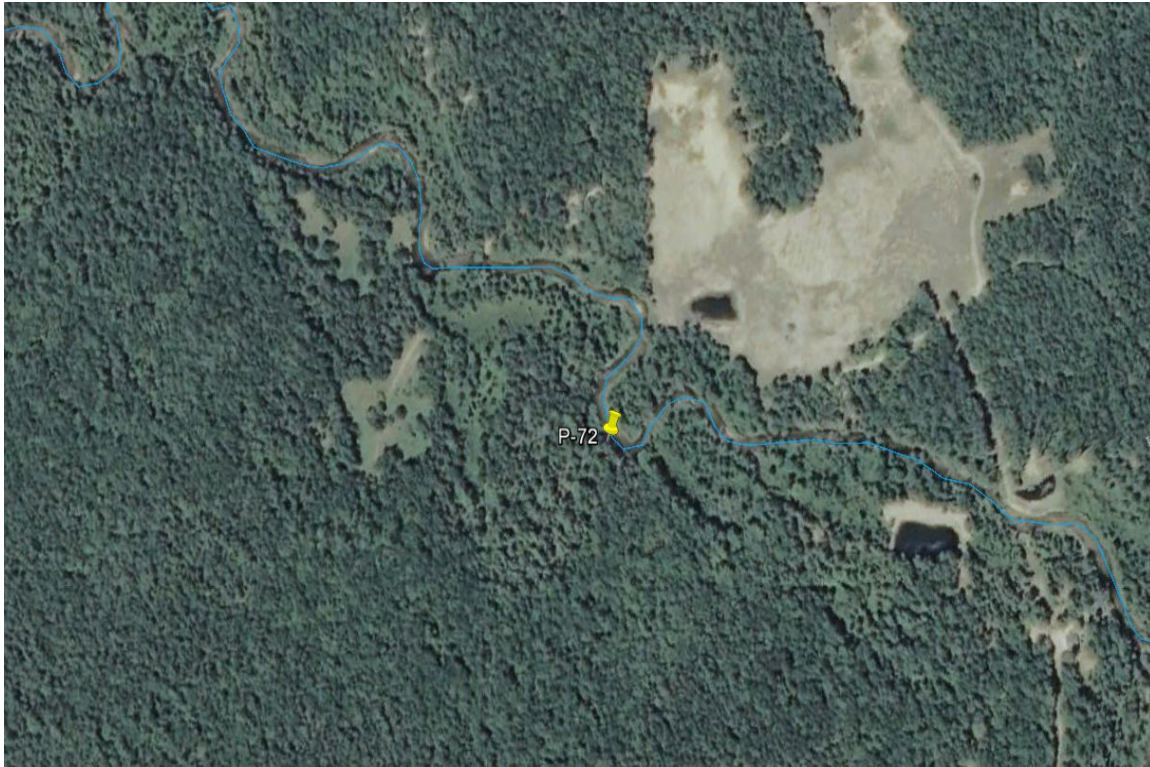
Ownership: Federal

River-left

Notes: new as of 2014 survey



View upstream and across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 73

44.17463, -86.13888

Aspect: SE

Slope: 1:1

Length: 45'

Height: 6'

Severity: Moderate

Ownership: Federal

River-left

Notes: substrate gravel/sand/wood, depth at toe 3'



View across (2011)



View across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 74

44.17569, -86.14110

Aspect: E

Slope: 2:1 (2011), 1:1 (2014)

Length: 50'

Height: 3'

Severity: Minor (2011), Moderate (2014)

Ownership: Federal

River-left

Notes: angler campsite and access, depth at toe 2', substrate gravel/cobble



View downstream (2011)



View upstream (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 75

44.17679, -86.14485

Aspect: N

Slope: 1:1

Length: 12'

Height: 4'

Severity: Moderate

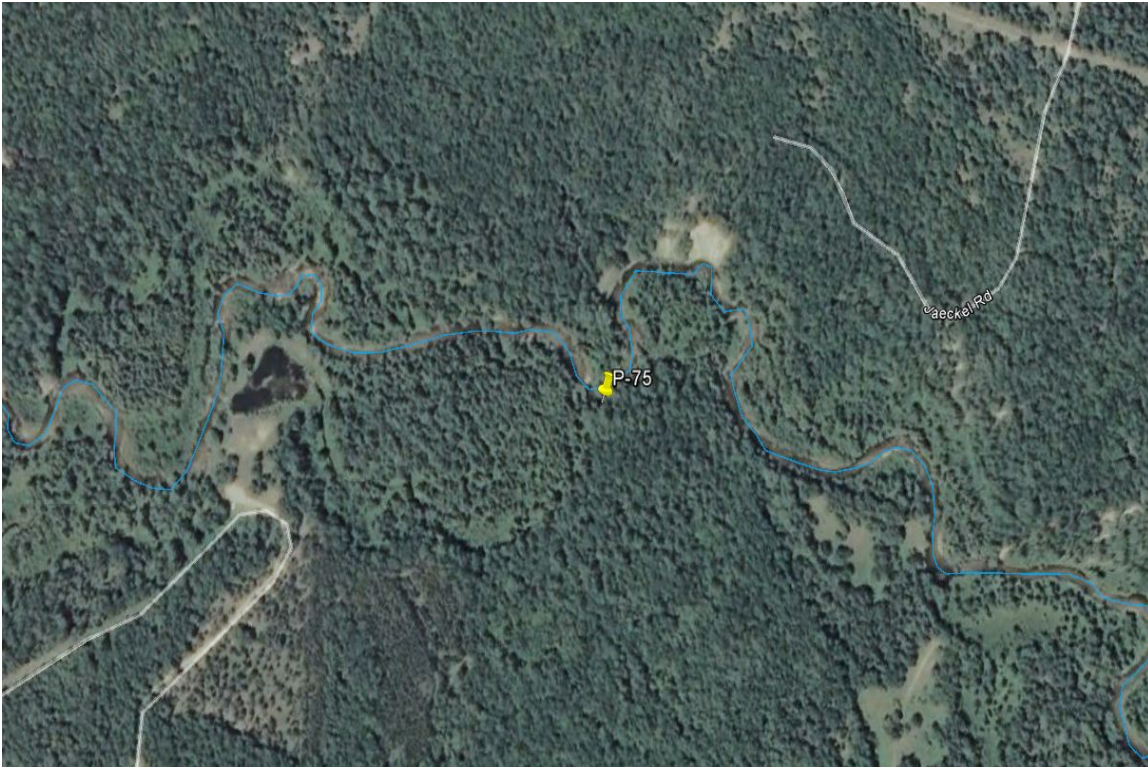
Ownership: Federal

River-left

Notes: depth at toe 2', substrate gravel, downstream of tributary confluence, angler access trail adjacent



View upstream and across (2011)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 76

44.17725, -86.14584

Aspect: S

Slope: 1:1, Vertical

Length: 50'

Height: 4', 13'

Severity: Severe

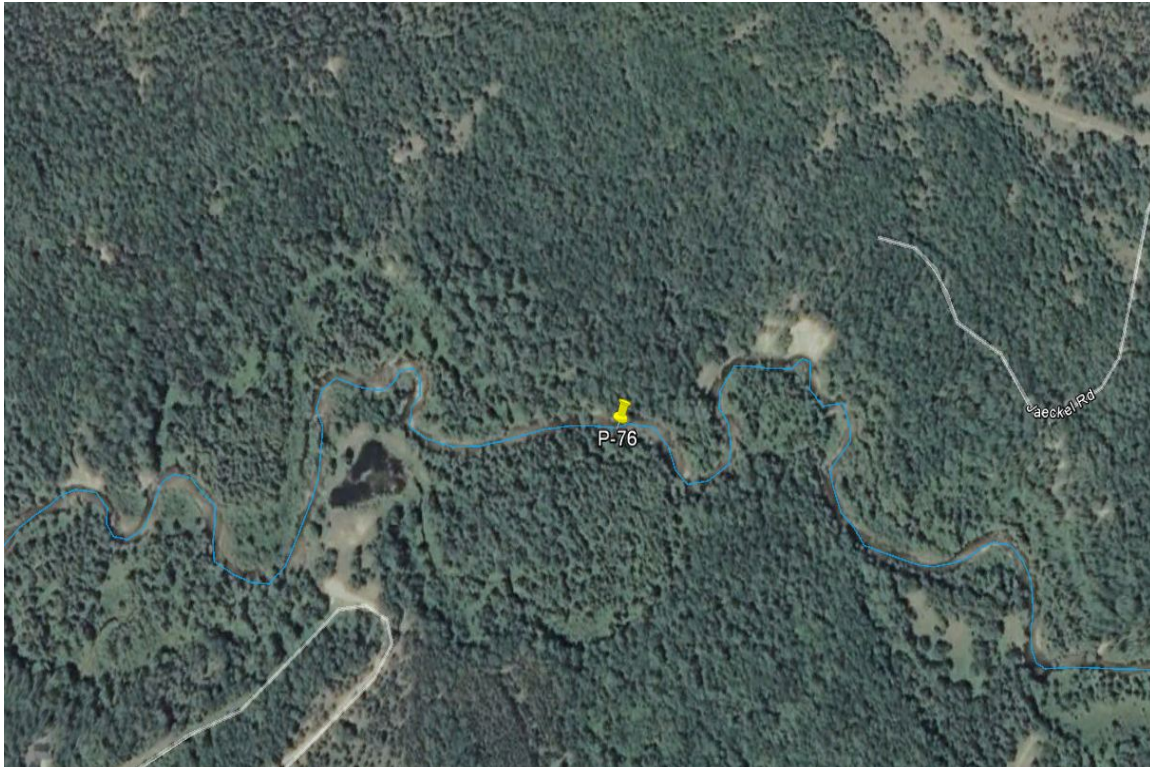
Ownership: Federal

River-right

Notes: stabilization efforts in past (toe-stone), calving of bank with tree slumping



View across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 77

44.17670, -86.15126

Aspect: E

Slope: 1.5:1

Length: 25'

Height: 20'

Severity: Moderate

Ownership: Federal

River-right

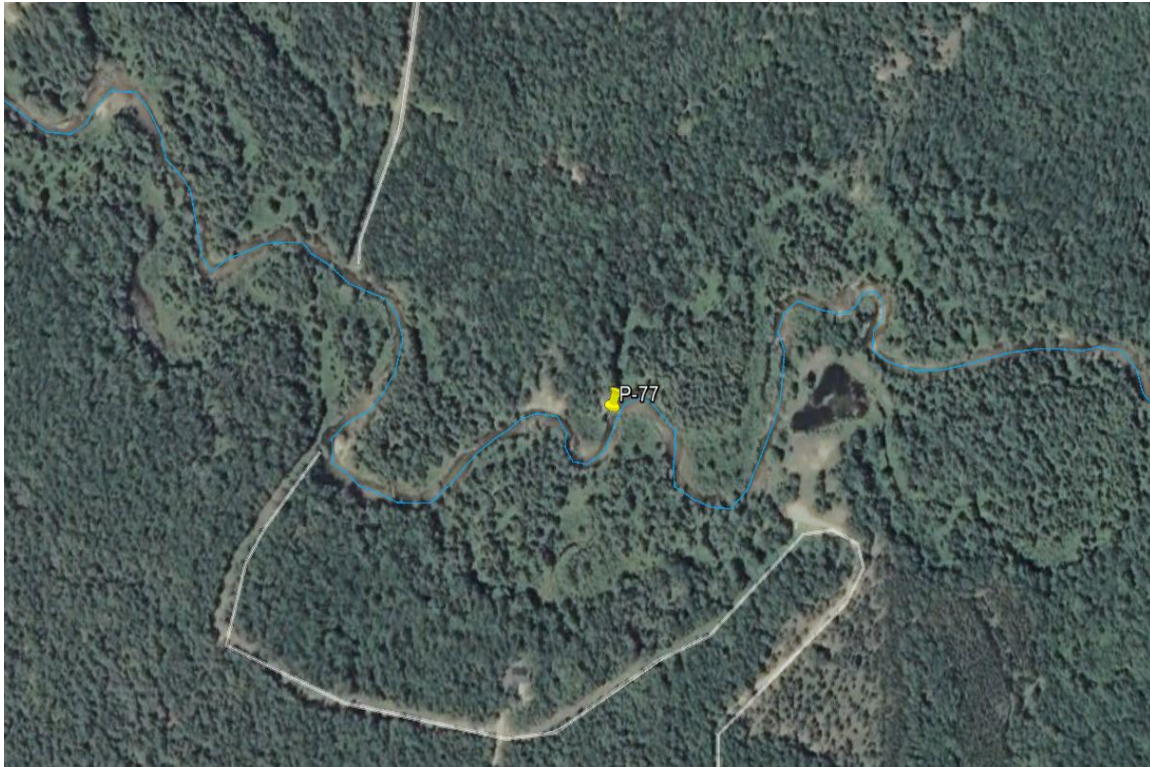
Notes: substrate gravel/sand, water depth 3'



View across (2011)



View across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 78

44.17964, -86.16131

Aspect: S

Slope: 1:1

Length: 40'

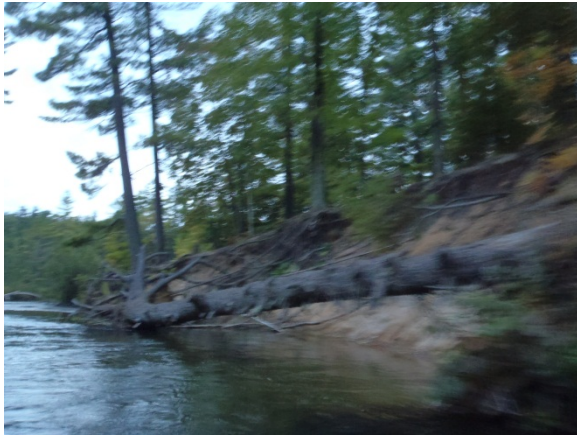
Height: 15'

Severity: Severe

Ownership: Federal

River-right

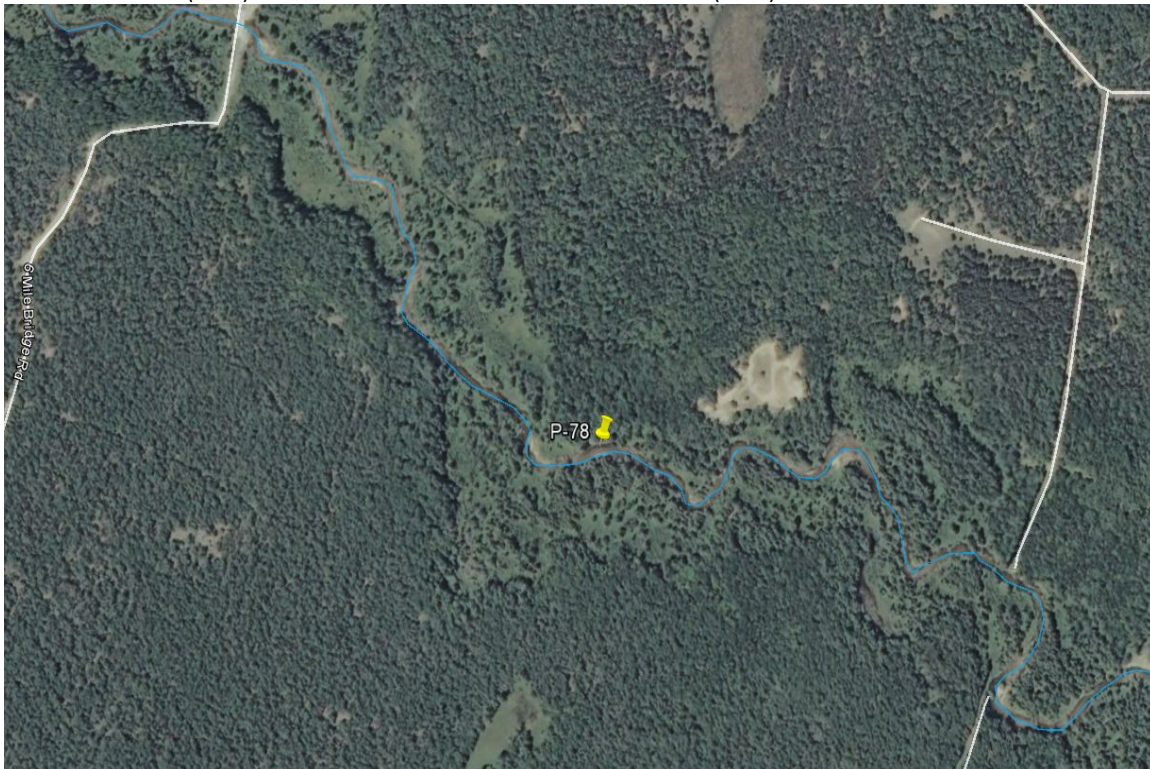
Notes: "Clyde's" bench, substrate small gravel, depth at toe 3.5'



View downstream (2011)



View across (2014)



9 Mile Bridge to 6 Mile Bridge (continued)

Site 79

44.18052, -86.16456

Aspect: N

Slope: 1:1

Length: 25'

Height: 25'

Severity: Severe

Ownership: Federal

River-left

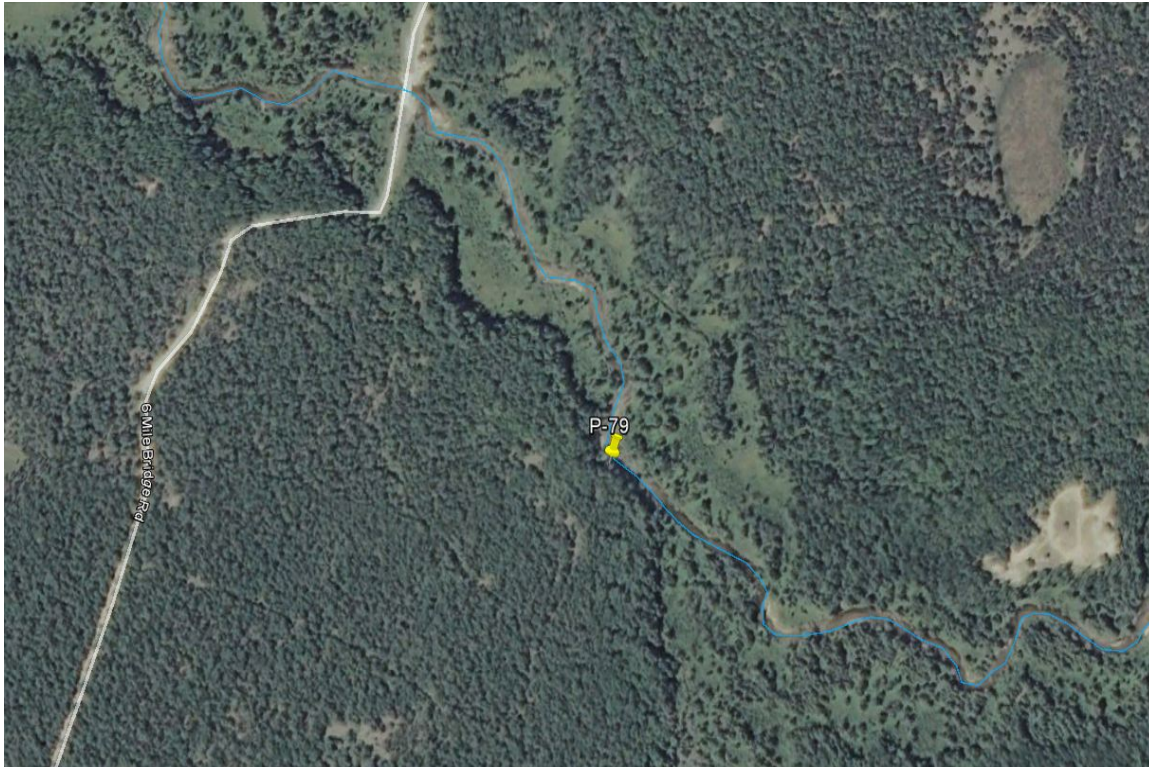
Notes: last site upstream of 6 Mile Bridge



View straight on (2011)



View downstream and across (2014)



Little Manistee River Eroding Stream Bank Assessment: Weir to Old Stronach Rd. Bridge

Site 80

44.20694, -86.22281

Aspect: SE

Slope: 3:1

Length: 90'

Height: 3'

Severity: Moderate

Ownership: Federal

River-right

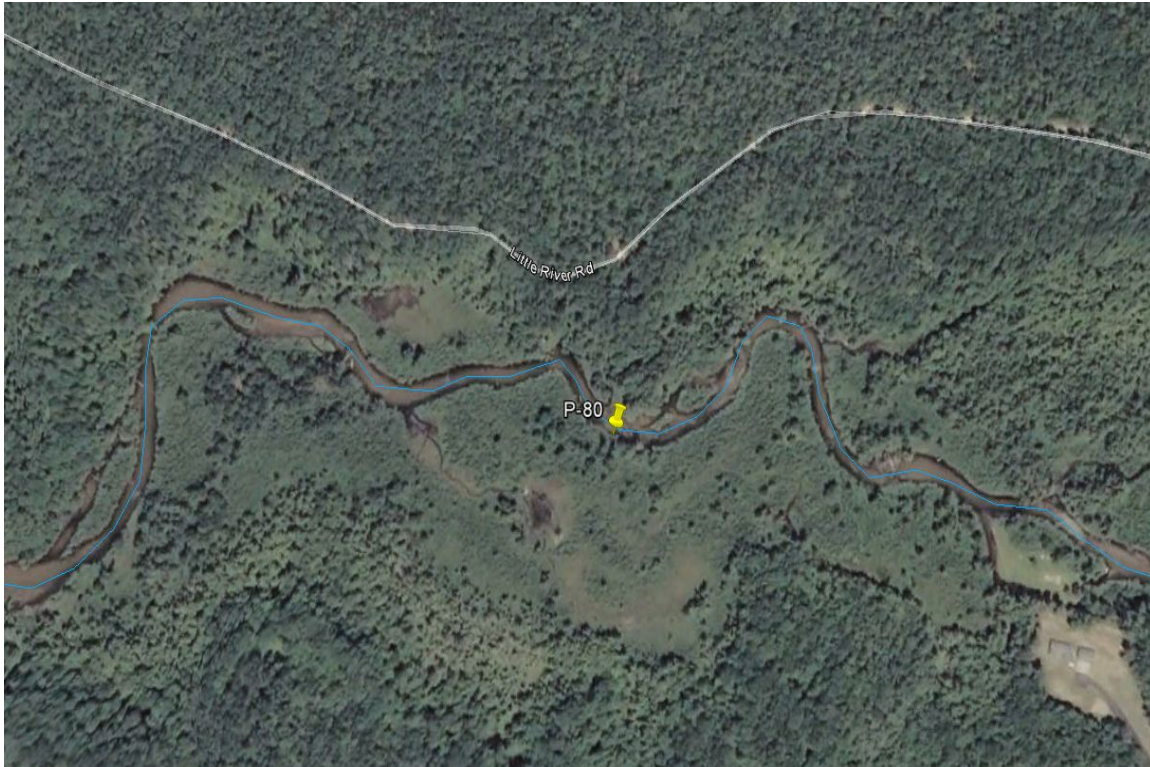
Notes: recreational access, depth at toe 1.5', substrate sand, relic structure present



View upstream, erosion extends around corner (2013)



View of mid-section (2013)



Weir to Old Stronach Rd. Bridge (continued)

Site 81

44.20755, -86.22346

Aspect: SW

Slope: Vertical

Length: 20'

Height: 4'

Severity: Moderate

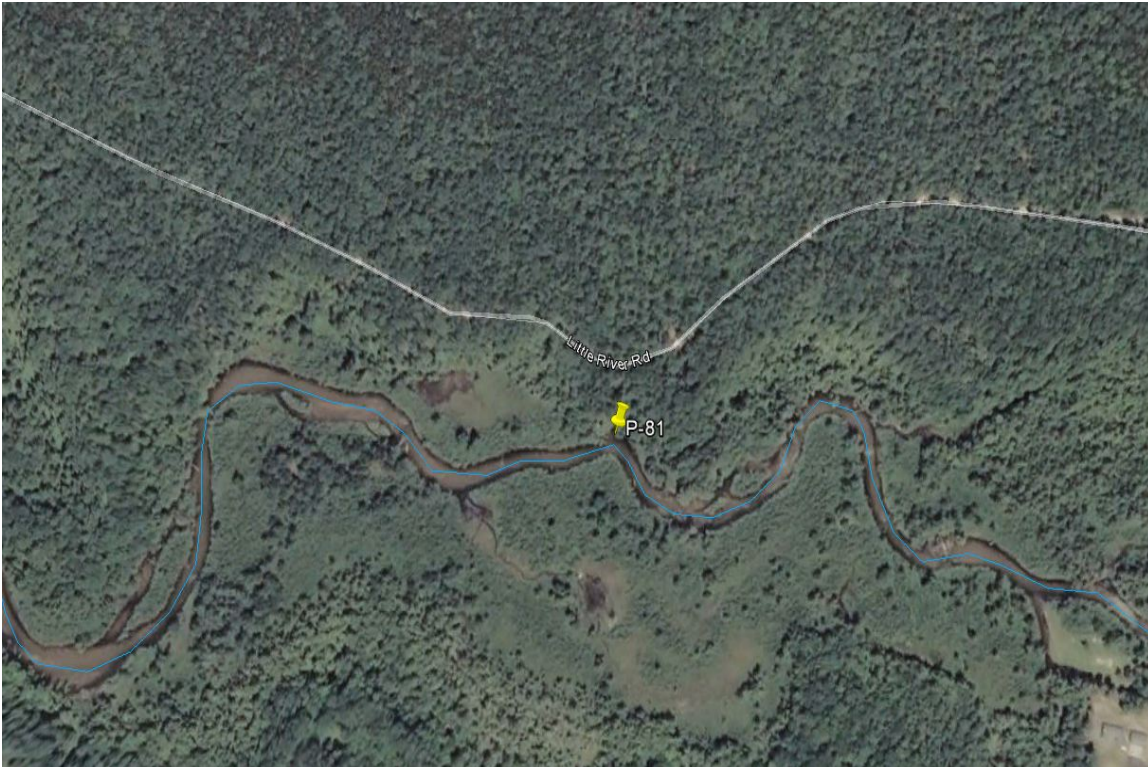
Ownership: Federal

River-right

Notes: depth at toe 1.75', substrate clay/sand, swimming hole (12' deep) adjacent



View across (2013)



Weir to Old Stronach Rd. Bridge (continued)

Site 82

44.20847, -86.24176

Aspect: E

Slope: Vertical

Length: 90'

Height: 4'

Severity: Severe

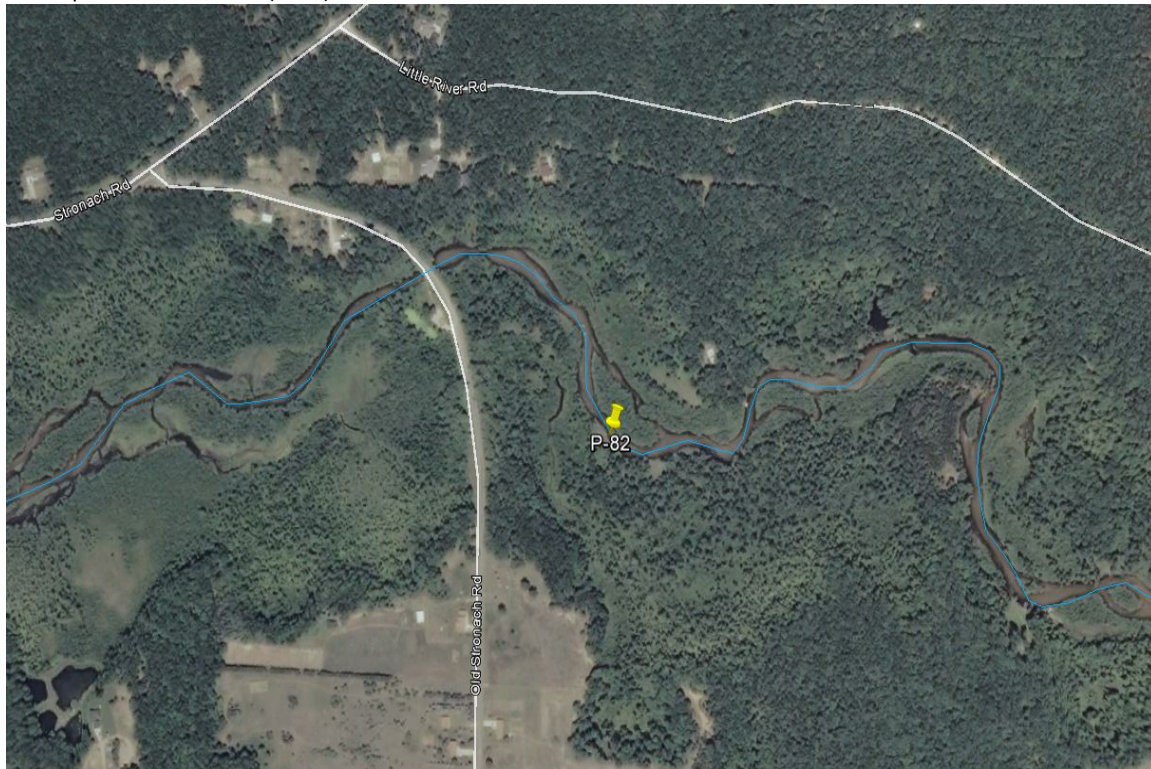
Ownership: Federal

River-left

Notes: depth at toe 3.5', substrate gravel/sand



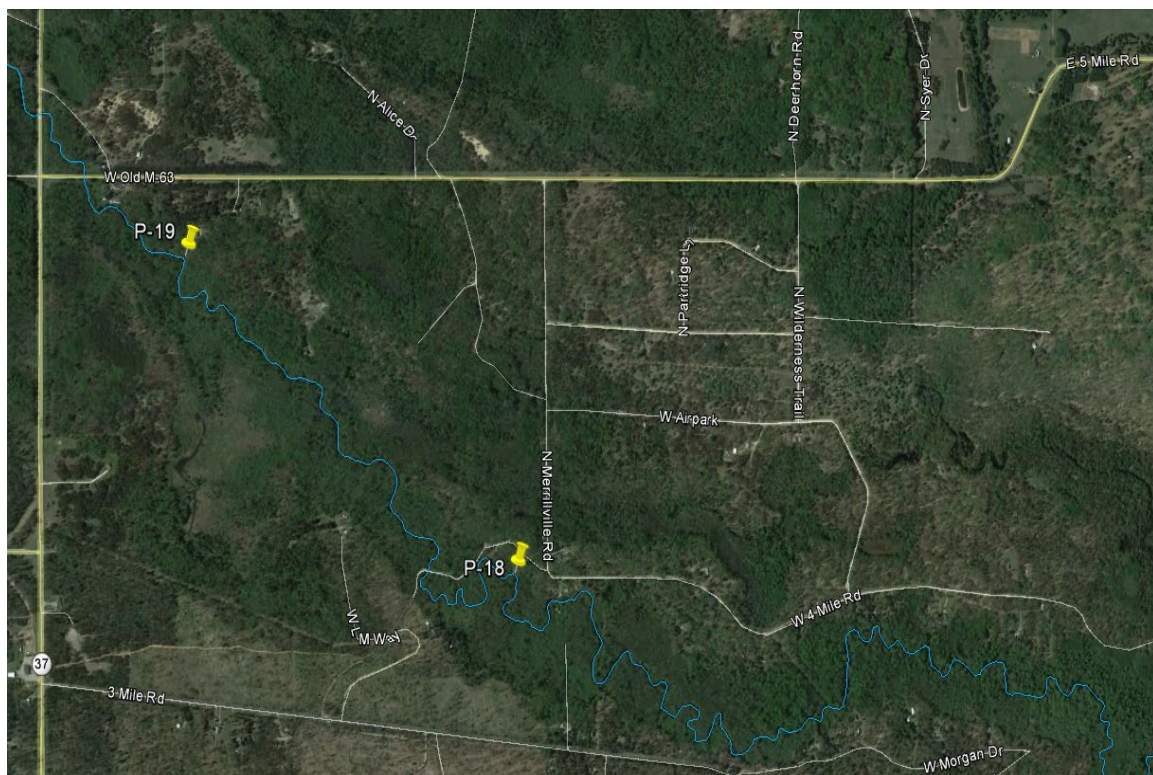
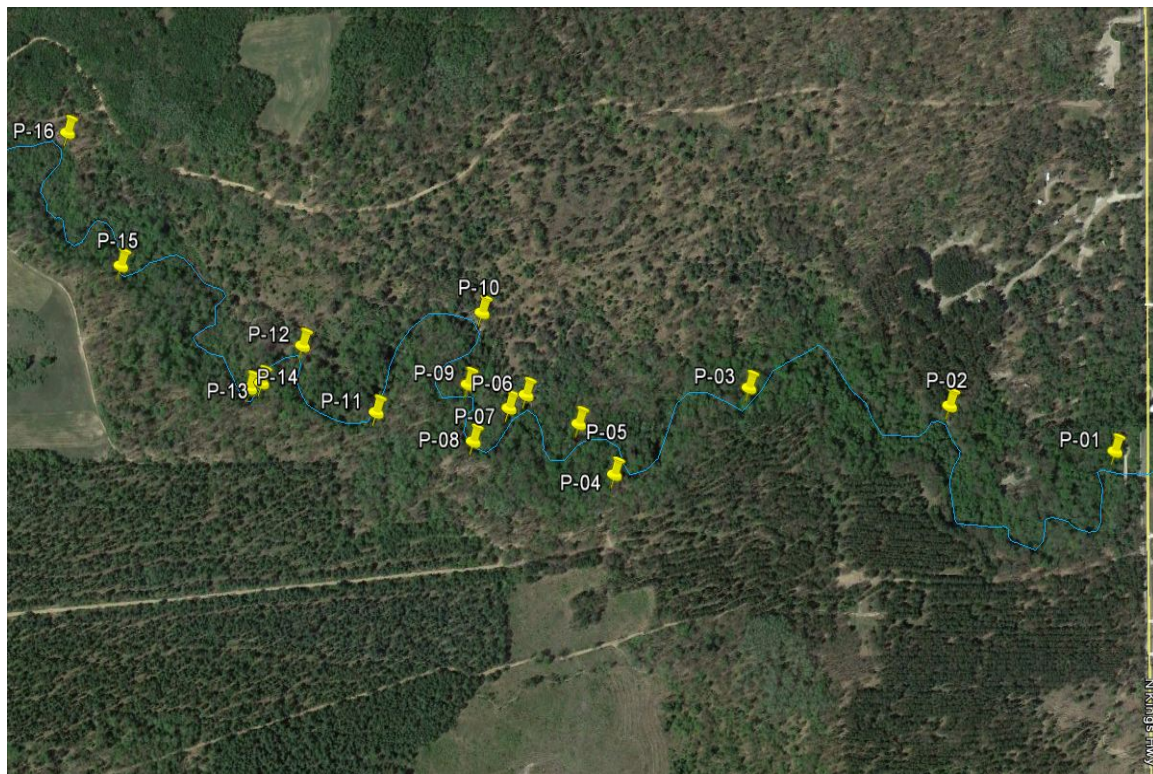
View upstream and across (2013)



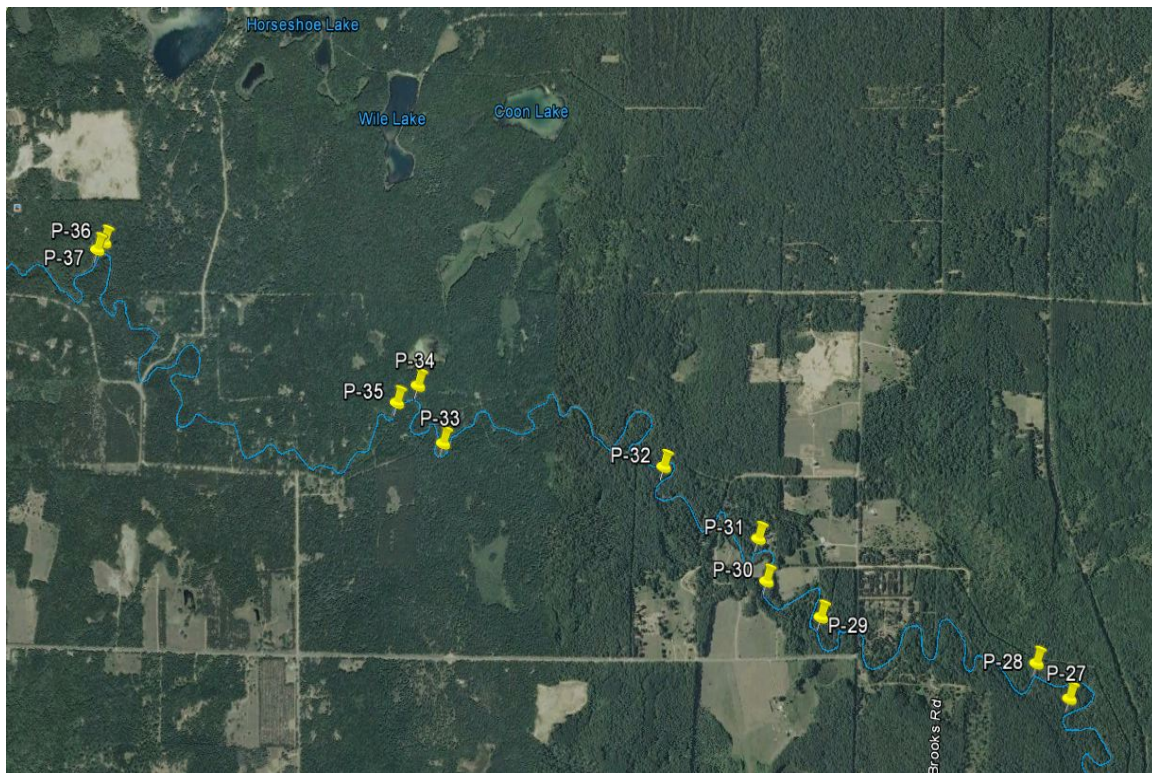
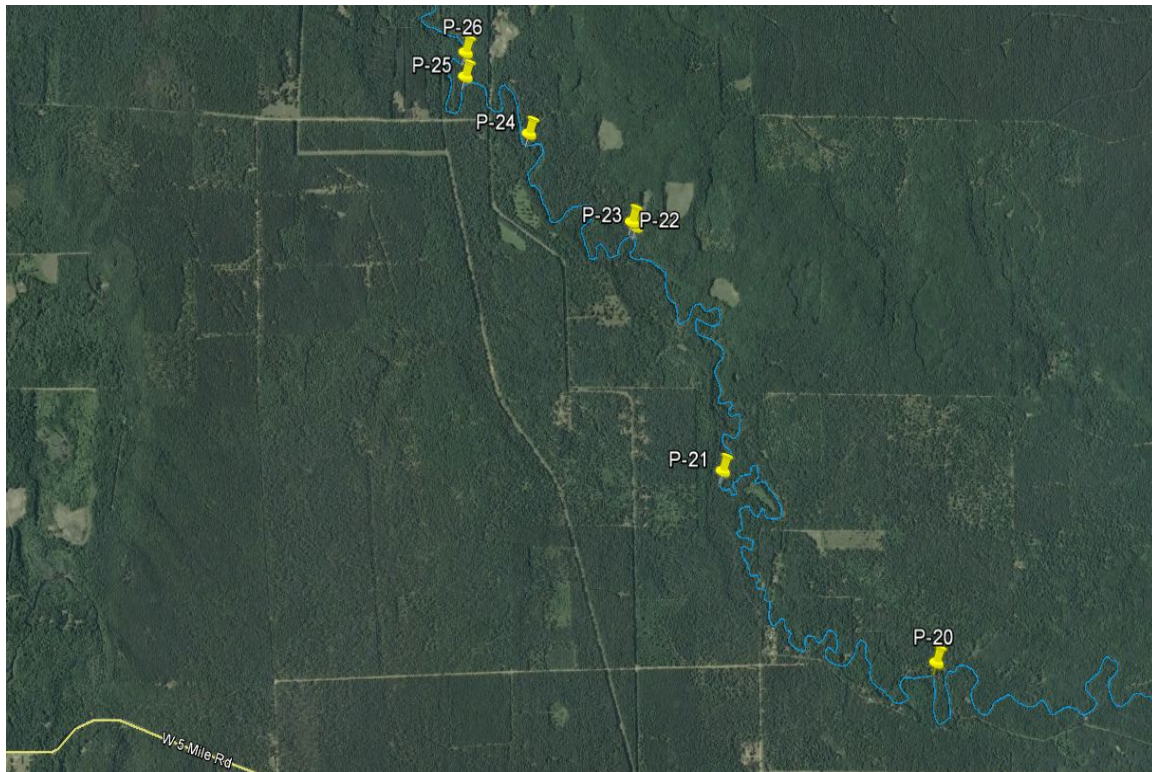
Little Manistee River Minor Eroding Sites		
Site#	Latitude	Longitude
1	44.03460	-85.72291
3	44.03531	-85.72869
4	44.03443	-85.73084
5	44.03493	-85.73140
6	44.03523	-85.73225
7	44.03511	-85.73254
8	44.03476	-85.73311
9	44.03536	-85.73319
11	44.03500	-85.73459
21	44.07075	-85.88659
22	44.08316	-85.89396
25	44.09072	-85.90729
26	44.09183	-85.90728
34	44.11472	-85.95557
40	44.14604	-86.02100
43	44.15312	-86.04842
49	44.17103	-86.09265
52	44.16944	-86.11571
64	44.17125	-86.12619
69	44.17371	-86.13341
70	44.17403	-86.13457
71	44.17411	-86.13509

Little Manistee River Severe Eroding Sites		
Site#	Latitude	Longitude
10	44.03605	-85.73297
13	44.03534	-85.73651
16	44.03795	-85.73965
20	44.06129	-85.86926
27	44.10229	-85.91377
28	44.10368	-85.91600
29	44.10558	-85.92979
30	44.10704	-85.93314
33	44.11264	-85.95417
42	44.14892	-86.03348
45	44.15800	-86.06942
46	44.15785	-86.07438
50	44.17063	-86.10652
53	44.17276	-86.11858
54	44.17276	-86.11858
55	44.17129	-86.11982
56	44.17105	-86.12032
57	44.17134	-86.12100
59	44.17273	-86.12226
60	44.17191	-86.12246
63	44.17156	-86.12486
65	44.17134	-86.12689
66	44.17019	-86.12878
67	44.17061	-86.13050
68	44.17126	-86.13128
72	44.17437	-86.13871
76	44.17725	-86.14584
78	44.17964	-86.16131
79	44.18052	-86.16456
82	44.20847	-86.24176

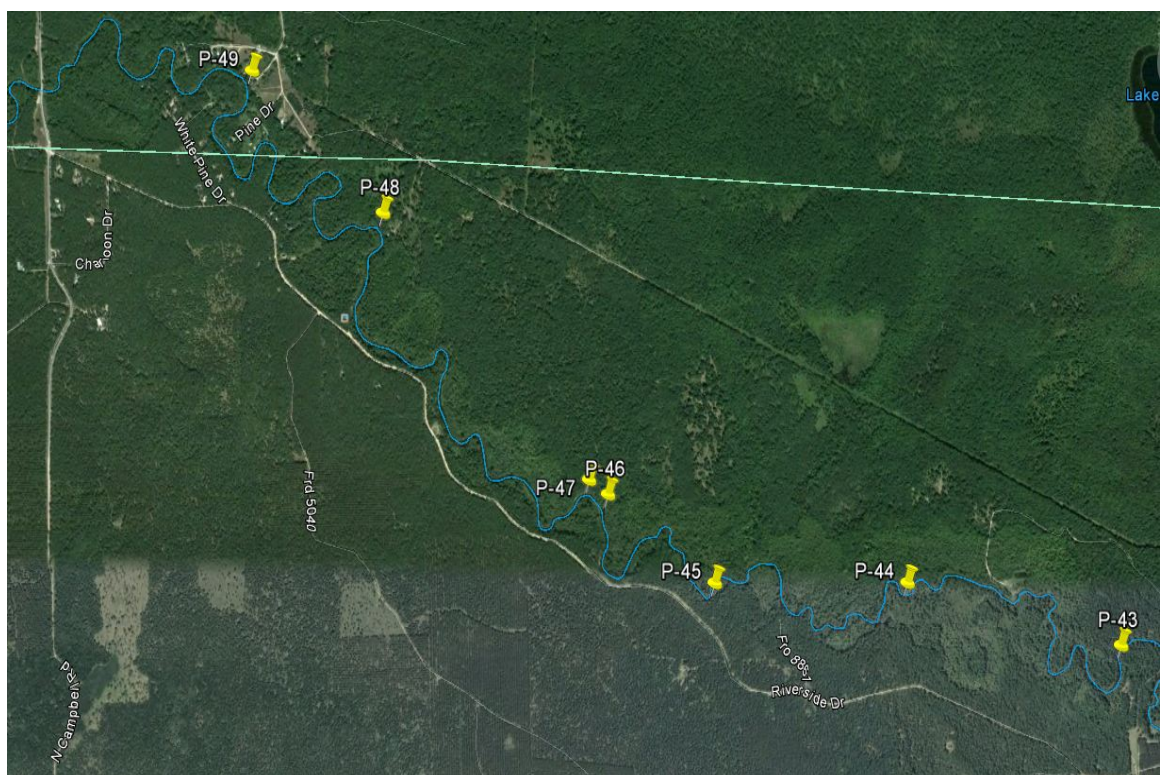
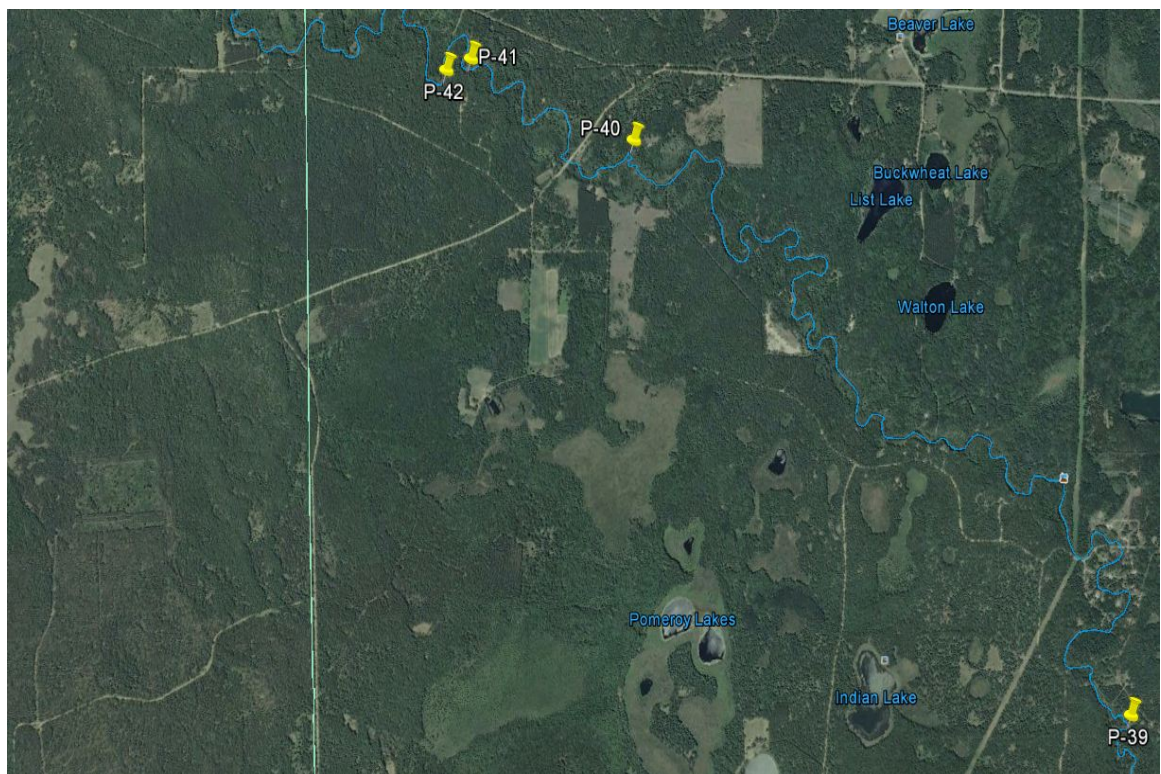
Little Manistee River Moderate Eroding Sites		
Site#	Latitude	Longitude
2	44.03514	-85.72549
12	44.03573	-85.73586
14	44.03533	-85.73666
15	44.03653	-85.73881
18	44.04644	-85.82390
19	44.05424	-85.83720
23	44.08305	-85.89362
24	44.08778	-85.90224
31	44.10852	-85.93373
32	44.11152	-85.93974
35	44.11395	-85.95700
36	44.12045	-85.97579
37	44.12045	-85.97579
39	44.12311	-85.98900
41	44.14946	-85.03151
44	44.15501	-86.05926
47	44.15840	-86.07536
48	44.16675	-86.08632
51	44.17343	-86.11155
58	44.17248	-86.12090
61	44.17218	-85.12317
62	44.17180	-86.12465
73	44.17463	-86.13888
74	44.17569	-86.14110
75	44.17679	-86.14485
77	44.17670	-86.15126
80	44.20694	-86.22281
81	44.20755	-86.22346



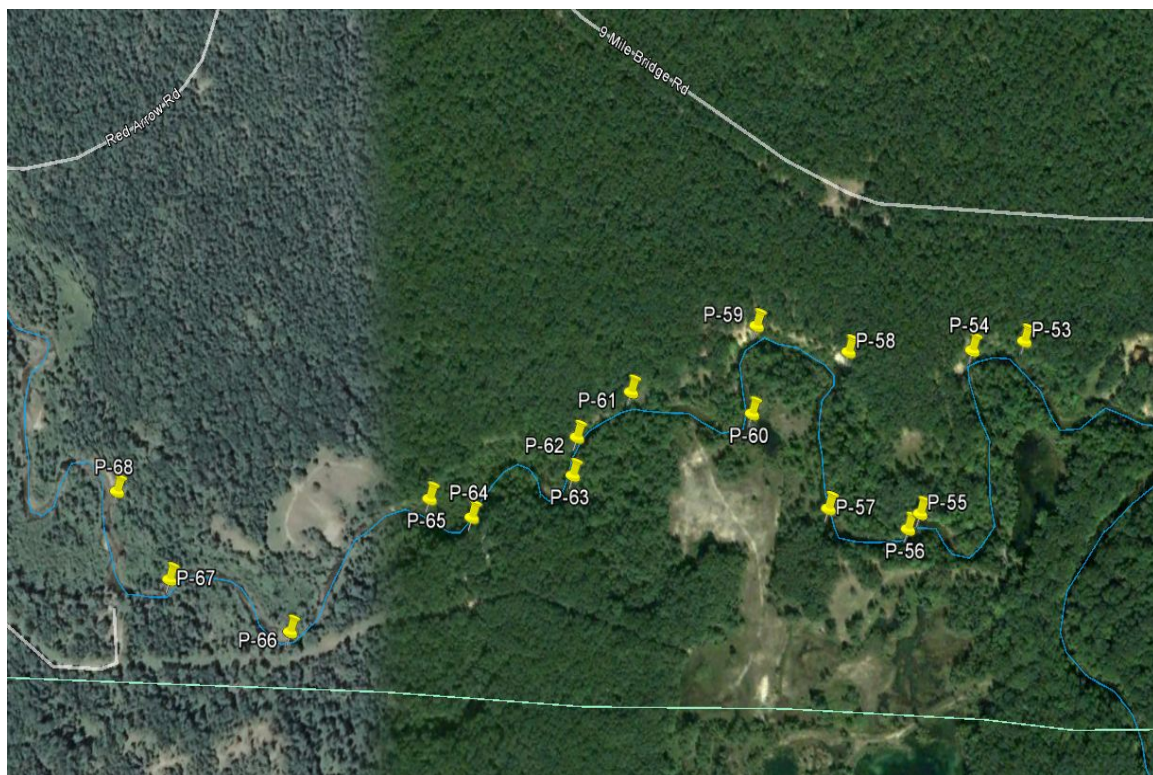
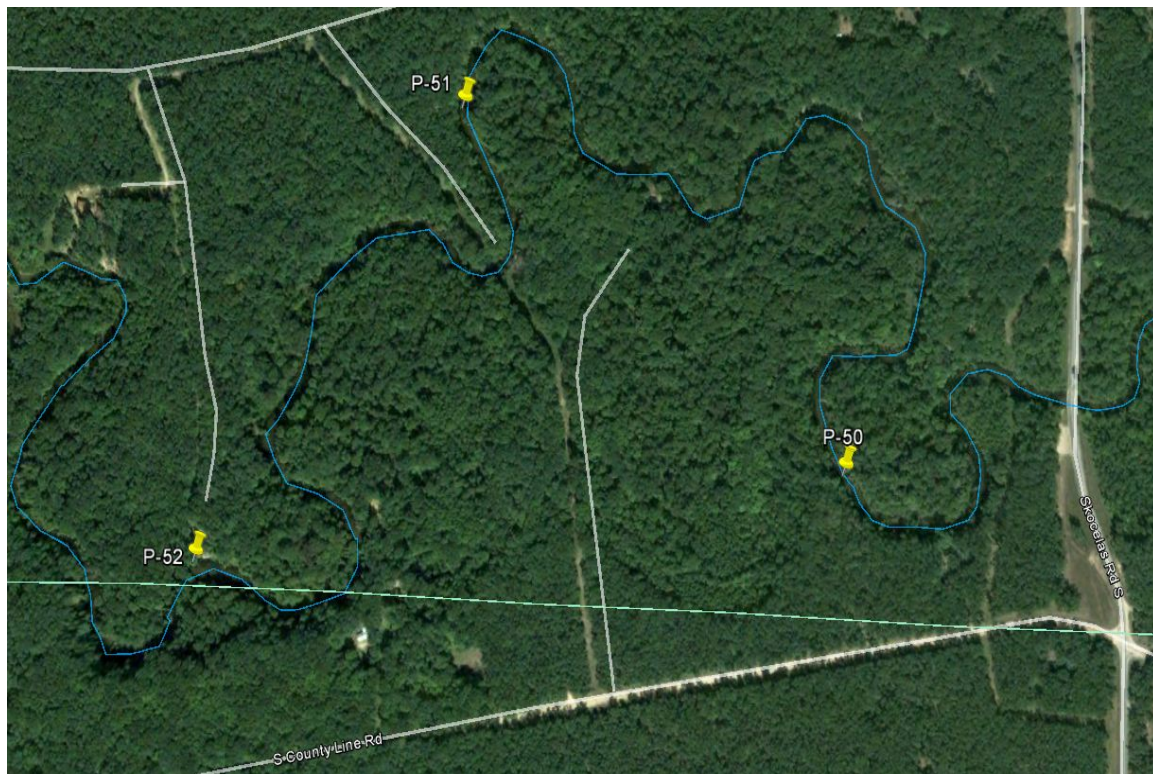
Little Manistee River Eroding Stream Bank Assessment: Carrieville (Kings Highway) Bridge to Old Stronach Rd. Bridge

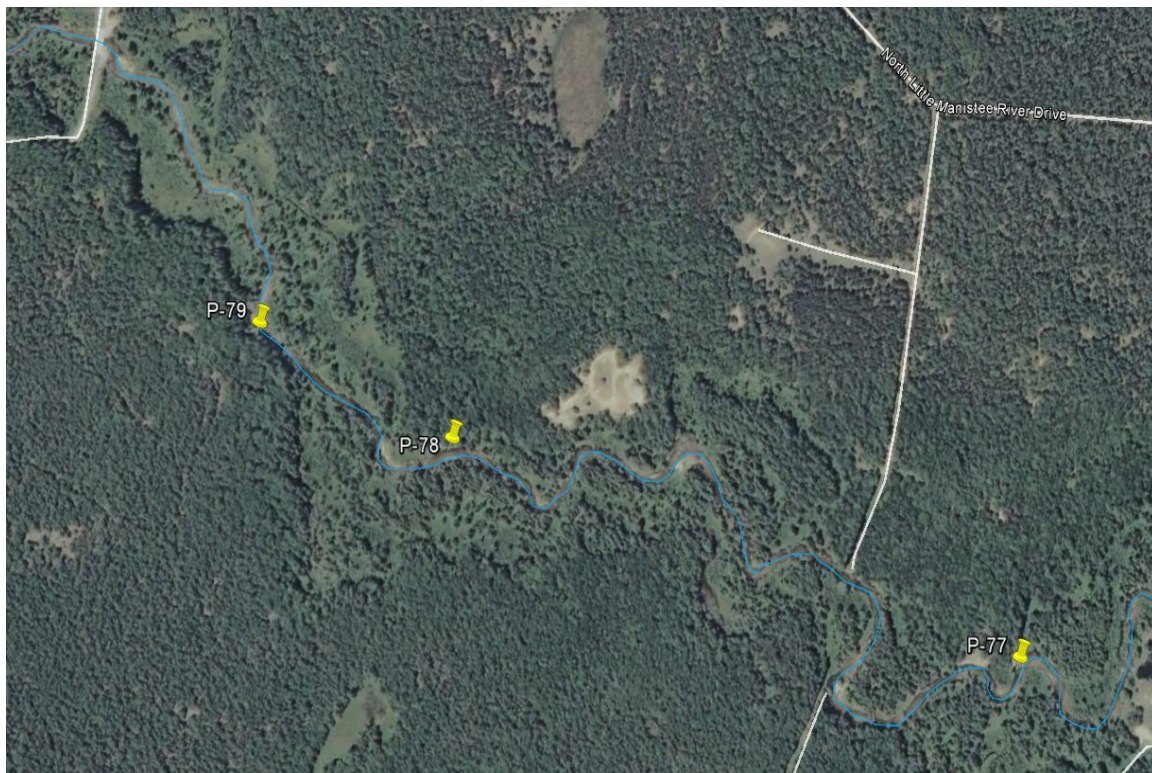
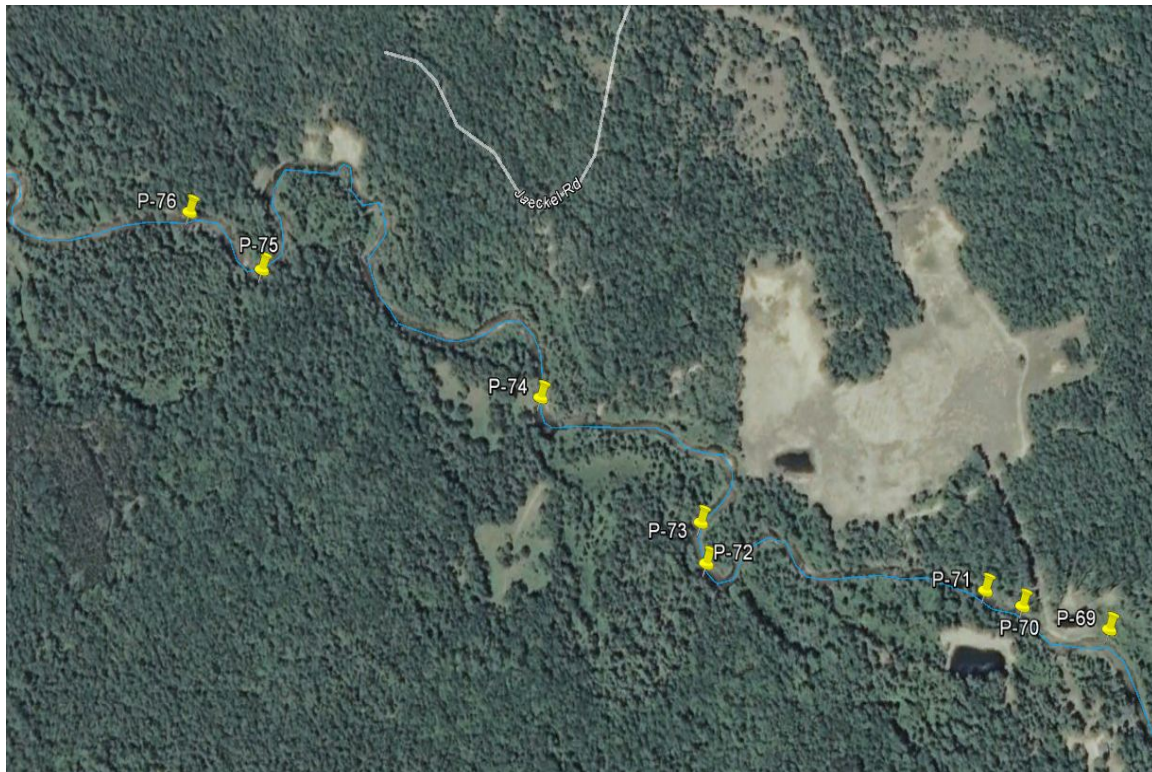


Little Manistee River Eroding Stream Bank Assessment: Carrieville (Kings Highway) Bridge to Old Stronach Rd. Bridge

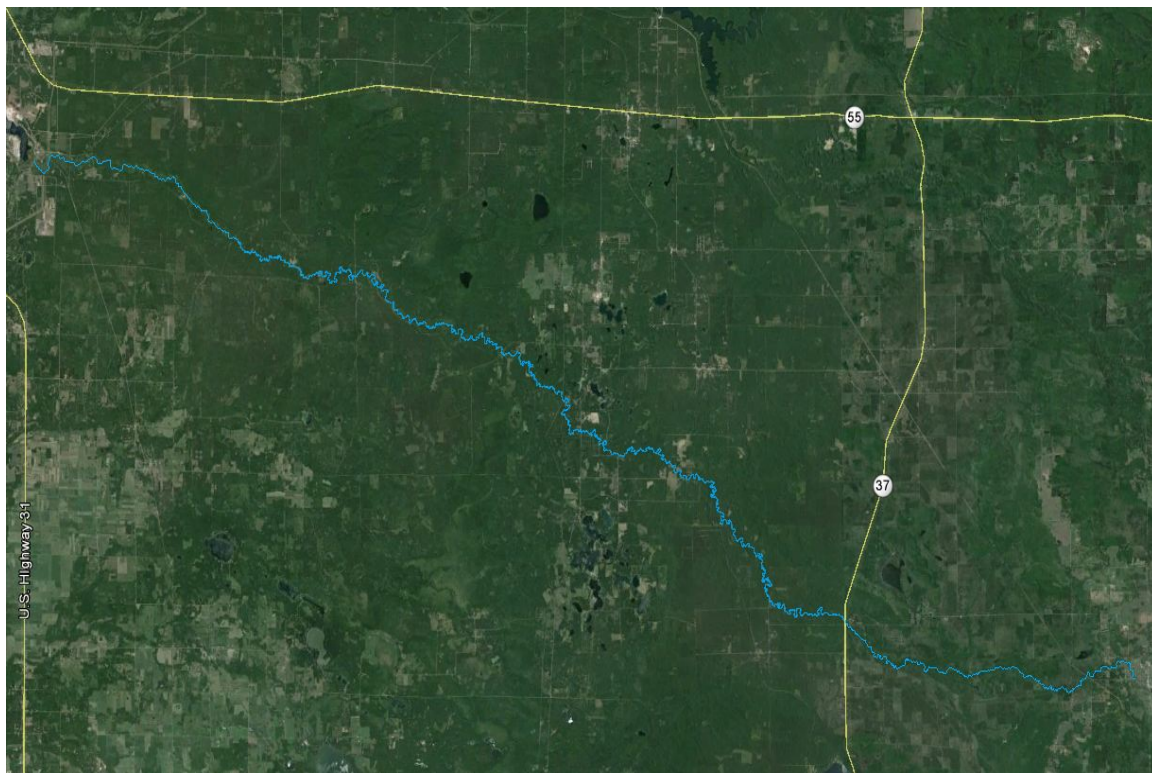


Little Manistee River Eroding Stream Bank Assessment: Carrieville (Kings Highway) Bridge to Old Stronach Rd. Bridge





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