CONSERVATION RESOURCE ALLIANCE

Little Manistee River Eroding Stream Bank Assessment

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

Conservation Resource Alliance
Coordinating Sensible Stewardship of the Land

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Table of Contents

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)

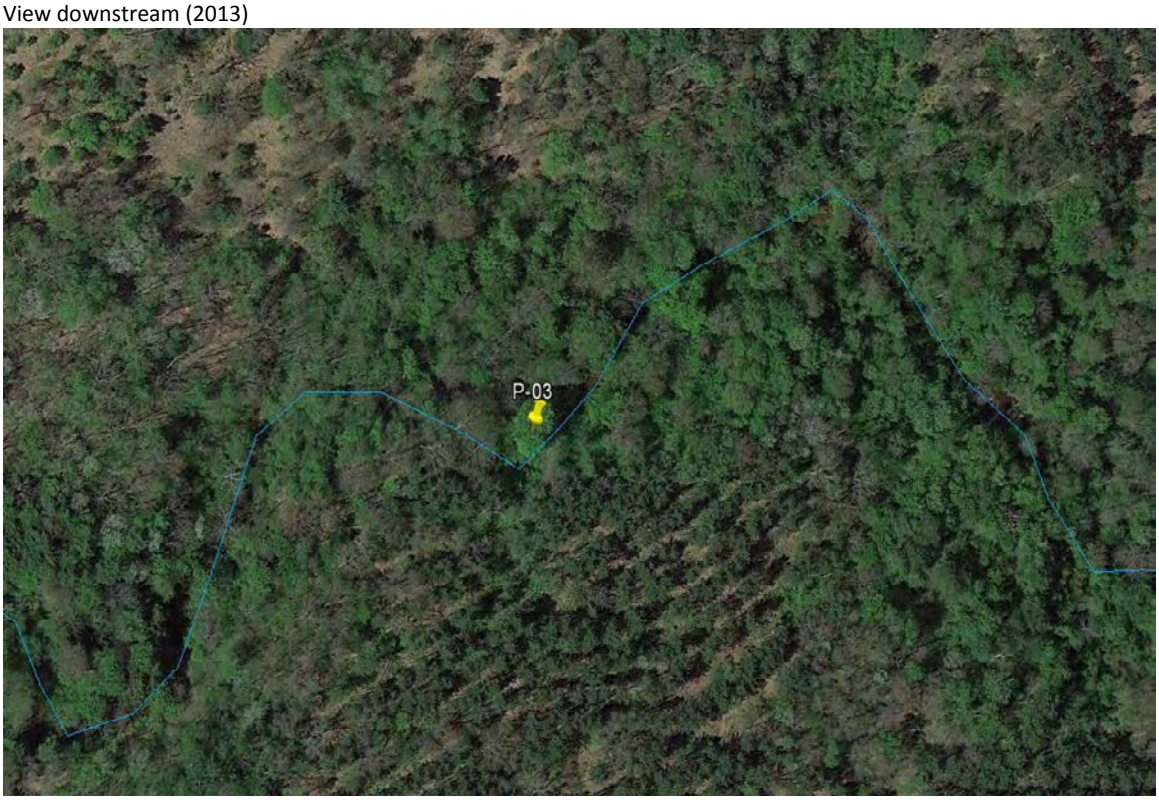
Site 2
44.03514, -85.72549
Aspect: SW
Slope: 1:1
Length: 12’
Height: 7’
Severity: Moderate
Ownership: State
River-right
Notes: substrate sand, channel width 16’, water depth 2.0-4.0’ maximum

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)

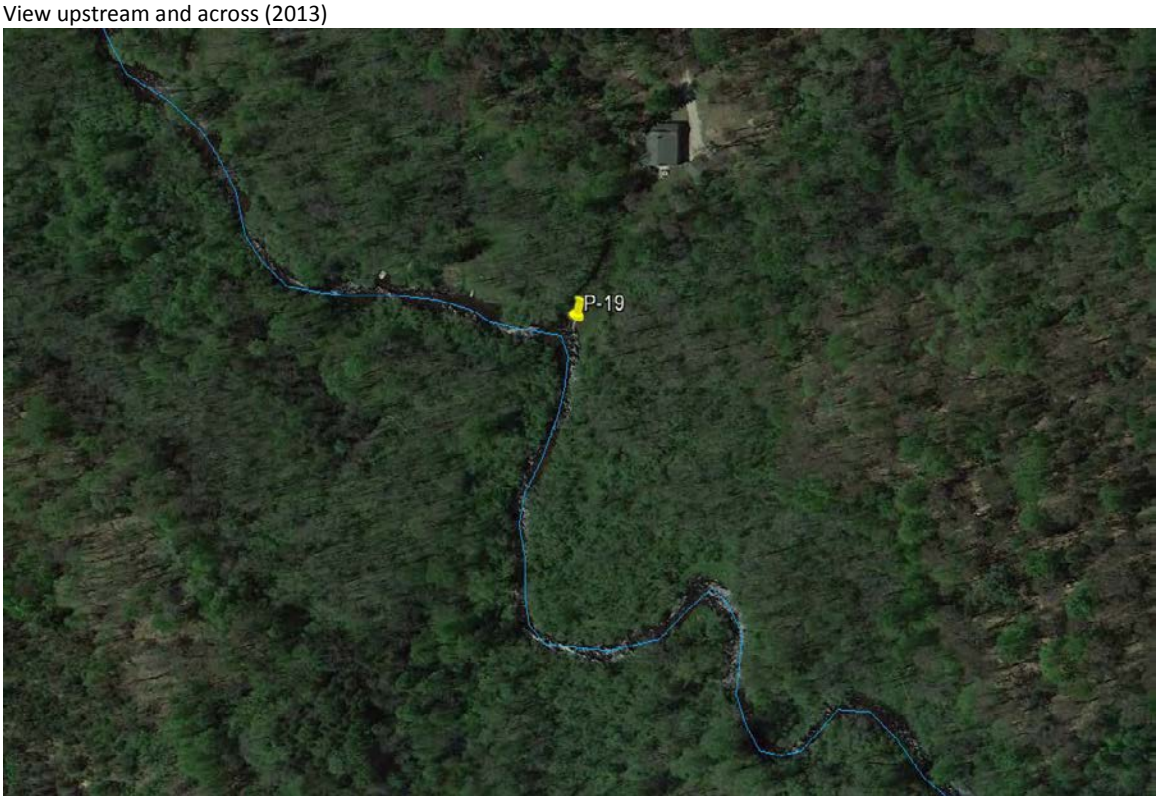
Site 18
44.04644, -85.82390
Aspect: WSW
Slope: 1:1
Length: 20’
Height: 10’
Severity: Moderate
Ownership: State
River-right
Notes: channel width 24’, water depth 3.0’, substrate sand

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)

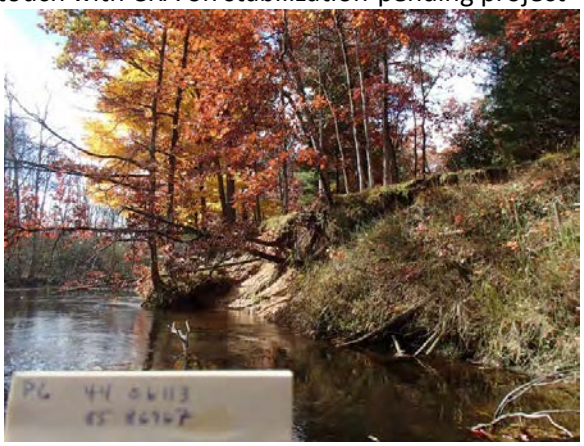


Little Manistee River Eroding Stream Bank Assessment: Old Grade (M-37) to Johnson's Bridge

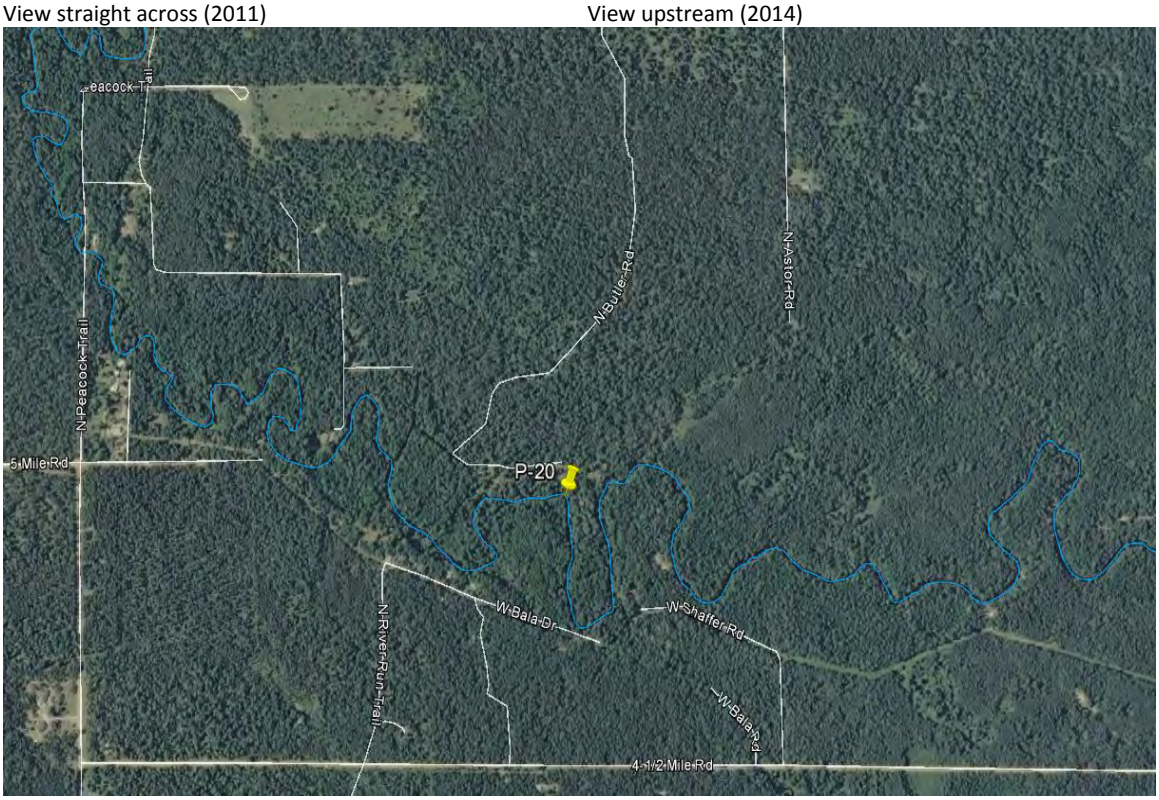
Site 20

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)



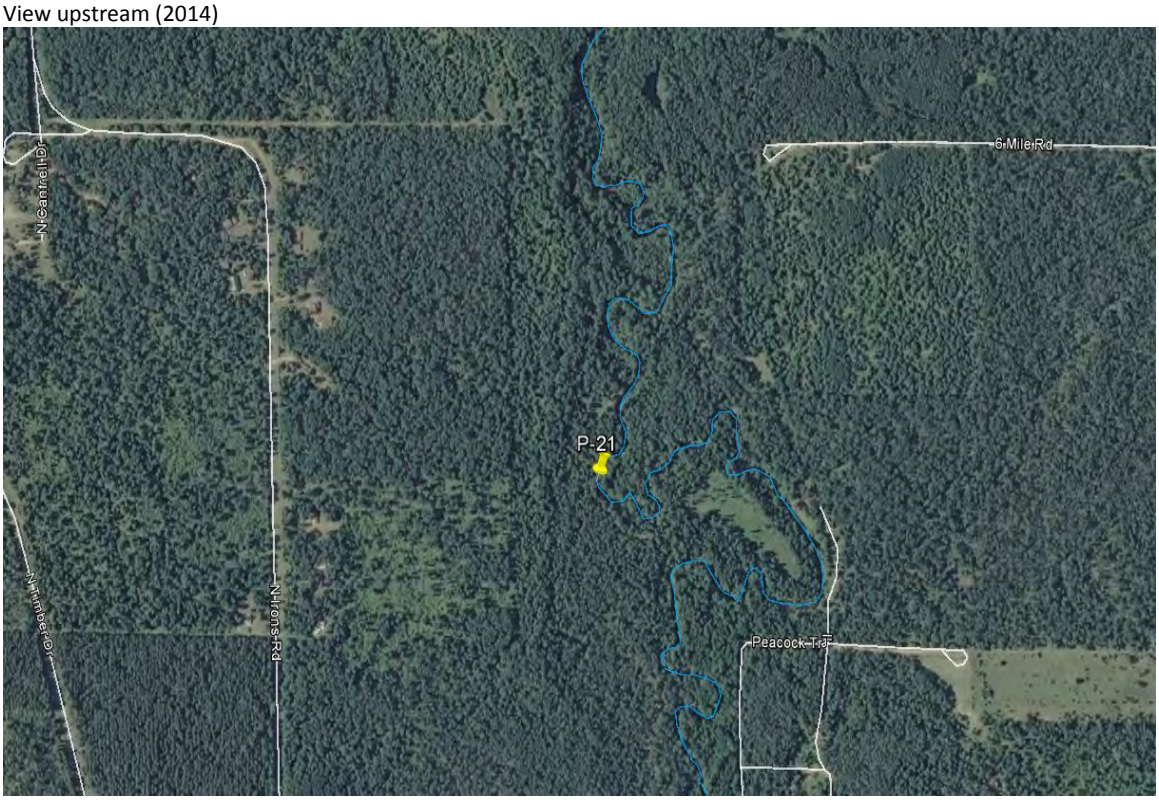
View upstream (2014)



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'

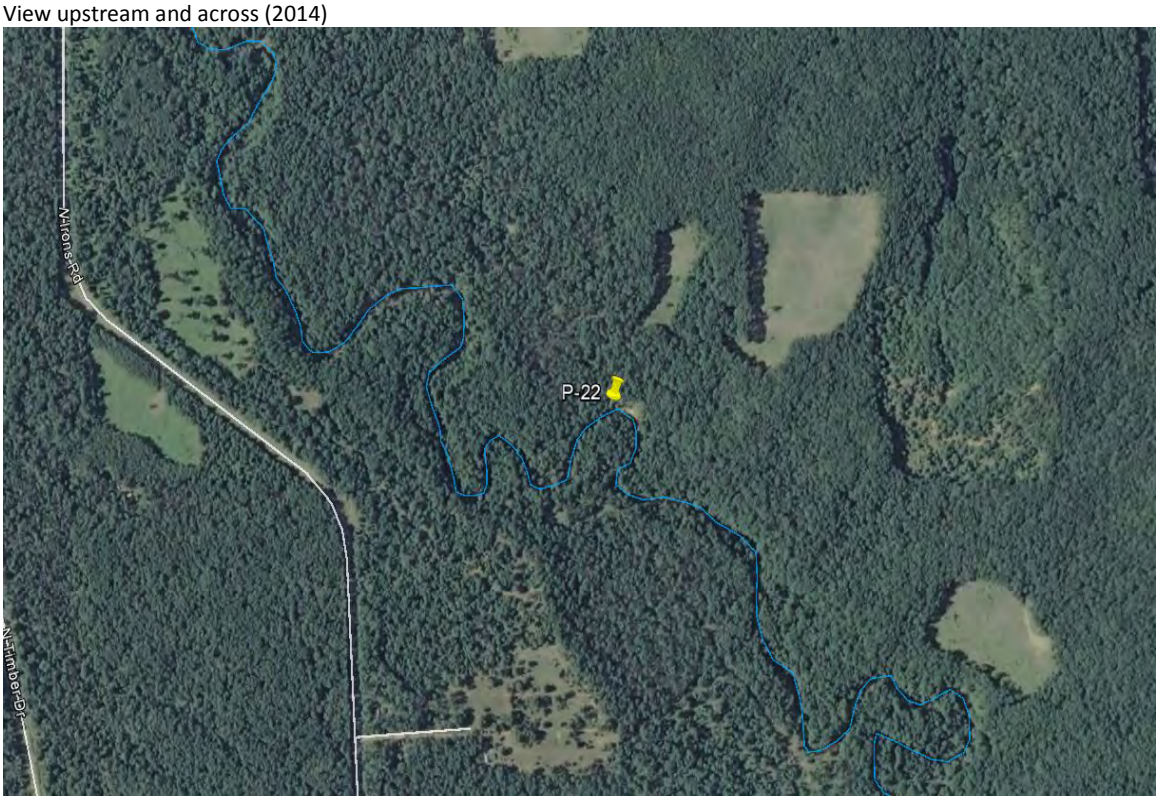
View upstream (2014)



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'

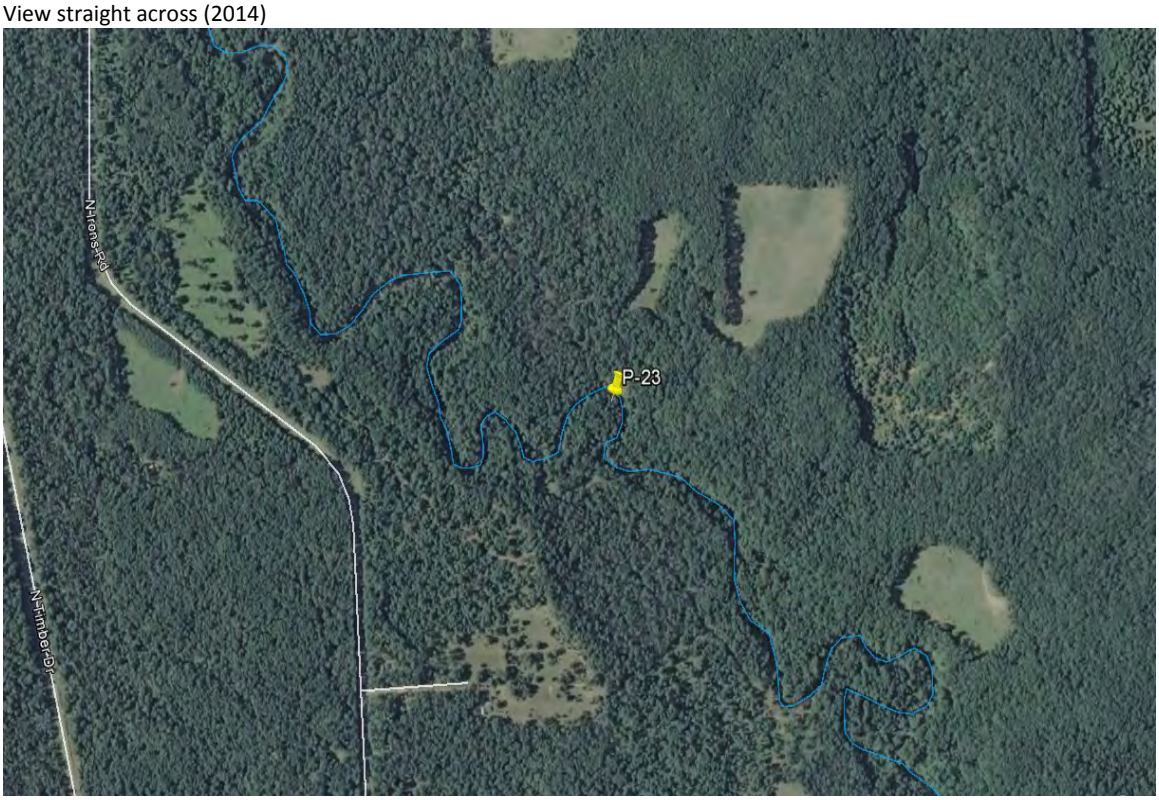
View upstream and across (2014)



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:

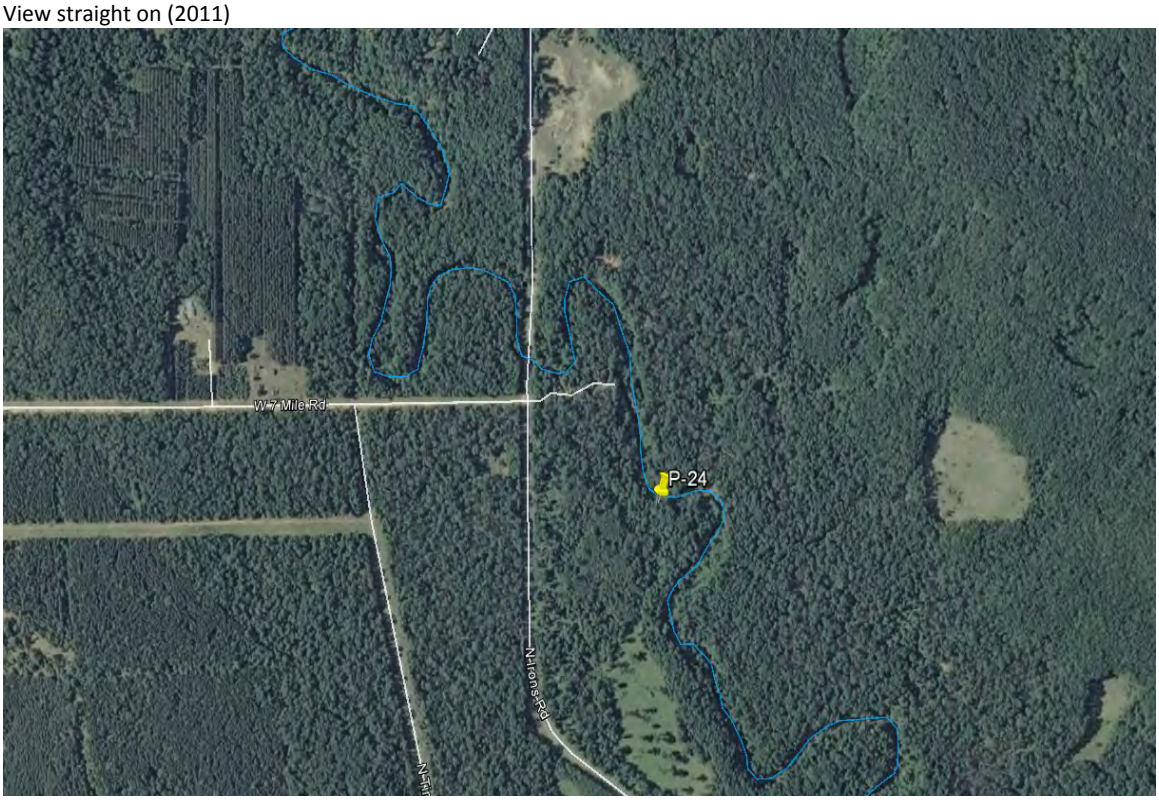
View straight across (2014)



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)

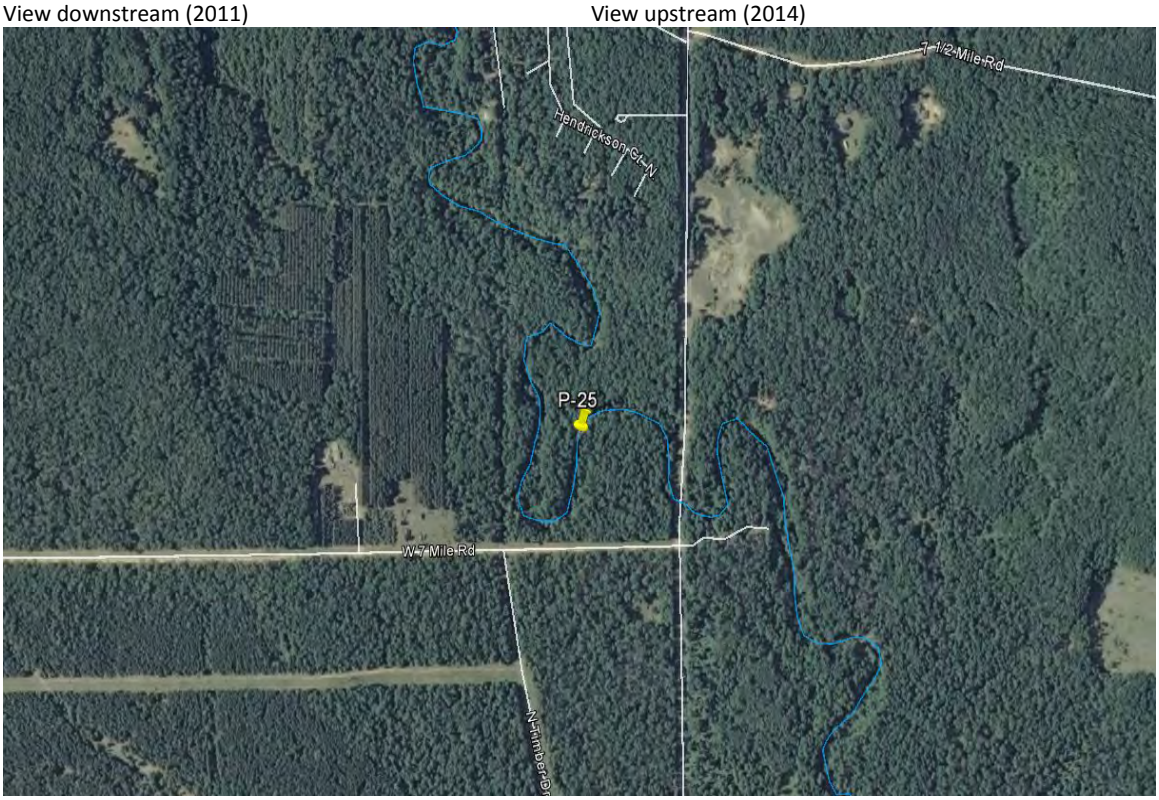


Old Grade (M-37) to Johnson's Bridge (continued)

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)

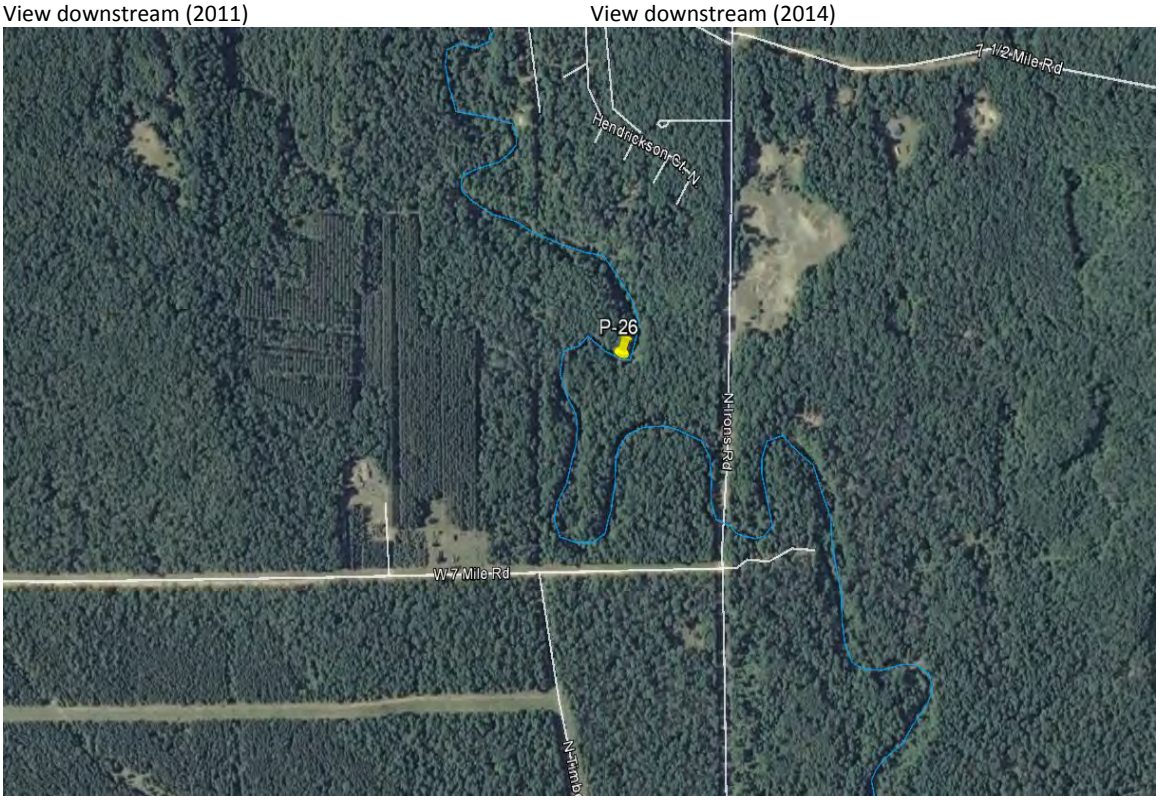


Old Grade (M-37) to Johnson's Bridge (continued)

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)

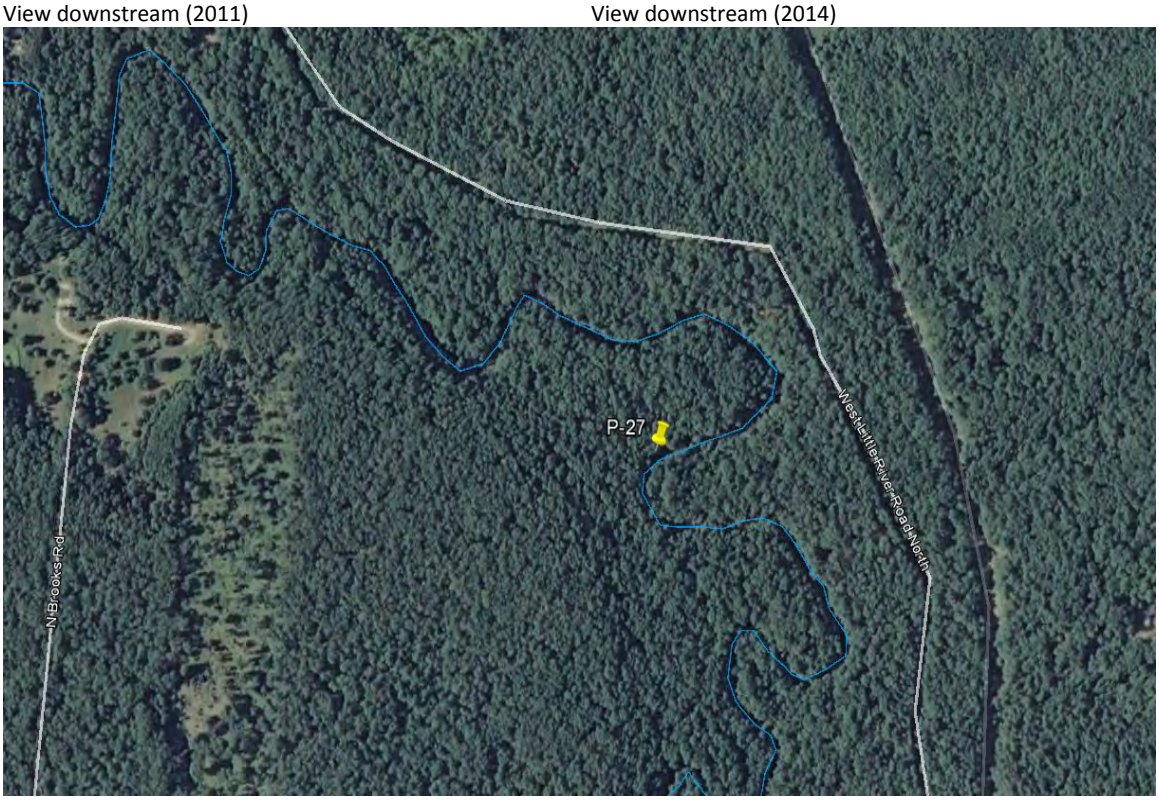


Old Grade (M-37) to Johnson's Bridge (continued)

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)

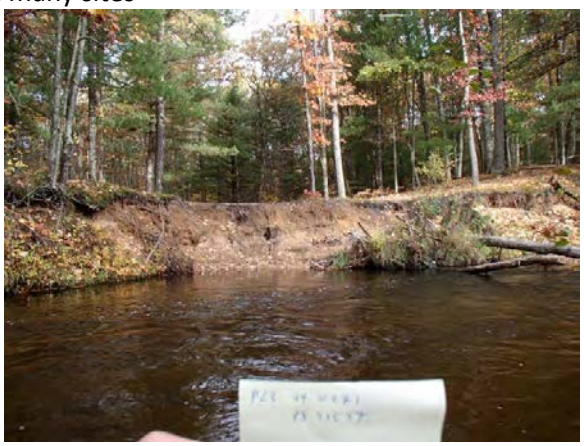
View downstream (2014)



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)

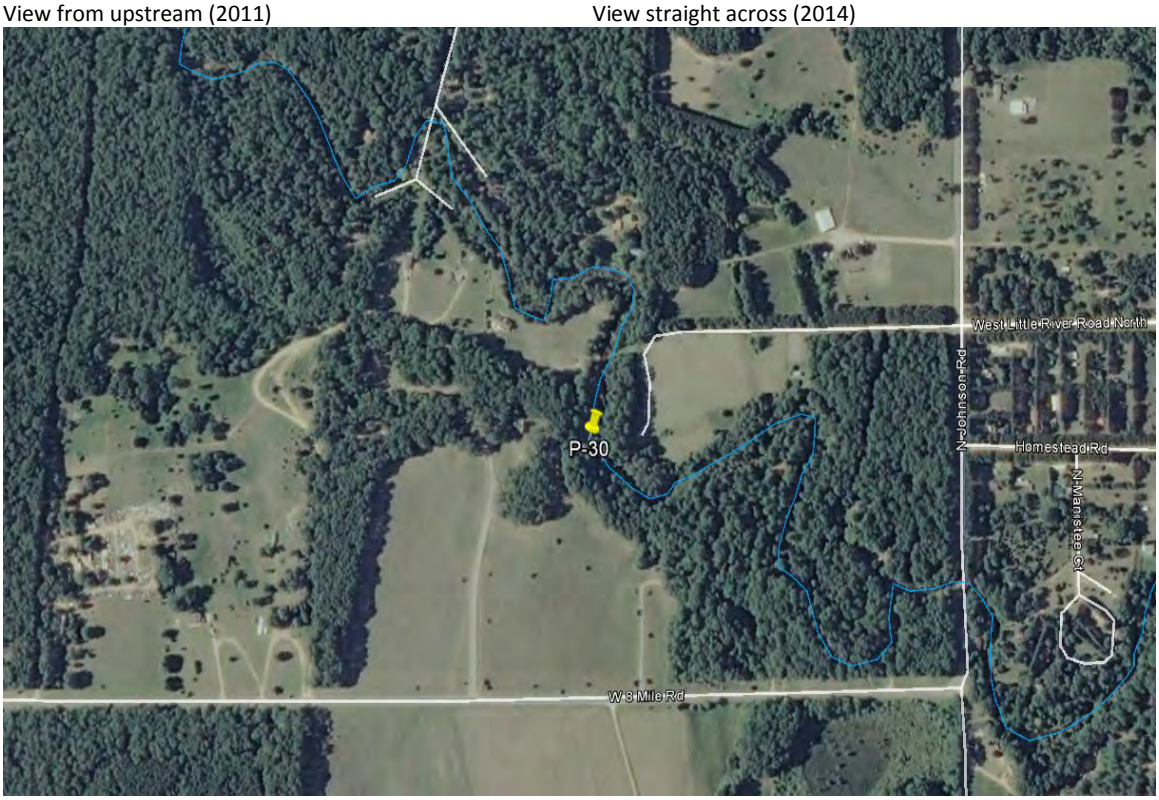

View directly across (2014)

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)

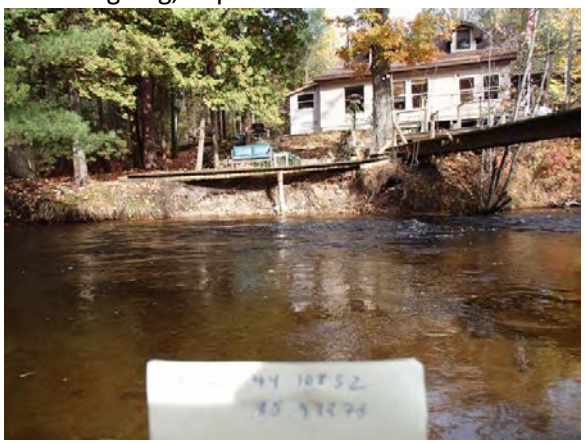

View straight across (2014)



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'

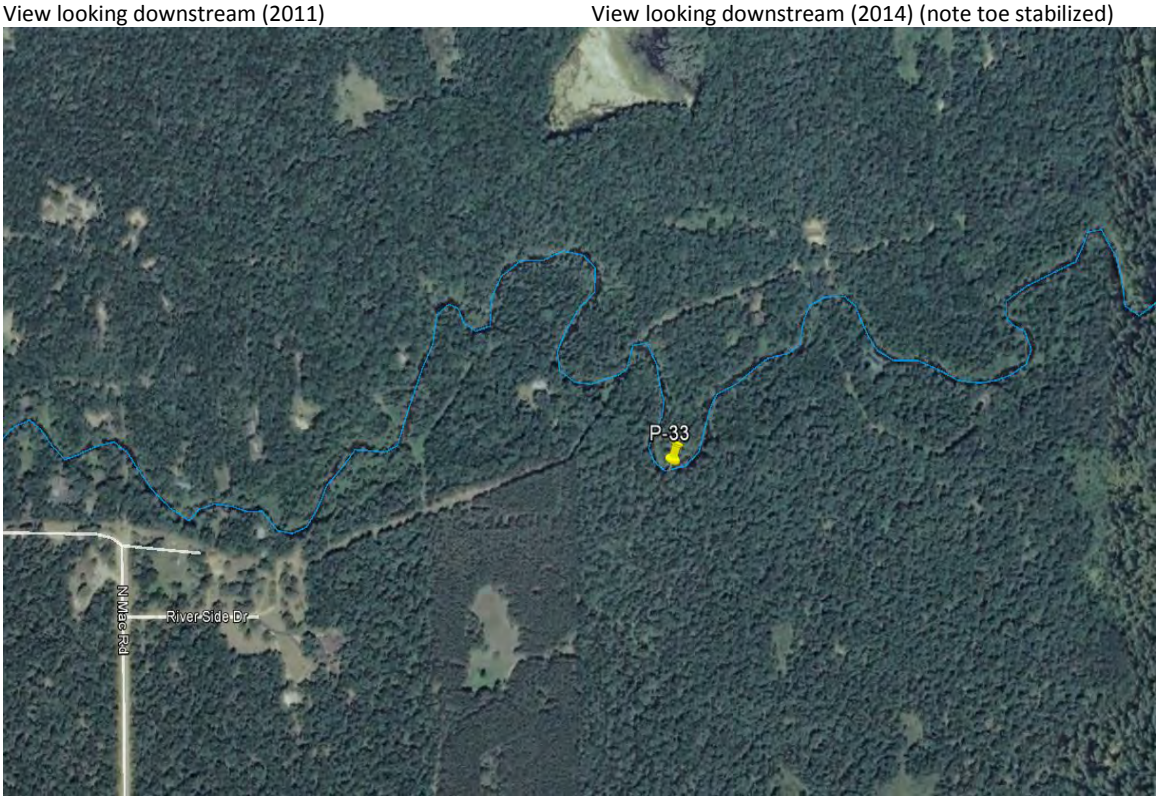
View upstream and across (2011)

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)

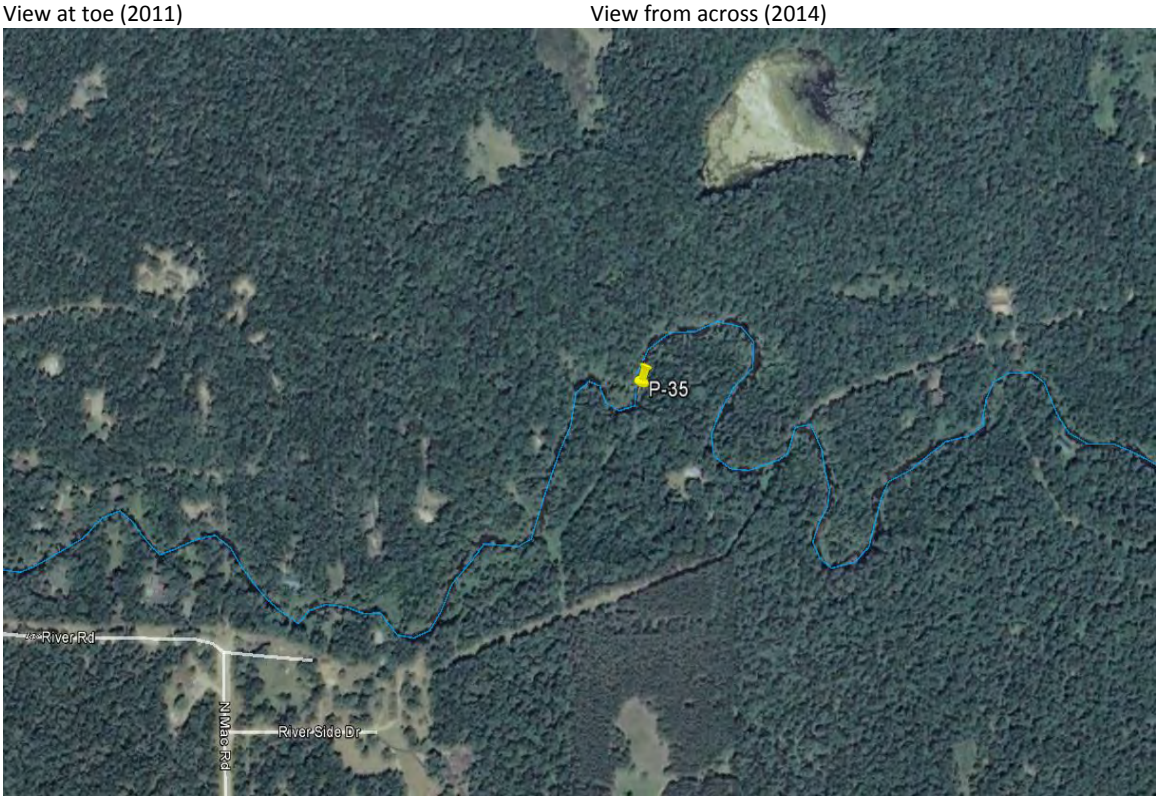

View upstream (2014)

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)

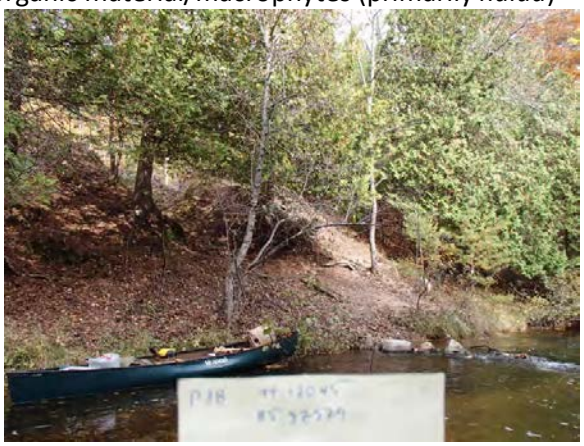

View from across (2014)

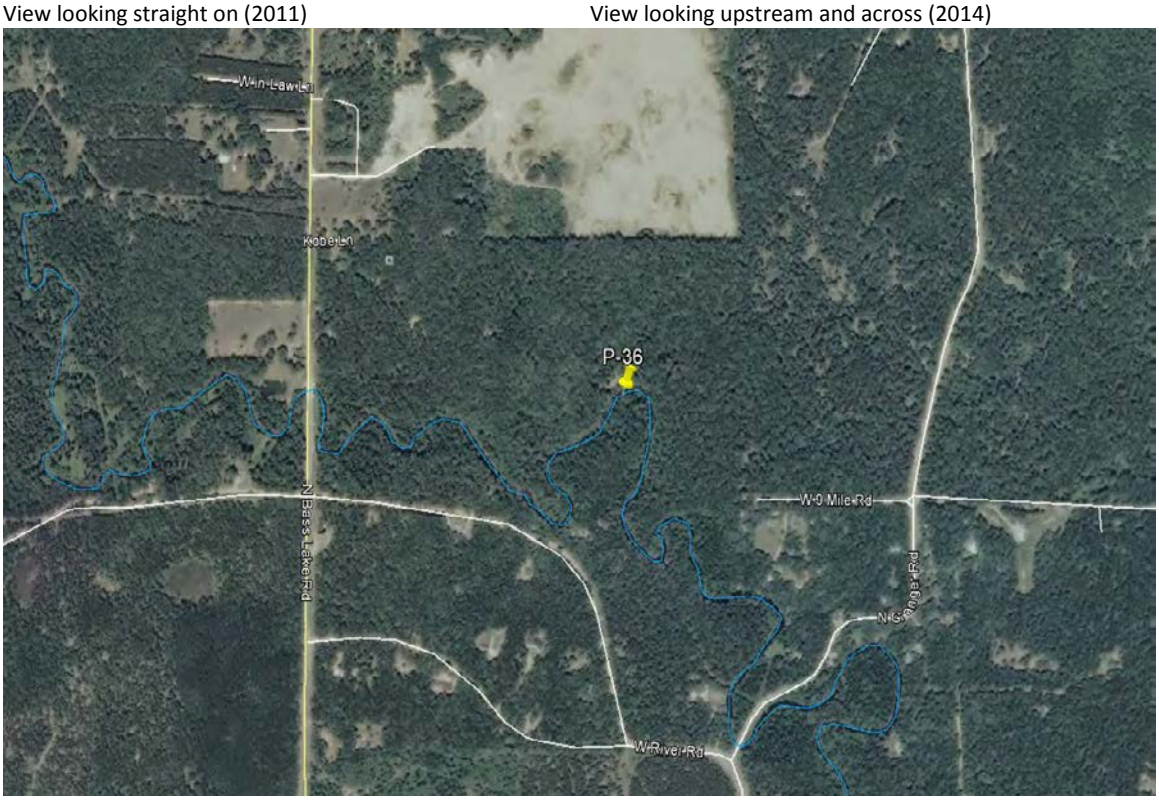


Johnson's Bridge to Bear Track (continued)

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)

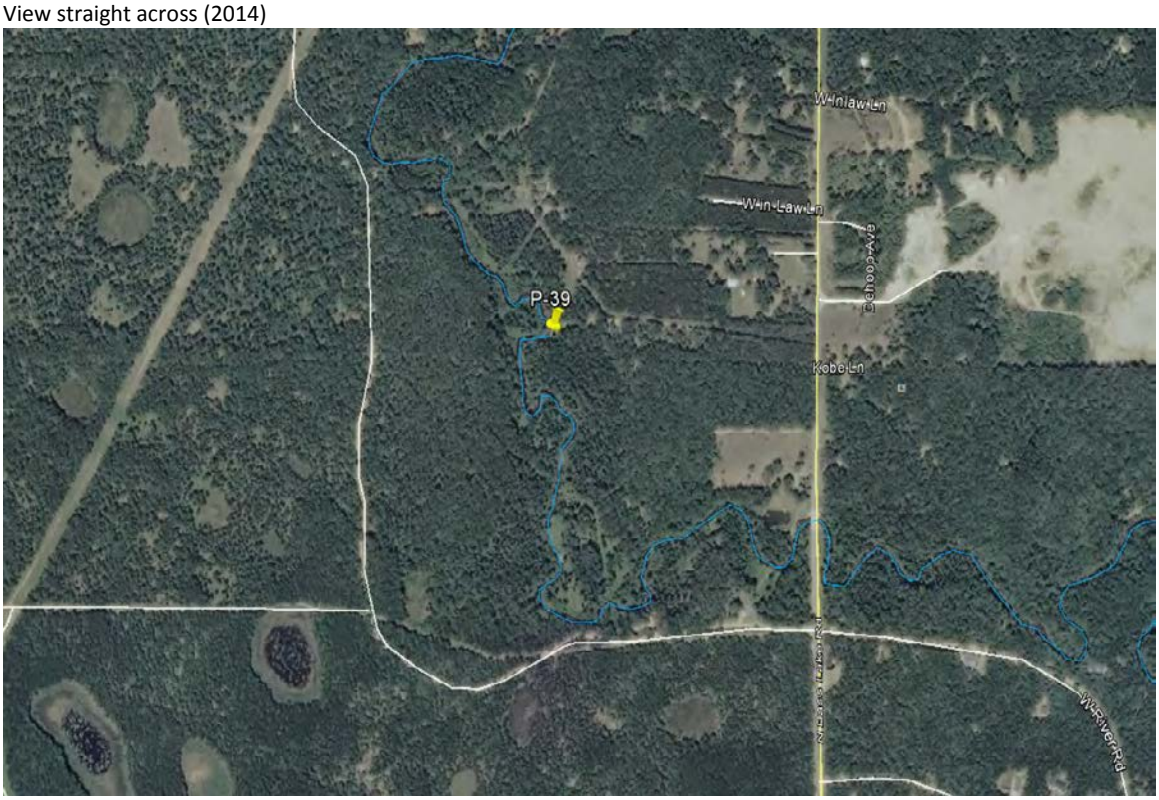
Site 37
(Immediately downstream of Site 36)
Aspect: SE
Slope: 2:1
Length: 15'
Height: 35'
Severity: Moderate
Ownership: State
River-right
Notes: two-track at top of bluff, recreation foot traffic, trail on both sides of river, channel width 46', substrate small gravel/sand/organic material/macrophytes, depth at toe 1.5'

View straight on (2011)

Johnson's Bridge to Bear Track (continued)

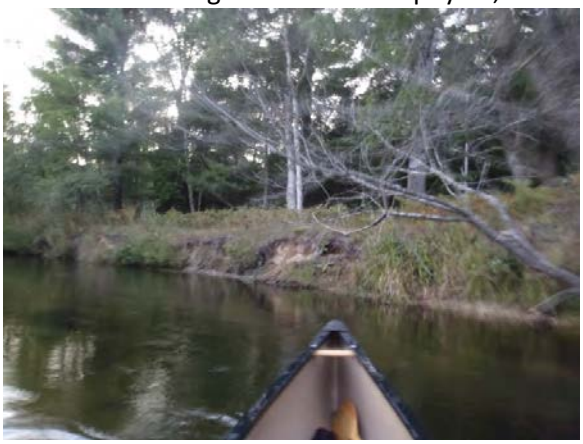
Site 39
44.12311, -85.98900
Aspect: W
Slope: 1:1
Length: 32'
Height: 5'
Severity: Moderate
Ownership: Private (red camp located upland from river)
River-right
Notes: toe of bank unstable, channel width 40', water depth 2', substrate gravel and sand, outside of meander bend

View straight across (2014)

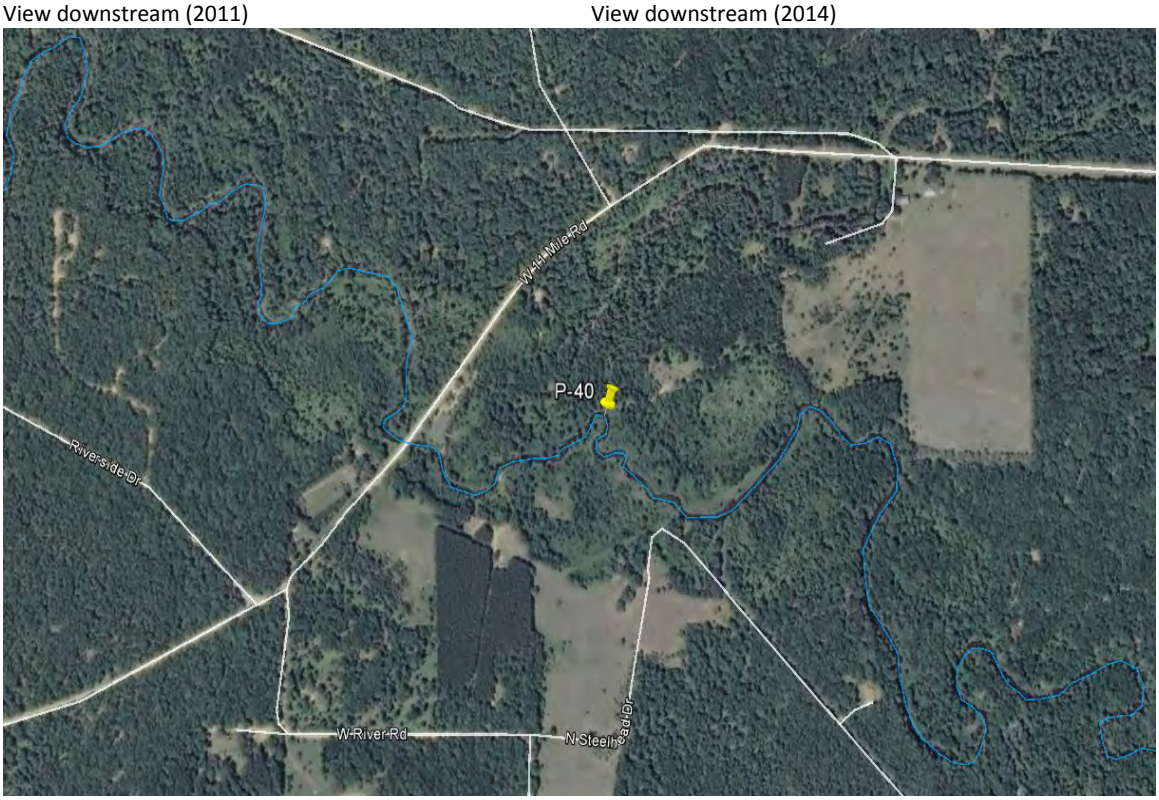


Johnson's Bridge to Bear Track (continued)

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)

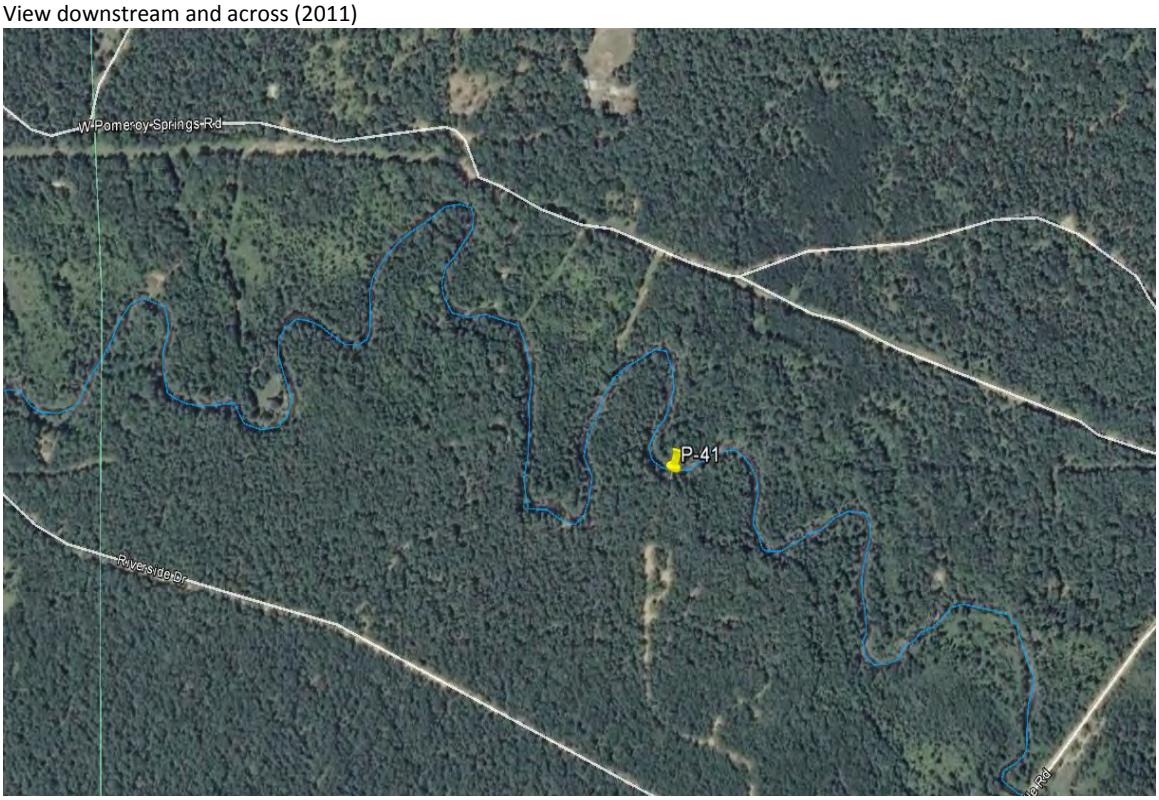

View downstream (2014)



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)

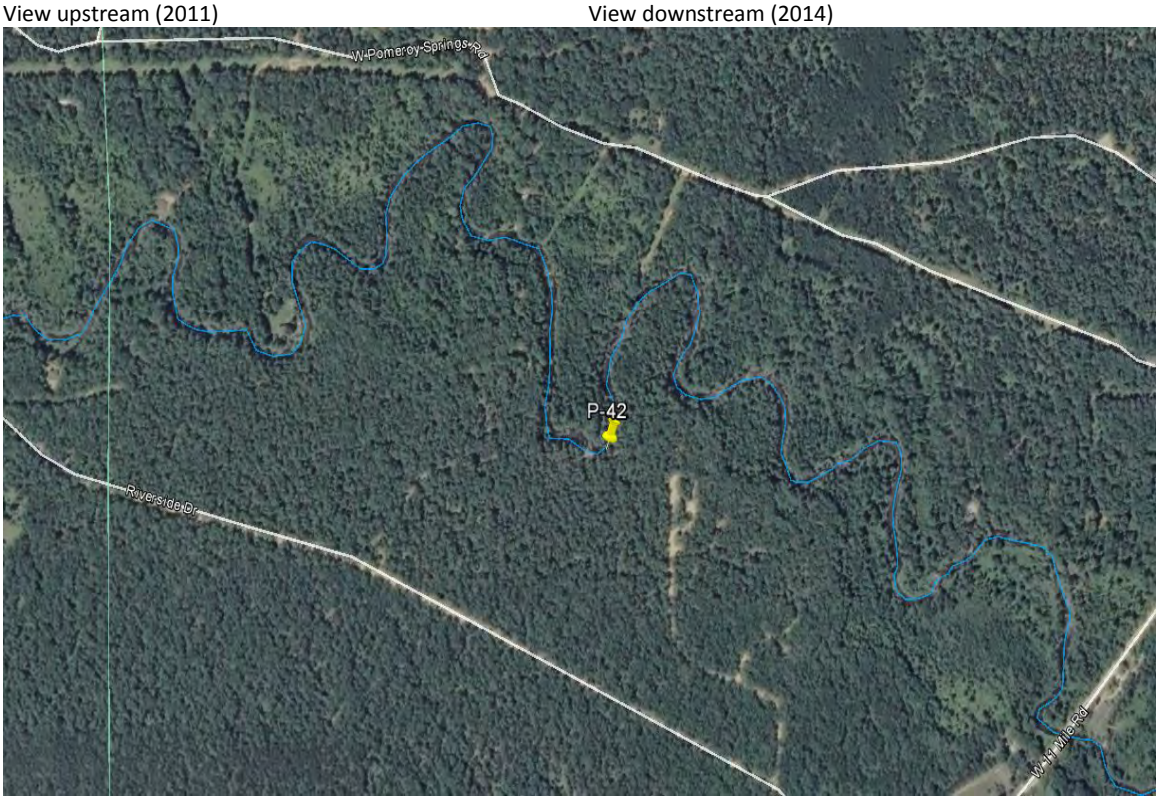


Little Manistee River Eroding Stream Bank Assessment: Bear Track to 9 Mile Bridge

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

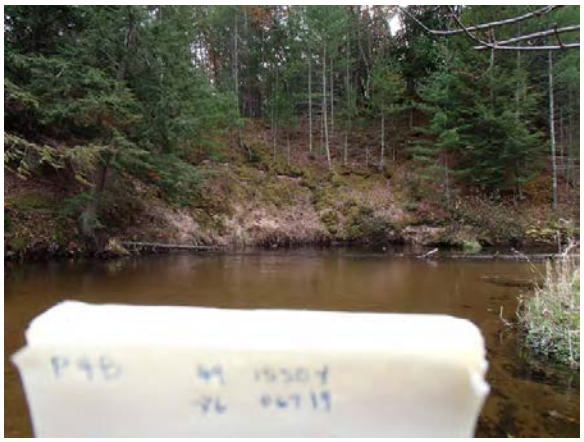
View upstream and across (2011)

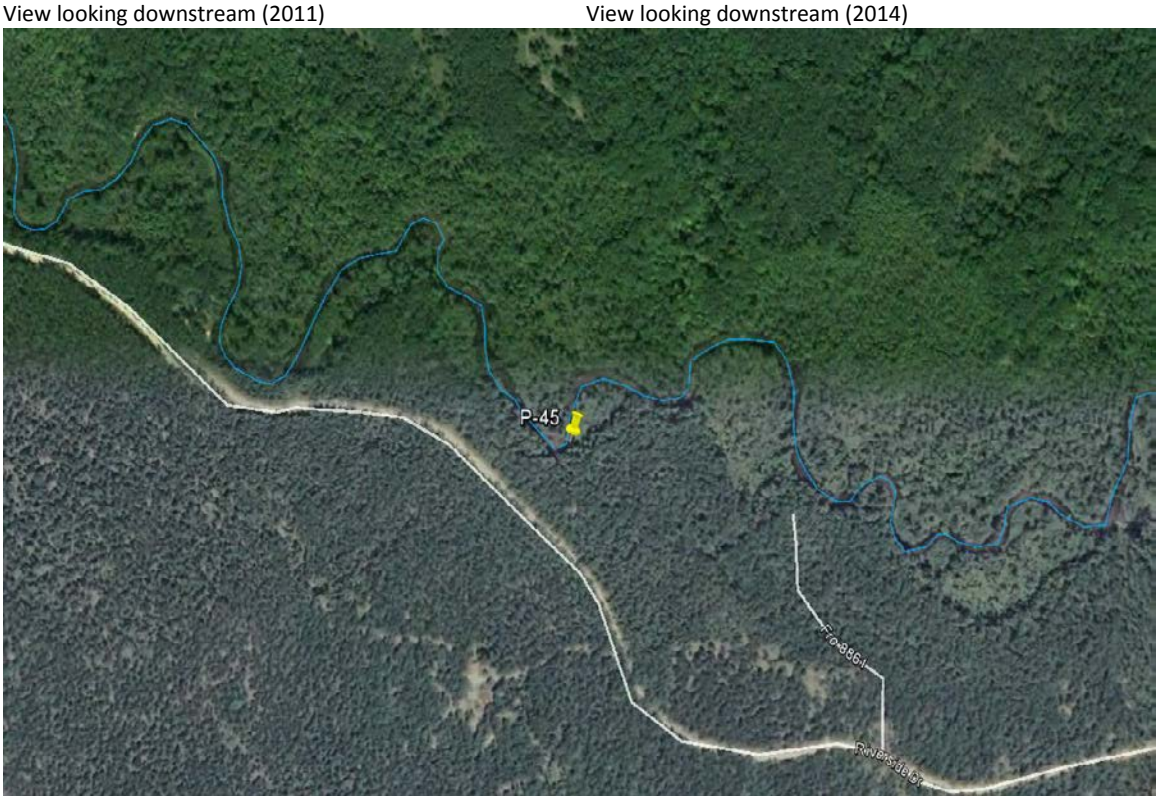

View upstream and across (2014)

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

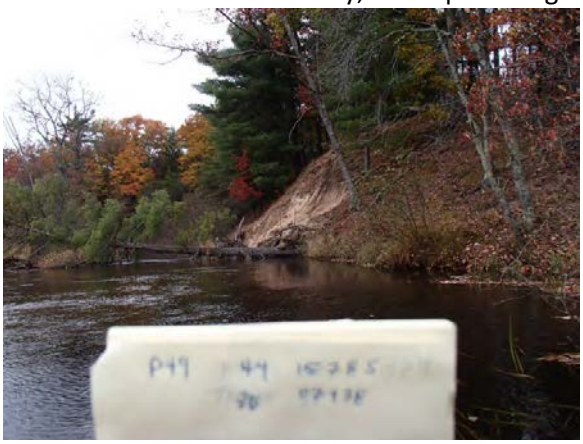

View looking downstream (2011)


View looking downstream (2014)

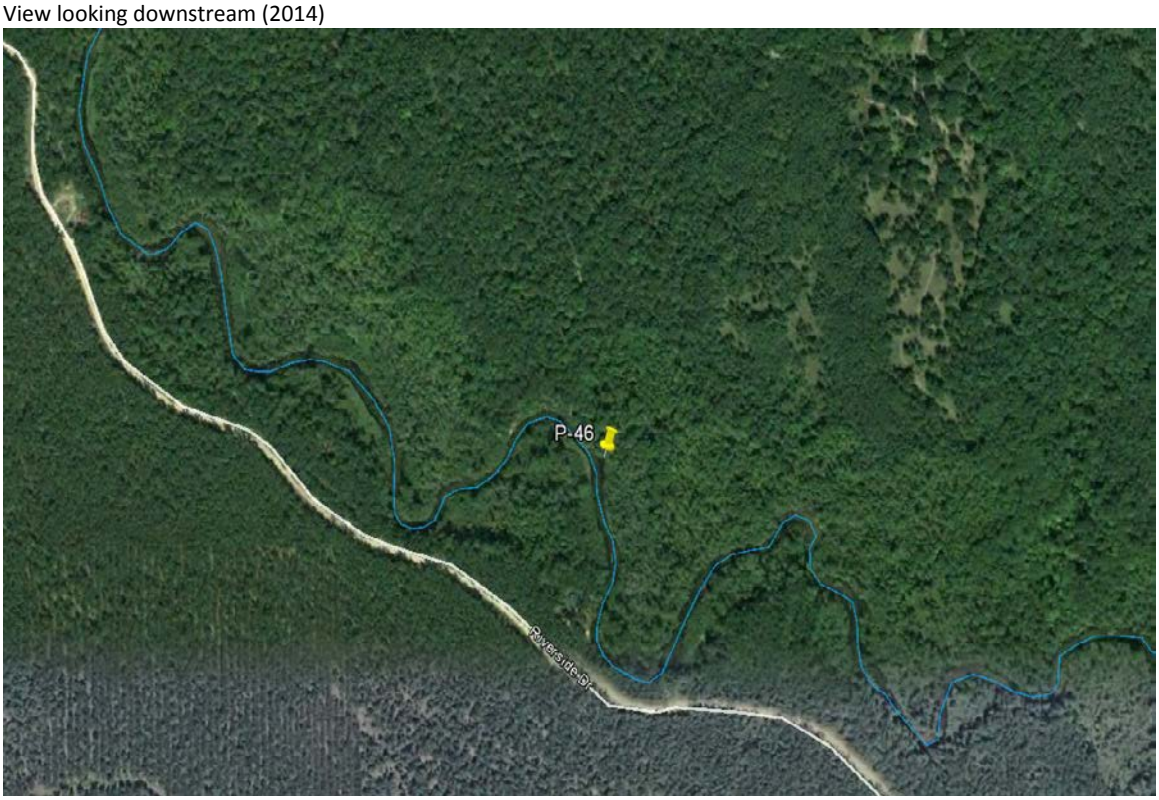


Bear Track to 9 Mile Bridge (continued)

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)

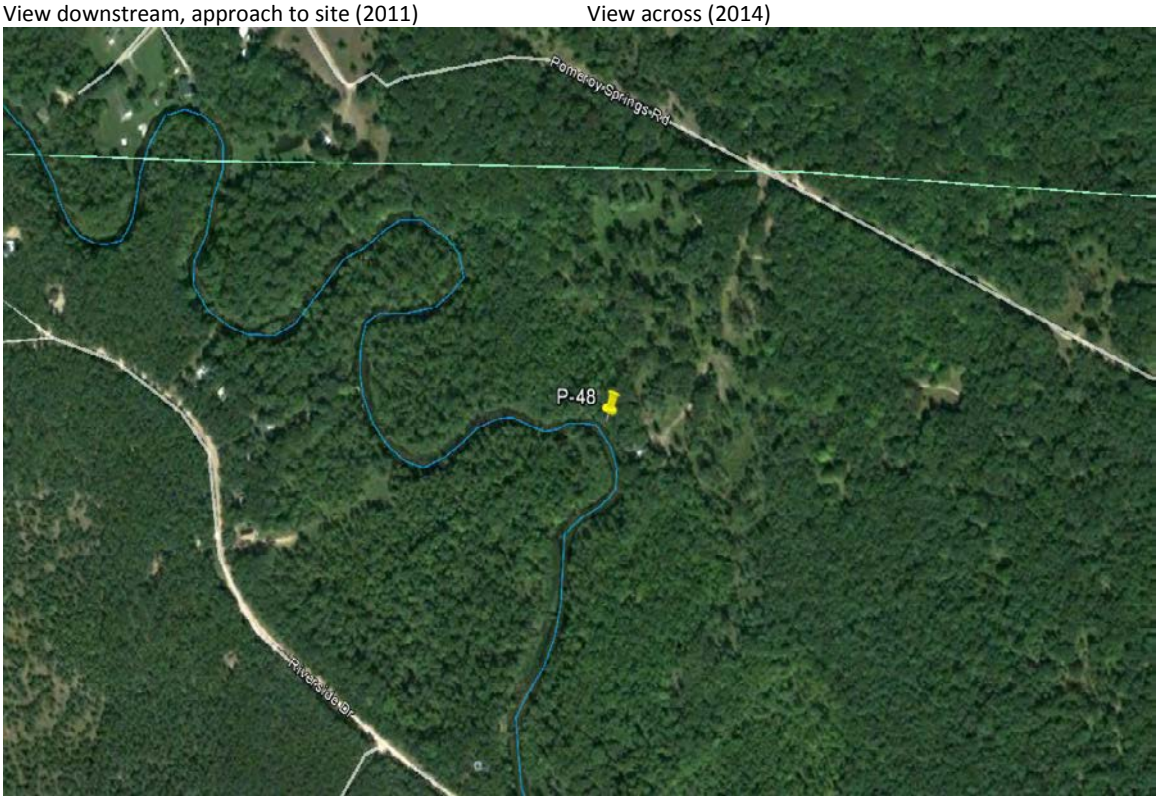

View downstream (2014)

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)

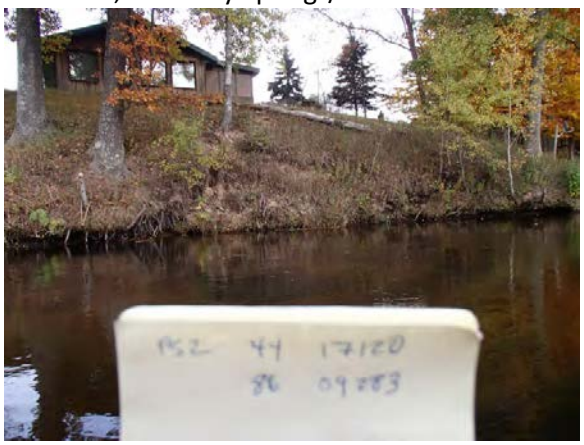

View across (2014)



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)



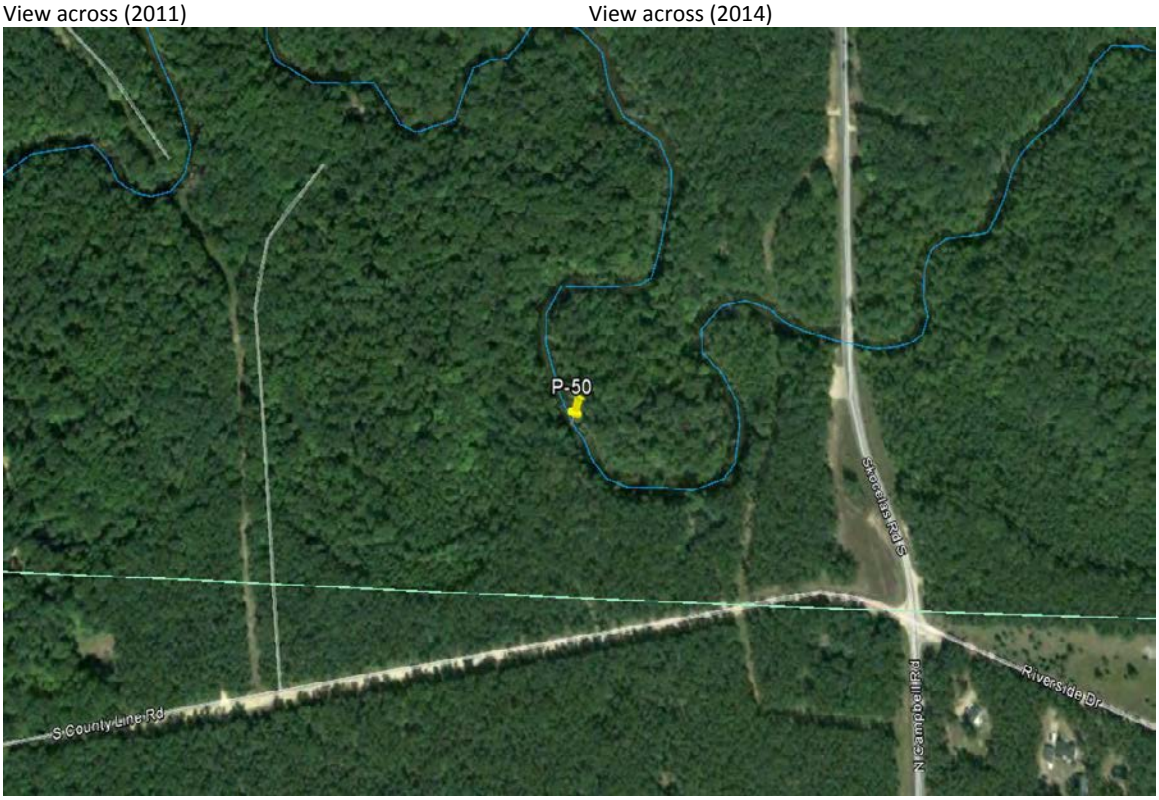
View across (2014)

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)

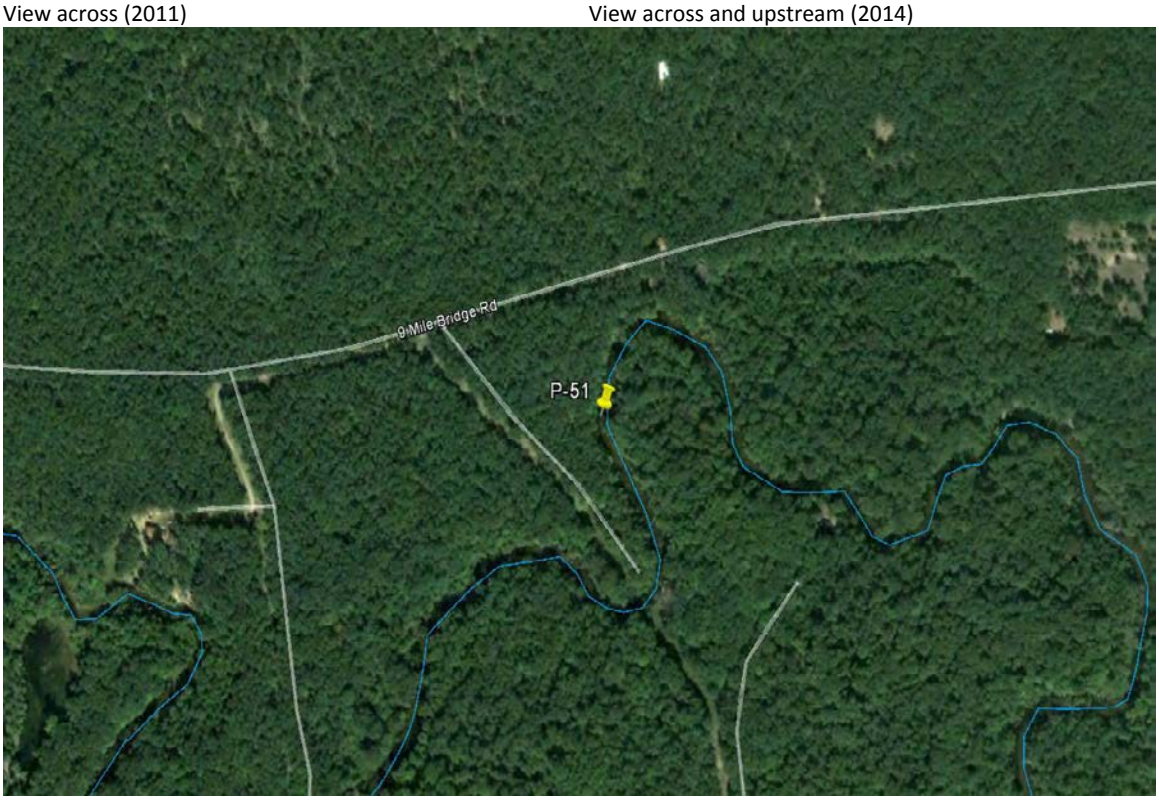


9 Mile Bridge to 6 Mile Bridge (continued)

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)

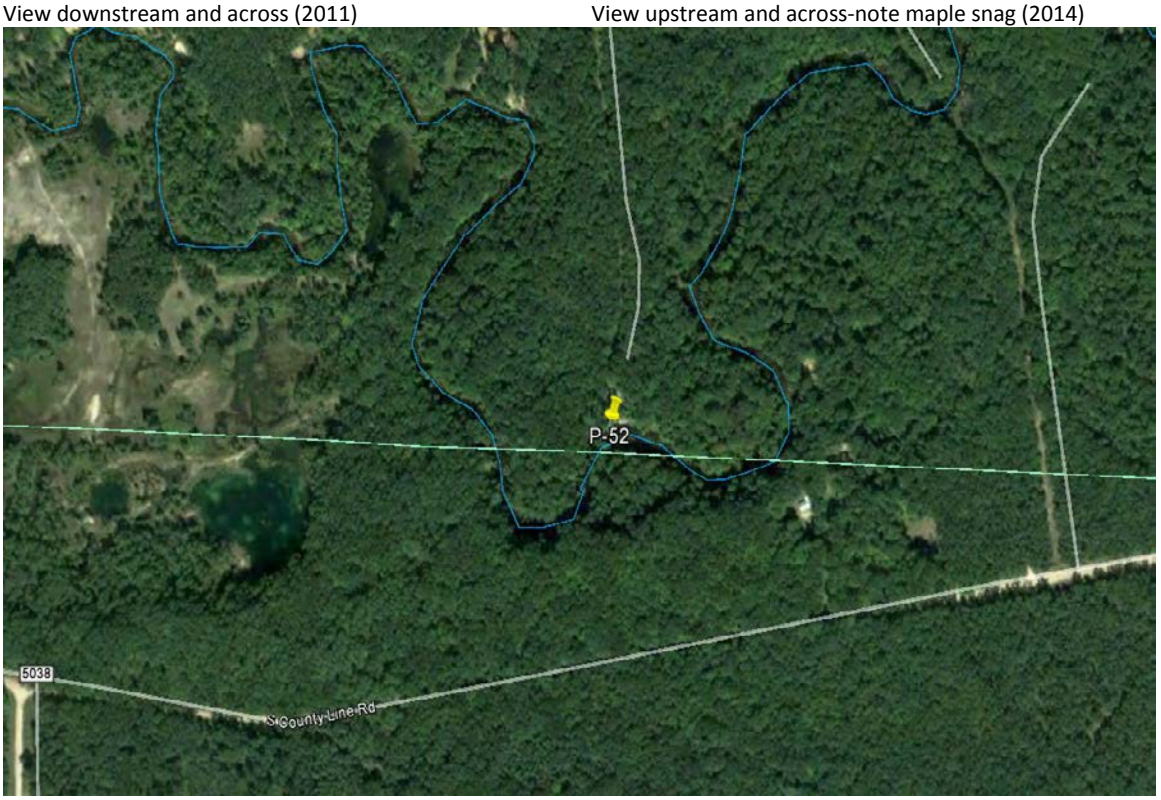


9 Mile Bridge to 6 Mile Bridge (continued)

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)

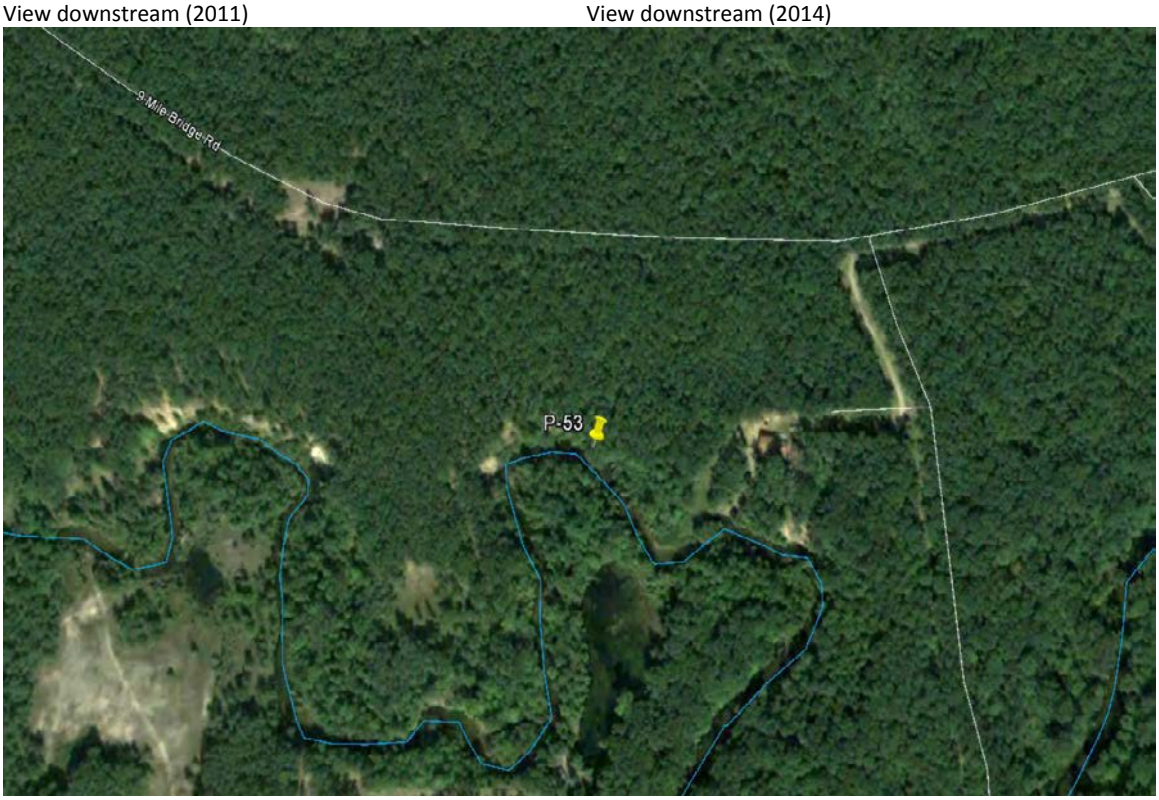


9 Mile Bridge to 6 Mile Bridge (continued)

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)

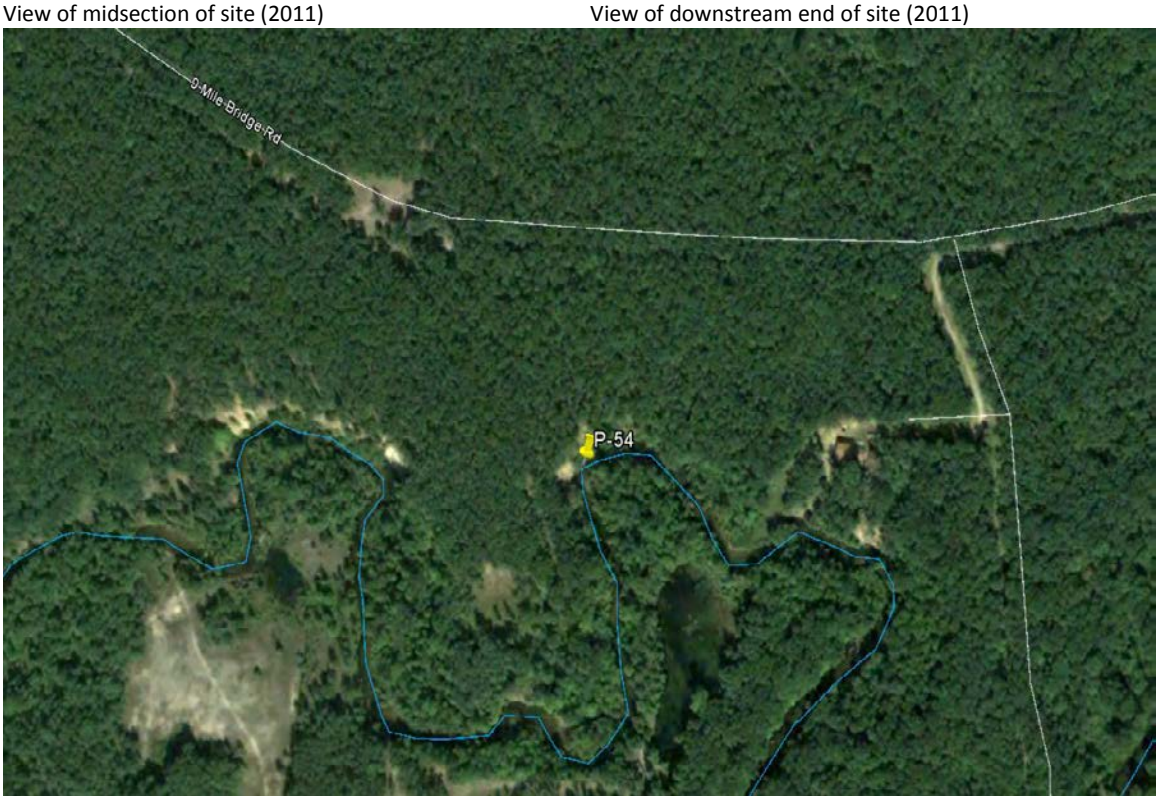


9 Mile Bridge to 6 Mile Bridge (continued)

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)

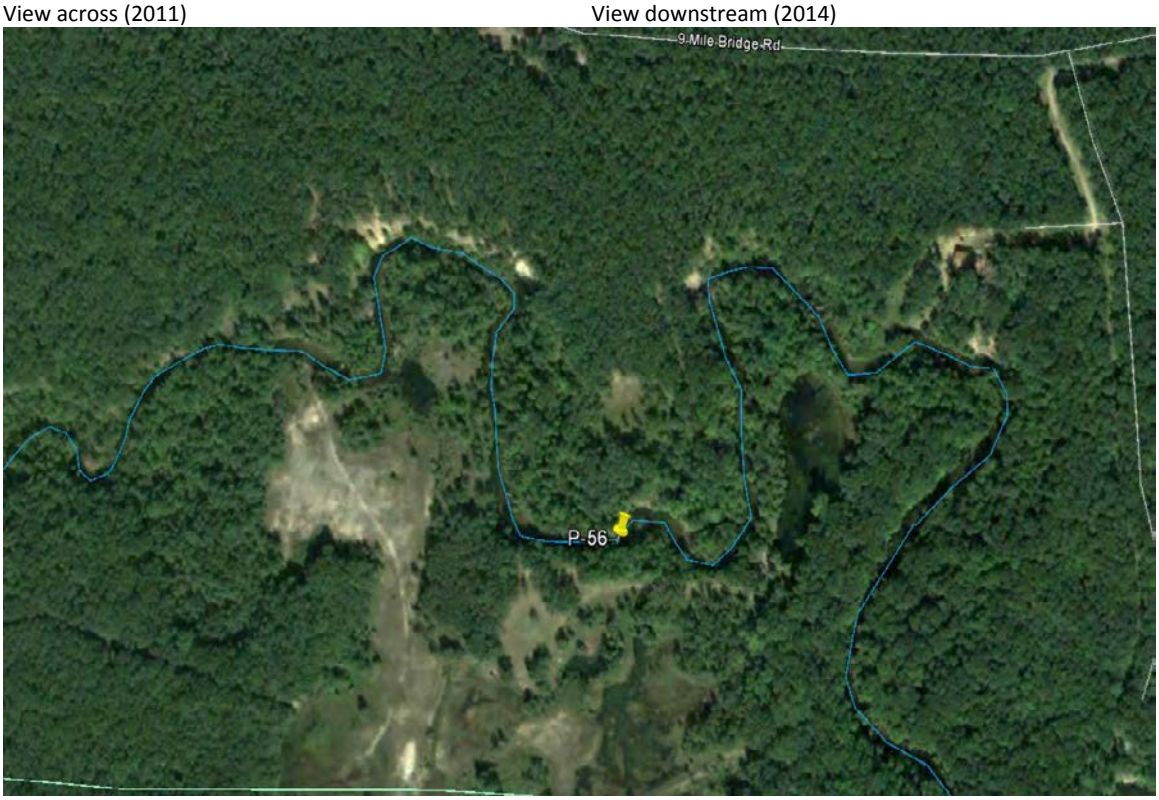

View upstream (2014)

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’

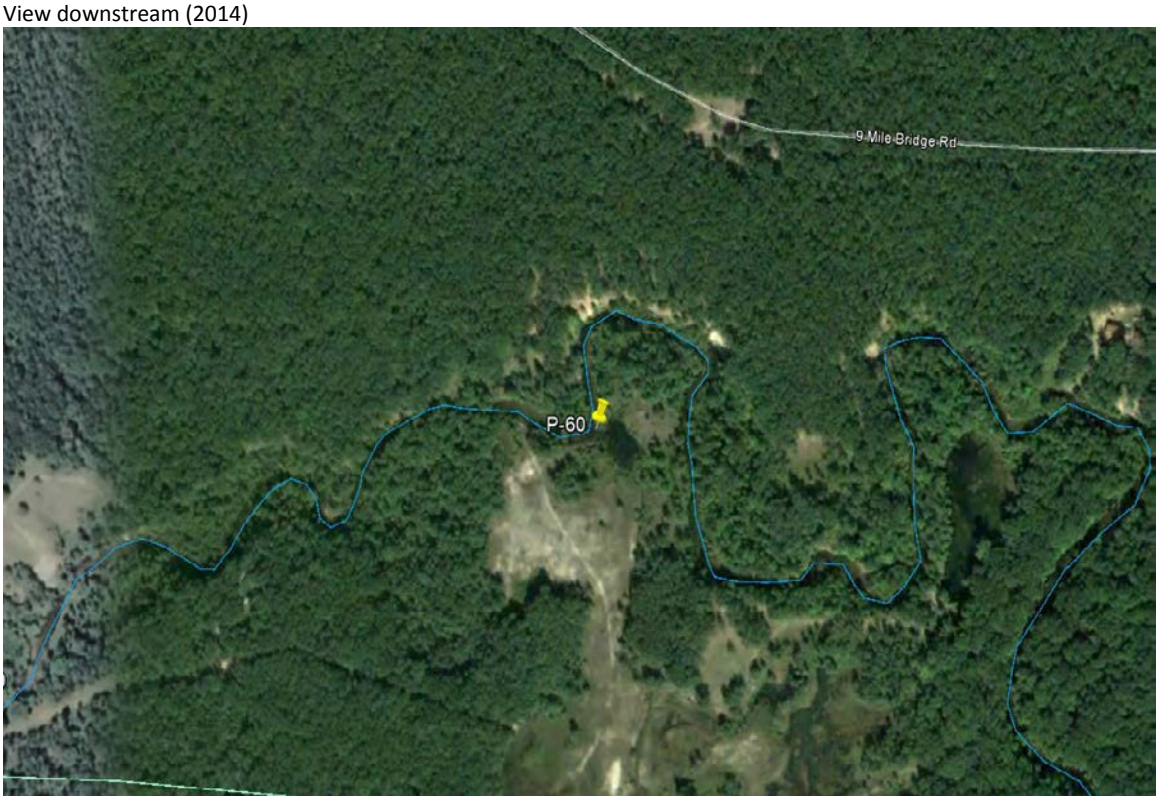

View downstream (2011)


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:

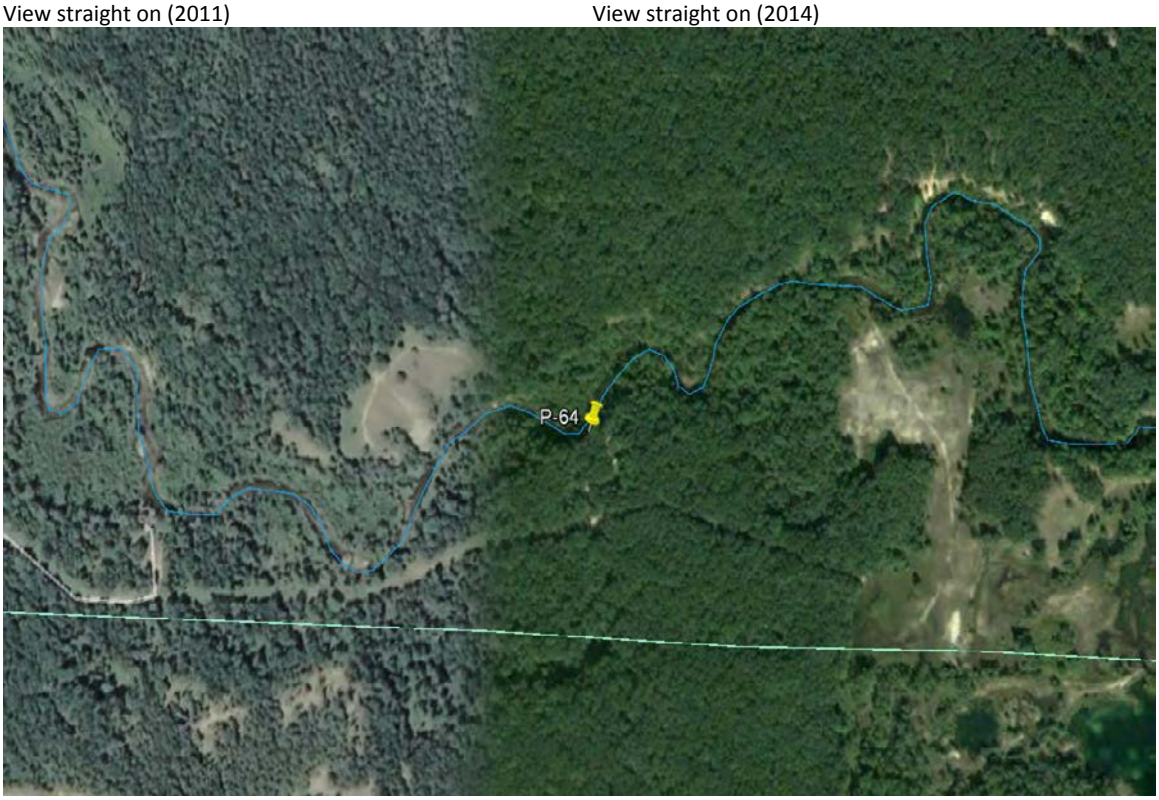
View downstream (2014)

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

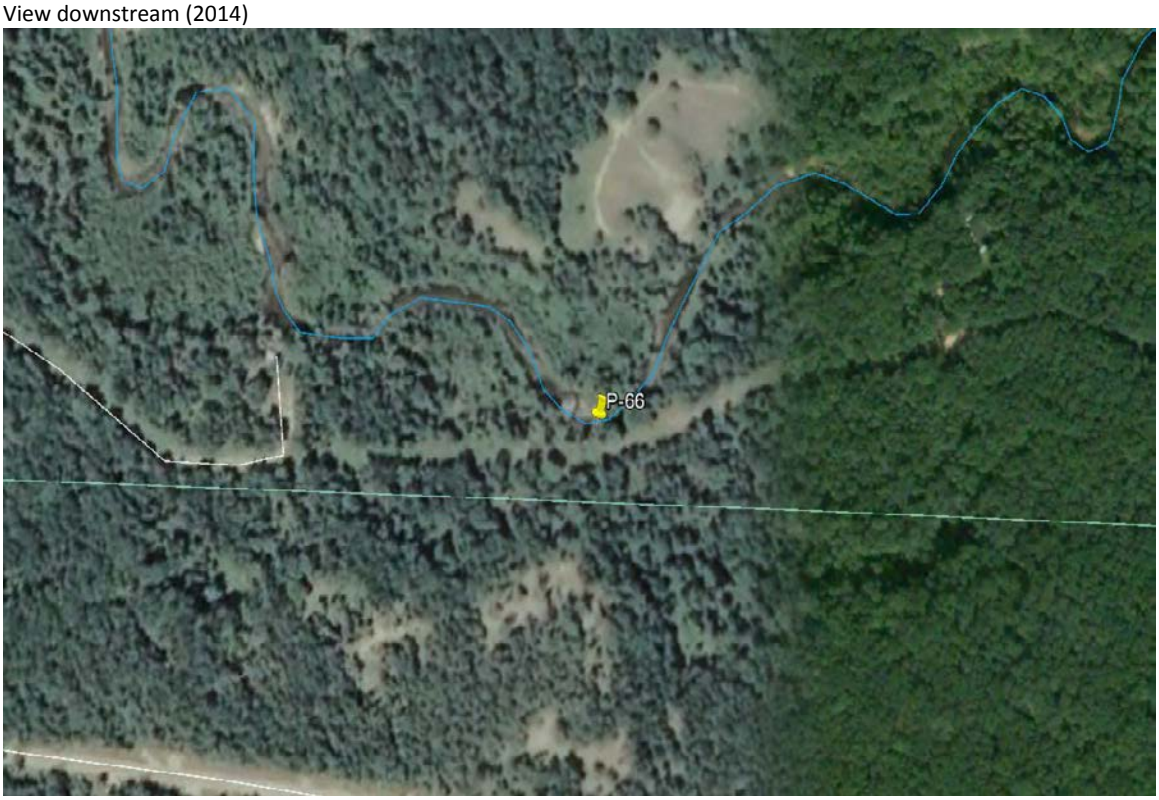

View upstream (2011)


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

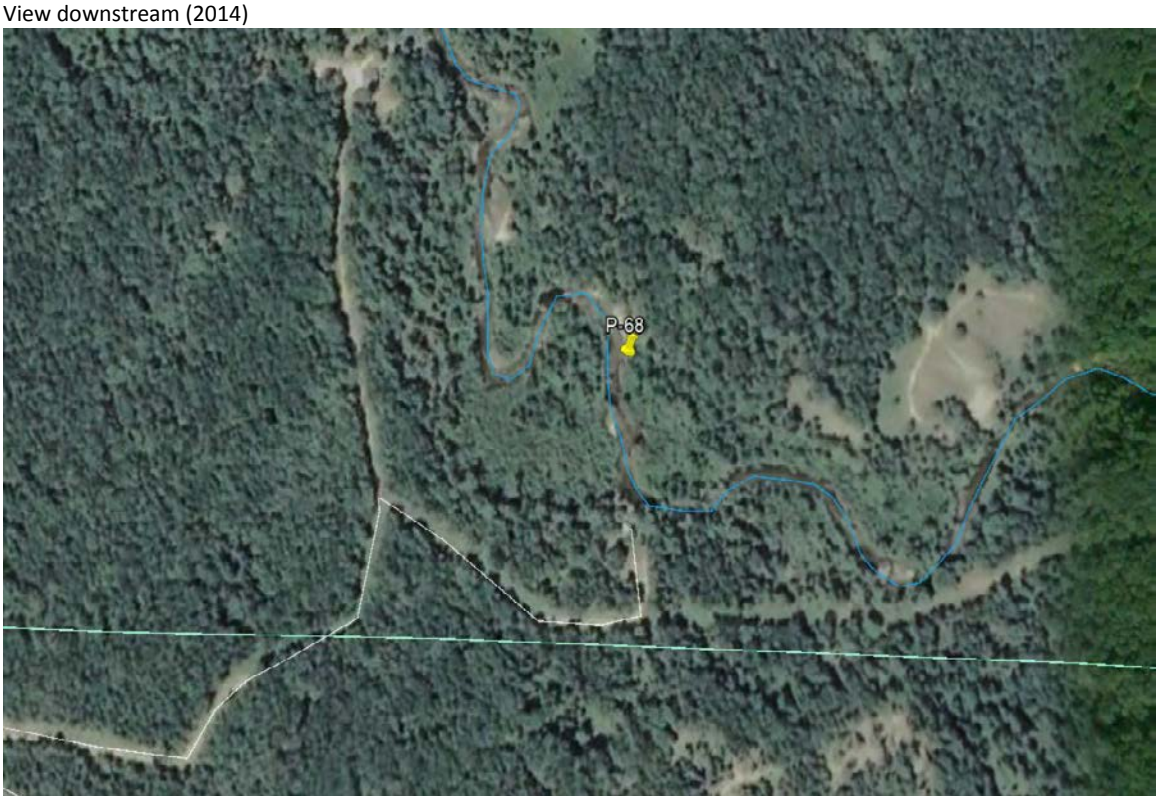
View downstream (2011)

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

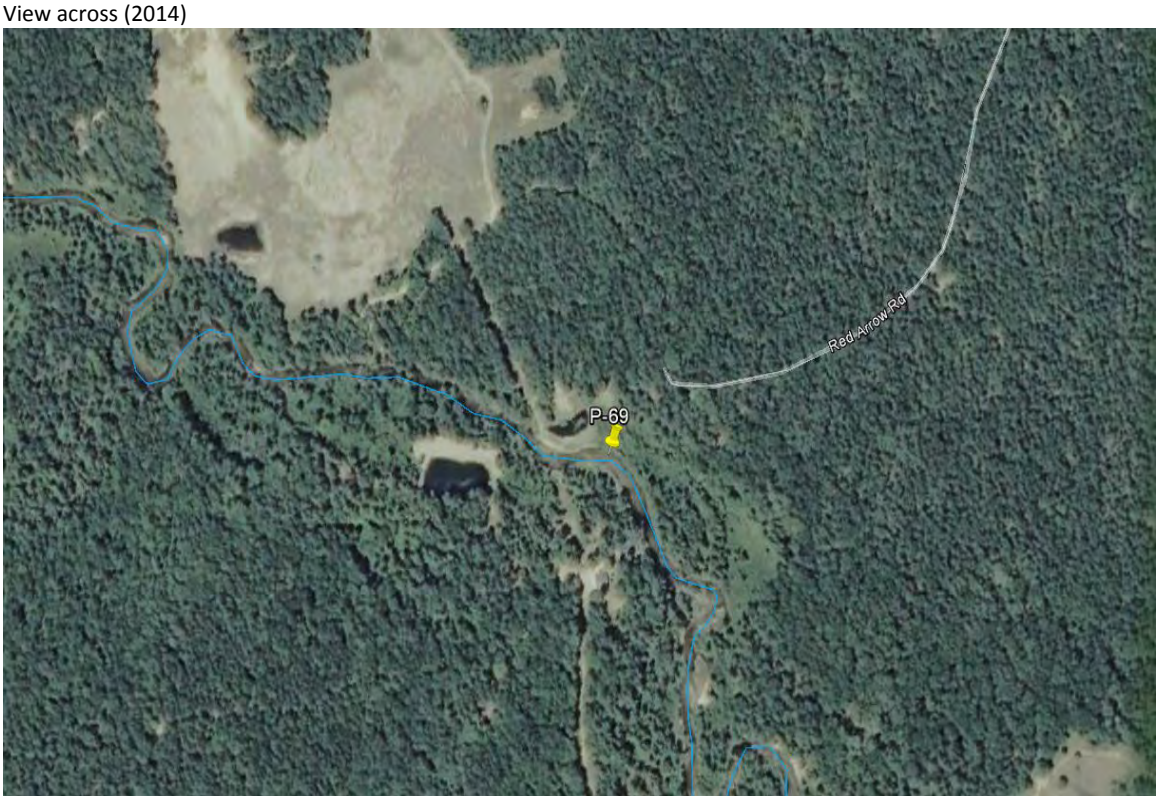
View downstream (2014)



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)

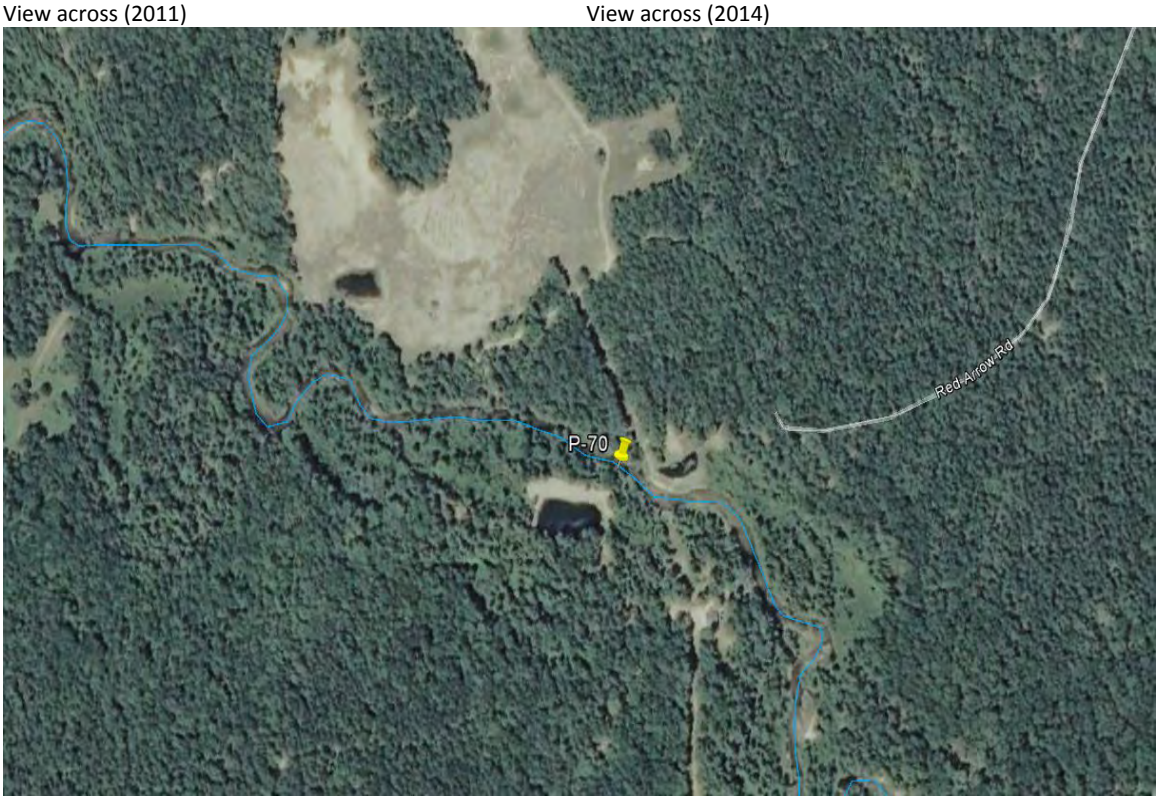


9 Mile Bridge to 6 Mile Bridge (continued)

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

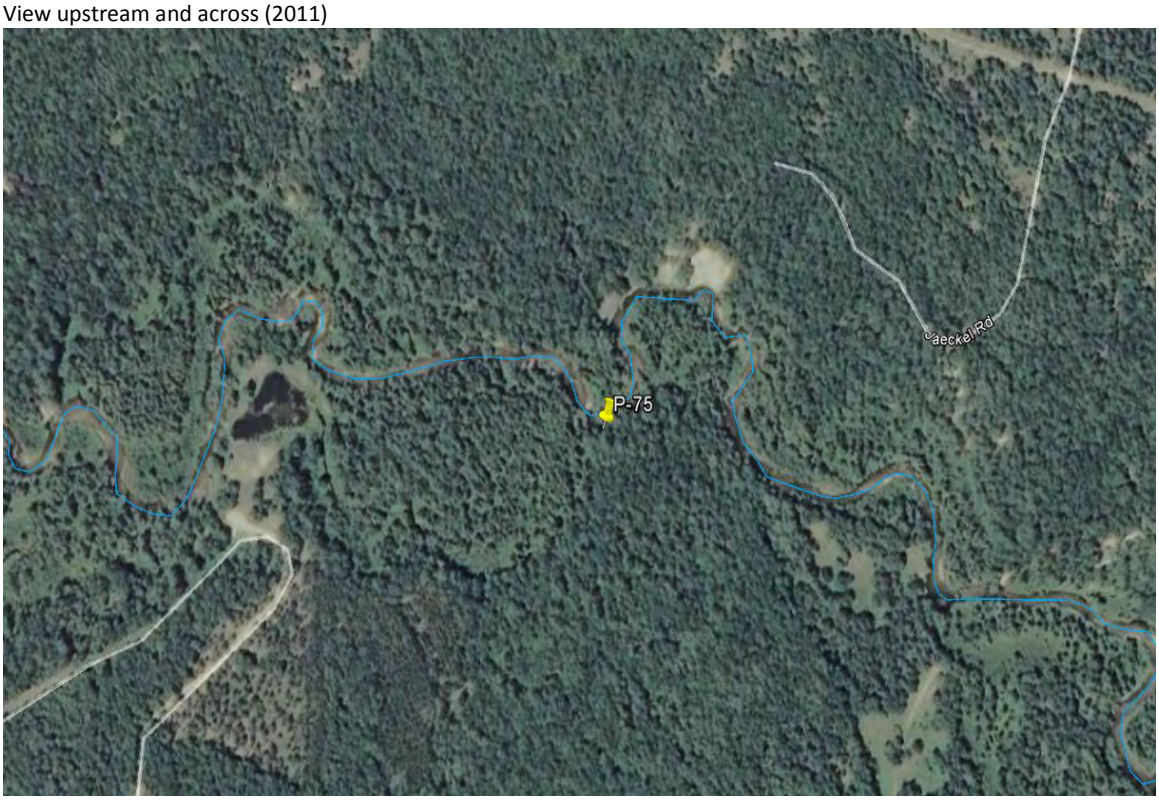

View downstream (2011)


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

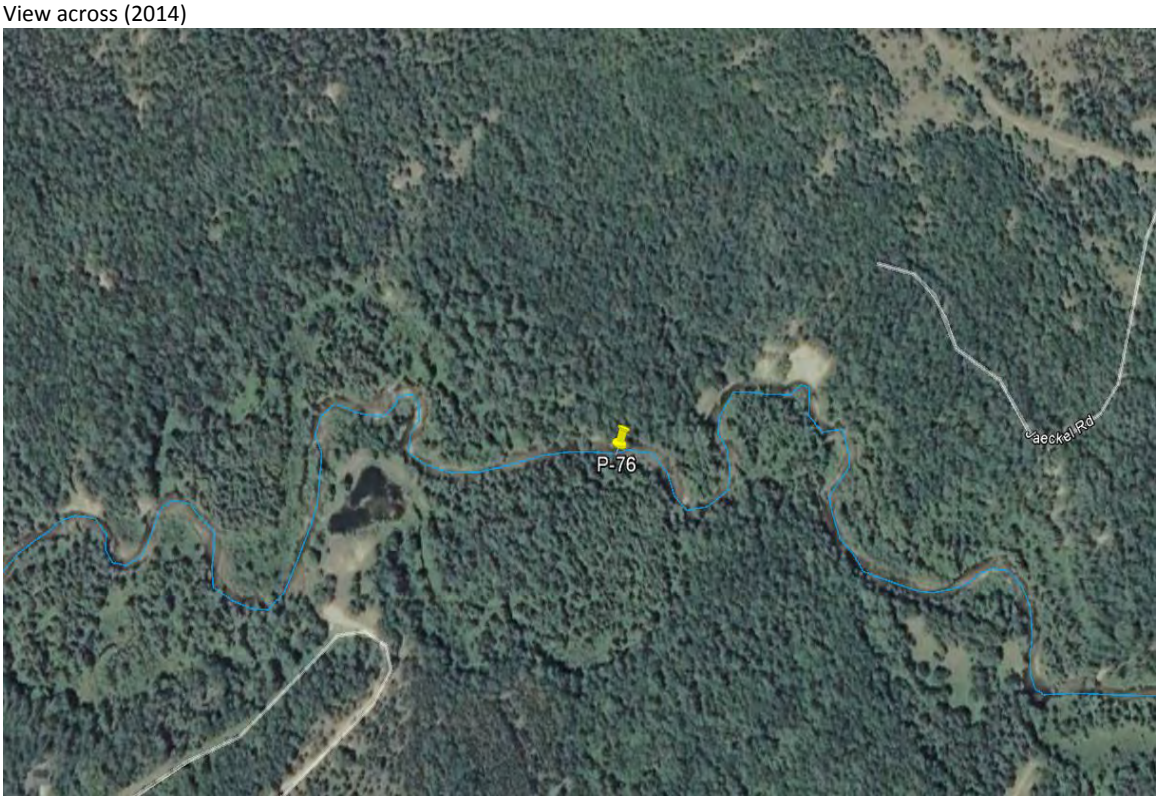
View upstream and across (2011)



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)

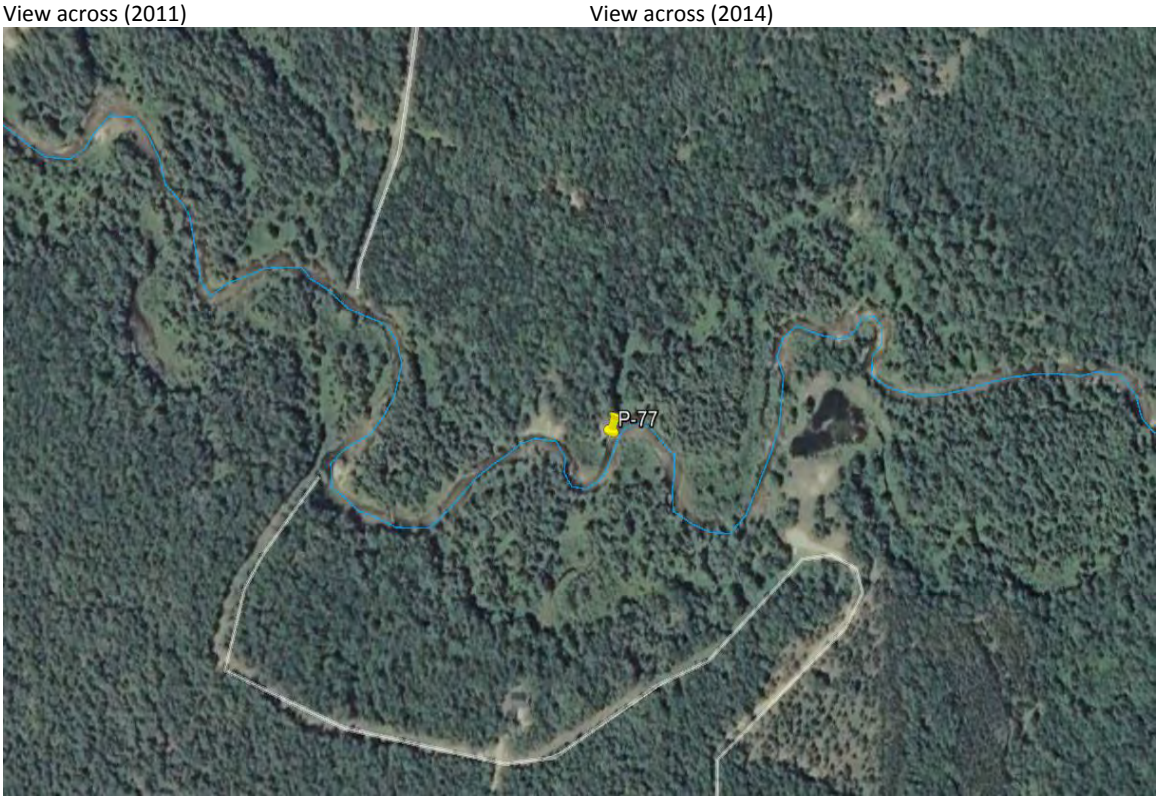


9 Mile Bridge to 6 Mile Bridge (continued)

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’

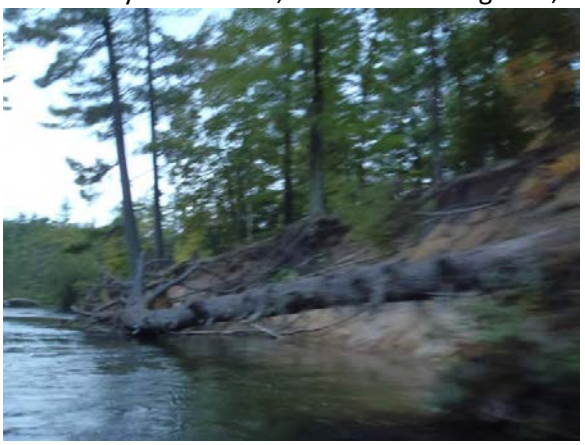

View across (2011)


View across (2014)

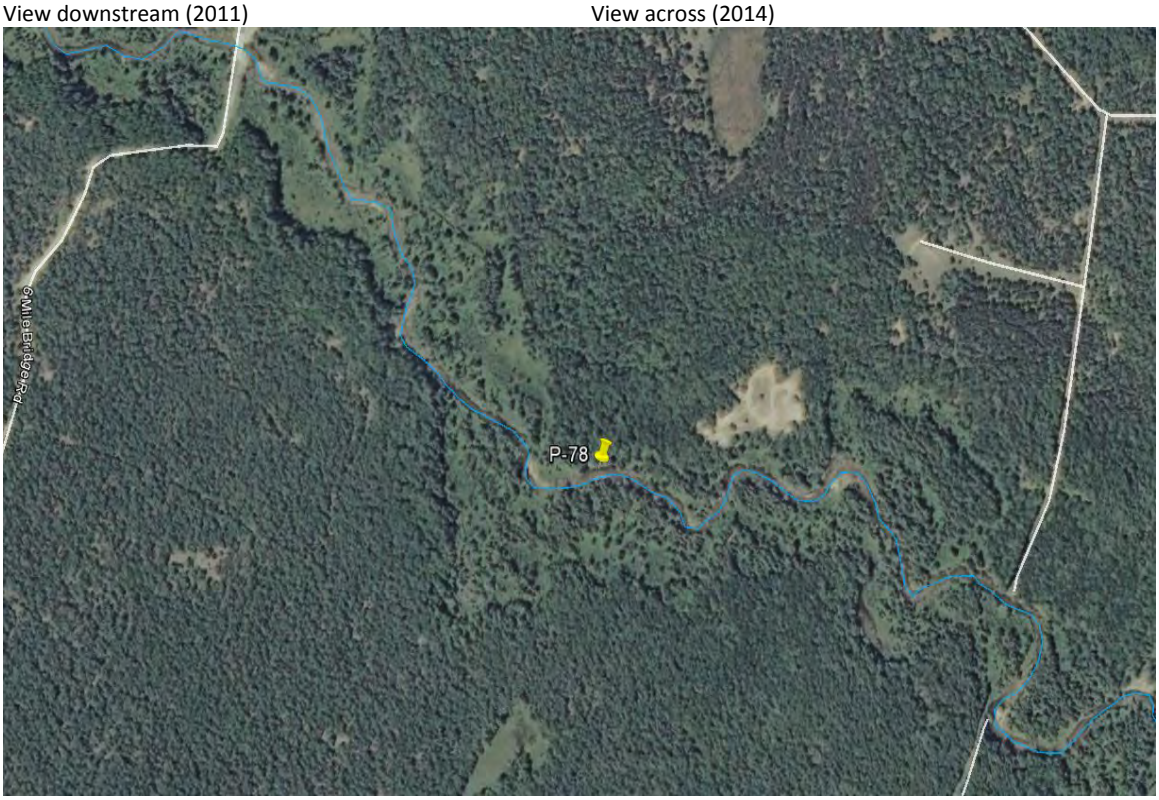


9 Mile Bridge to 6 Mile Bridge (continued)

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)

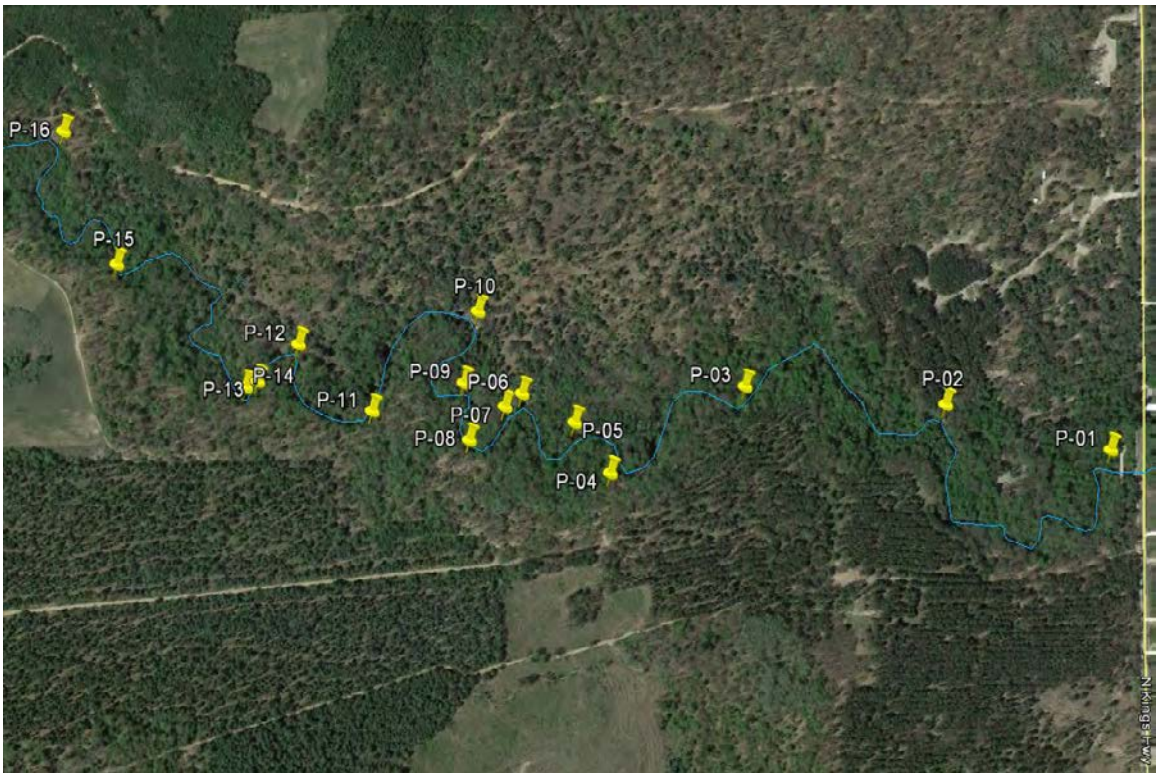
Site 82
44.20847, -86.24176
Aspect: E
Slope: Vertical
Length: 90’
Height: 4’
Severity: Severe
Ownership: Federal
River-left
Notes: depth at toe 3.5’, substrate gravel/sand

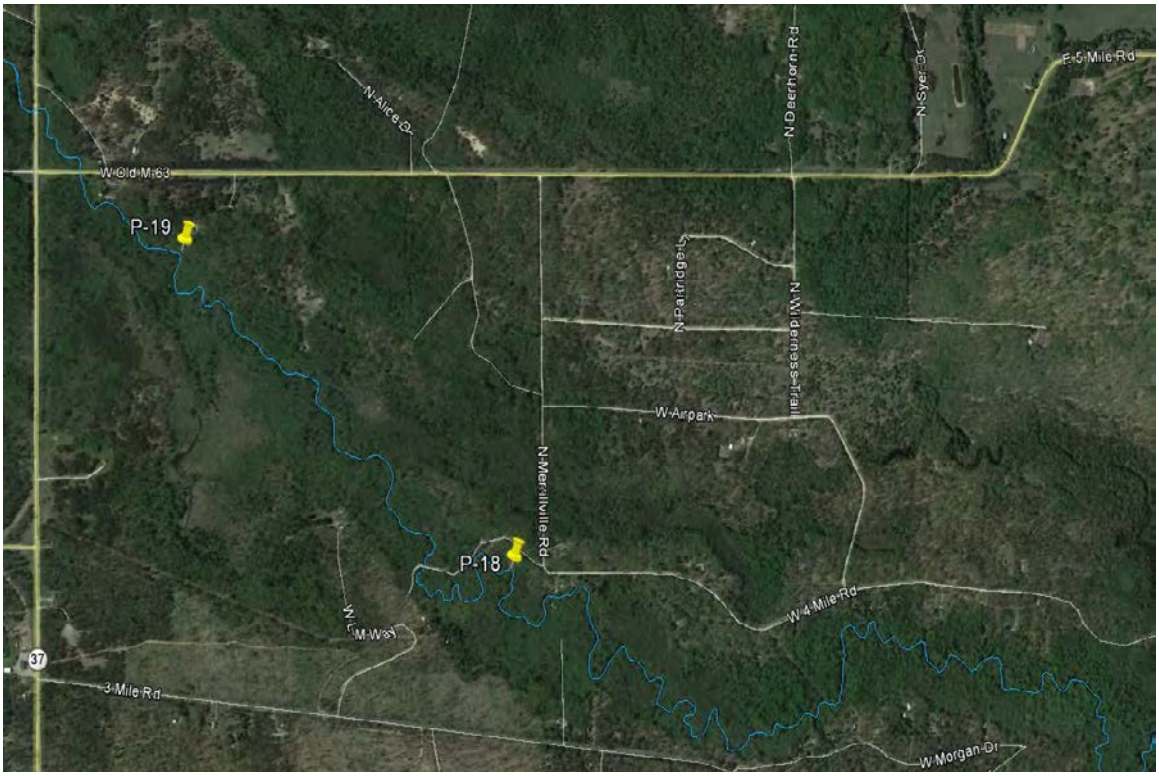
View upstream and across (2013)

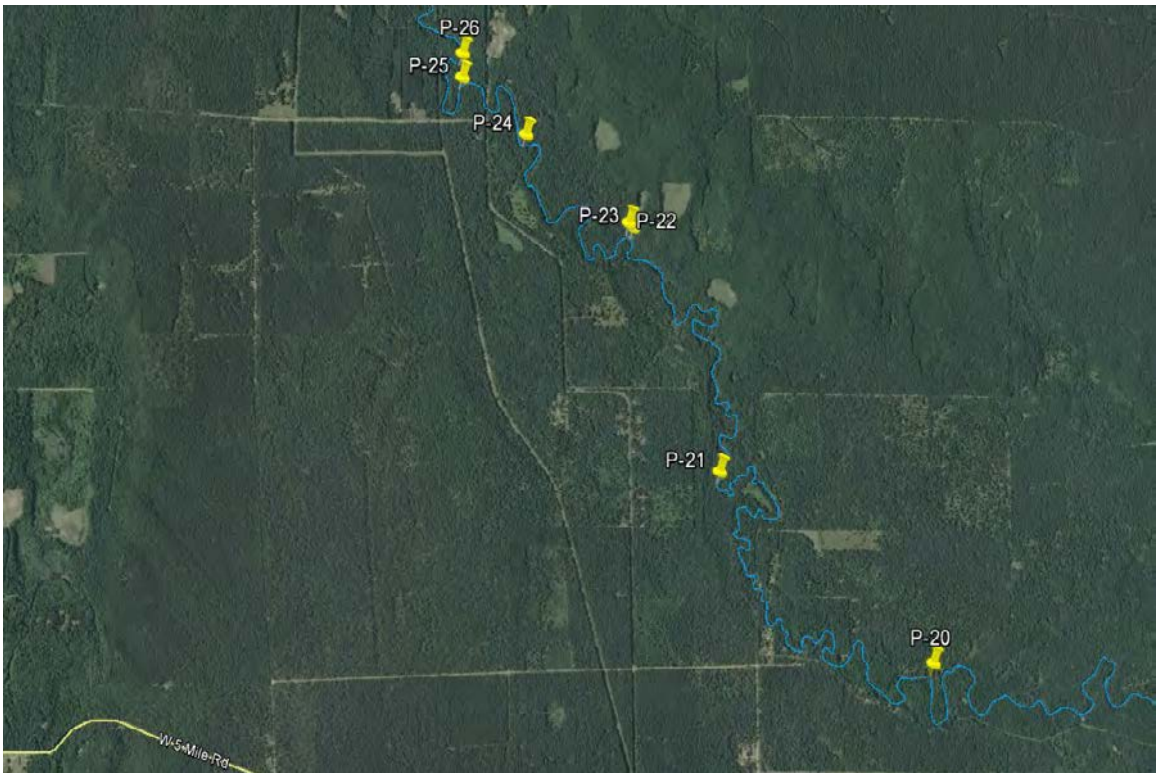
Little Manistee River **Minor** Eroding Sites		
Site#	Latitude	Longitude
1	44.03460	-85.72291
3	44.03531	-85.72869
4	44.03443	-85.73084
5	44.03493	-85.73140
6	44.03523	-85.73225
7	44.03511	-85.73254
8	44.03476	-85.73311
9	44.03536	-85.73319
11	44.03500	-85.73459
21	44.07075	-85.88659
22	44.08316	-85.89396
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

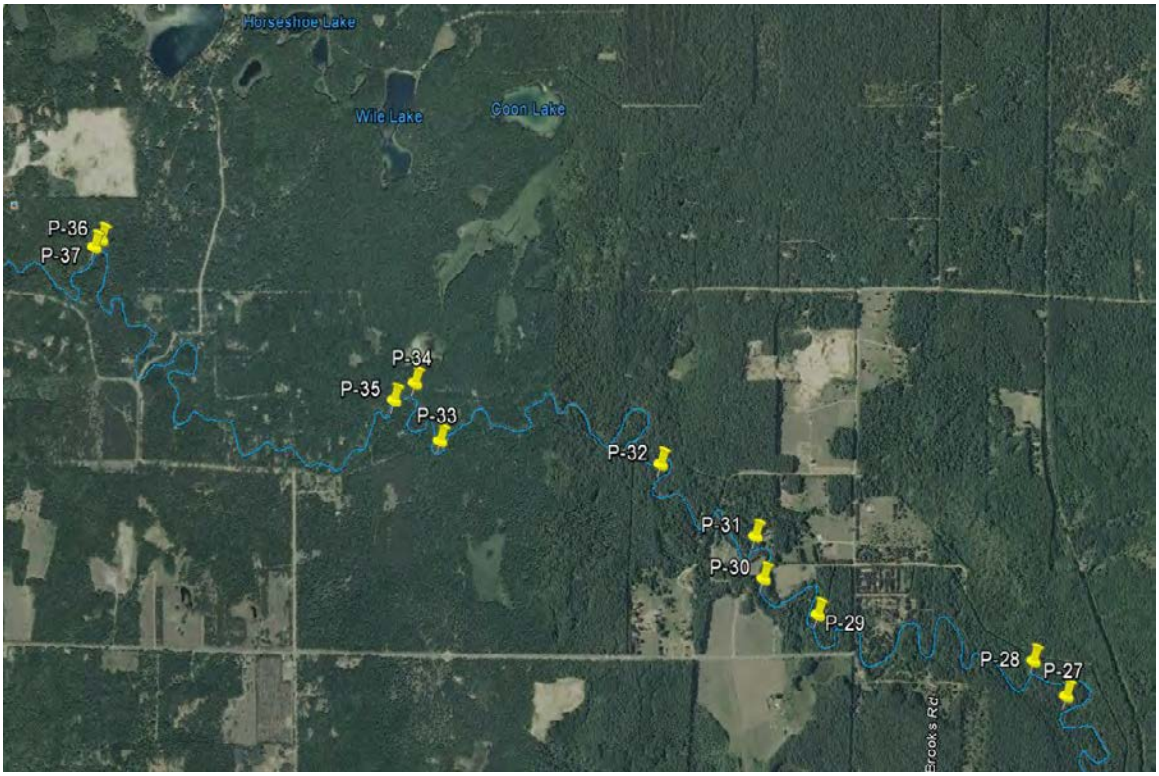
Little Manistee River **Severe** Eroding Sites		
Site#	Latitude	Longitude
10	44.03605	-85.73297
13	44.03534	-85.73651
16	44.03795	-85.73965
20	44.06129	-85.86926
27	44.10229	-85.91377
28	44.10368	-85.91600
29	44.10558	-85.92979
30	44.10704	-85.93314
33	44.11264	-85.95417
42	44.14892	-86.03348
45	44.15800	-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

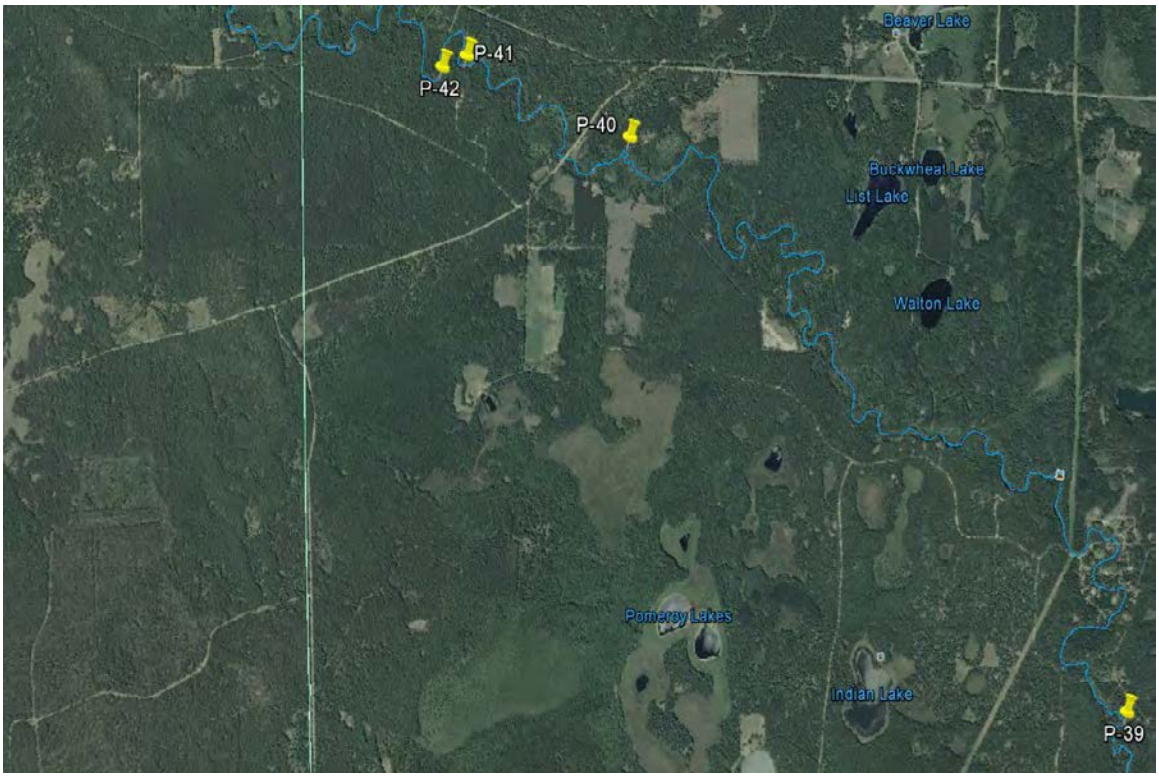
Little Manistee River **Moderate** Eroding Sites		
Site#	Latitude	Longitude
2	44.03514	-85.72549
12	44.03573	-85.73586
14	44.03533	-85.73666
15	44.03653	-85.73881
18	44.04644	-85.82390
19	44.05424	-85.83720
23	44.08305	-85.89362
24	44.08778	-85.90224
31	44.10852	-85.93373
32	44.11152	-85.93974
35	44.11395	-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

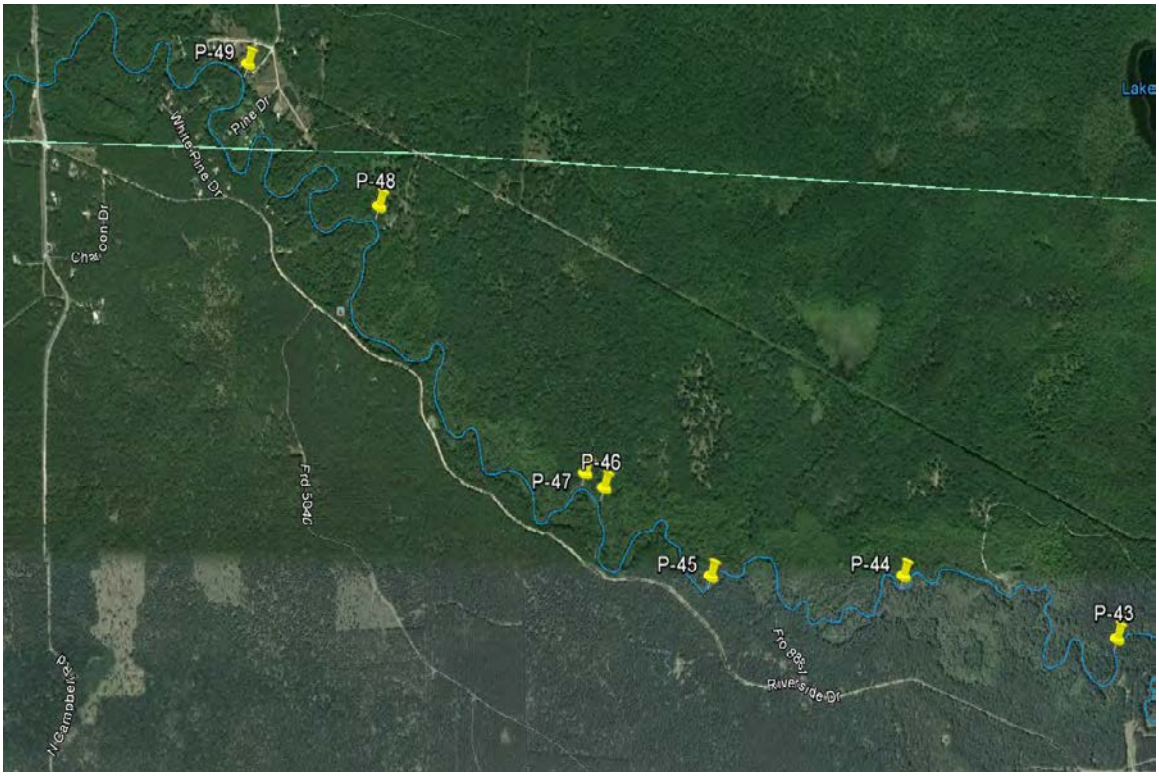

P-16
P-15
P-12
P-13
P-14
P-11
P-10
P-09
P-06
P-07
P-08
P-05
P-04
P-03
P-02
P-01

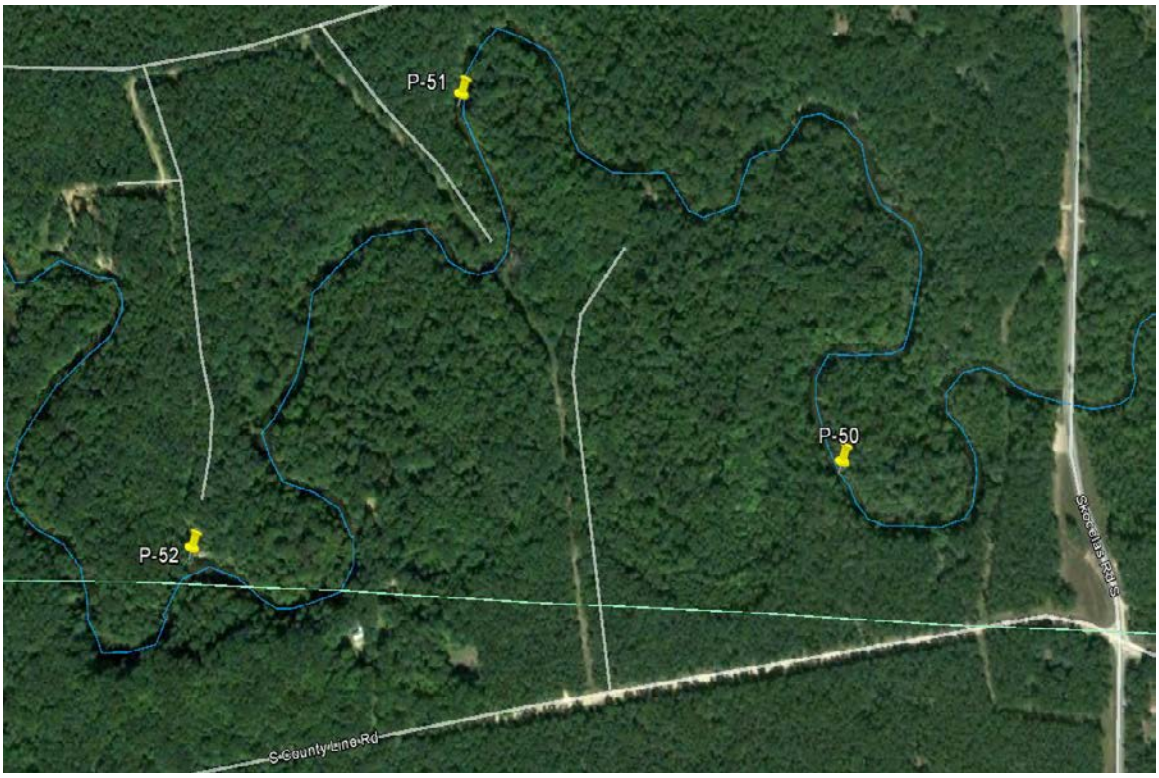

N-Alice-Dr
N-Deerhorn-Rd
N-Syer-Dr
E-5-Mile-Rd
W-Old-M-63
P-19
N-Partridge-Ln
N-Wilderness-Trail
W-Airpark
N-Merrillville-Rd
P-18
W-4-Mile-Rd
N
M-Way
37
3-Mile-Rd
W-Morgan-Dr

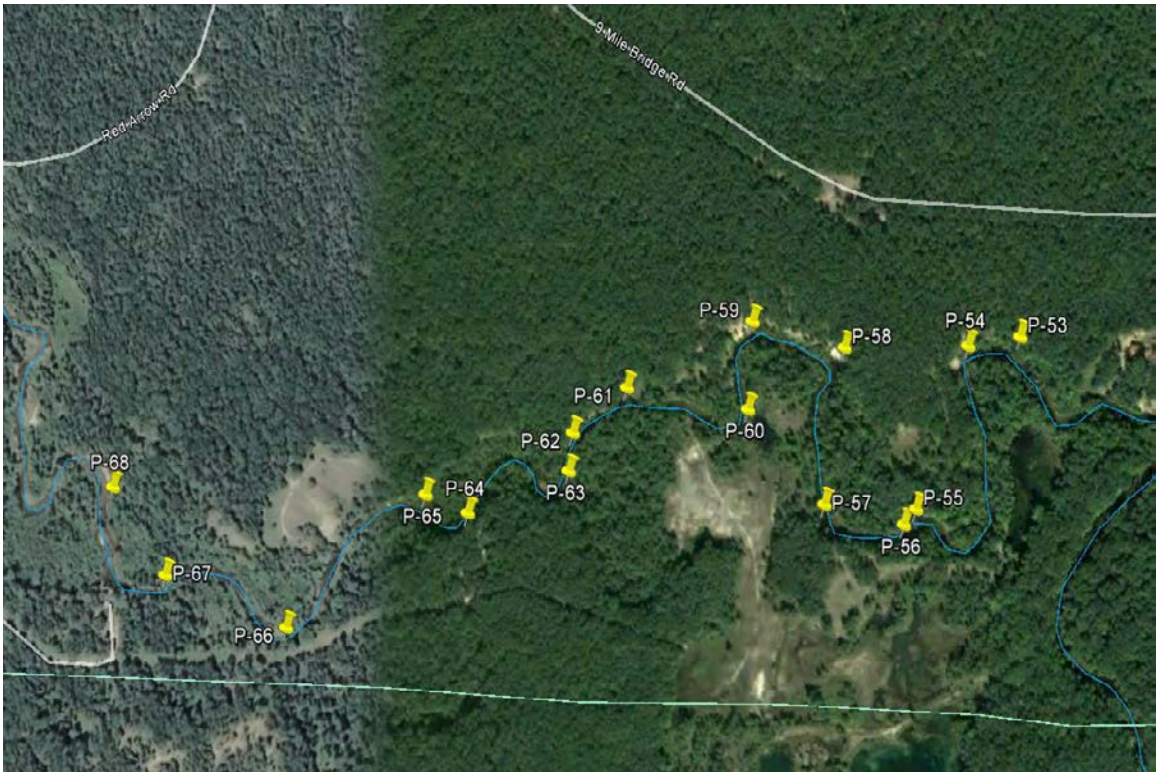

P-26
P-25
P-24
P-23
P-22
P-21
P-20
W-5-Mile-Rd

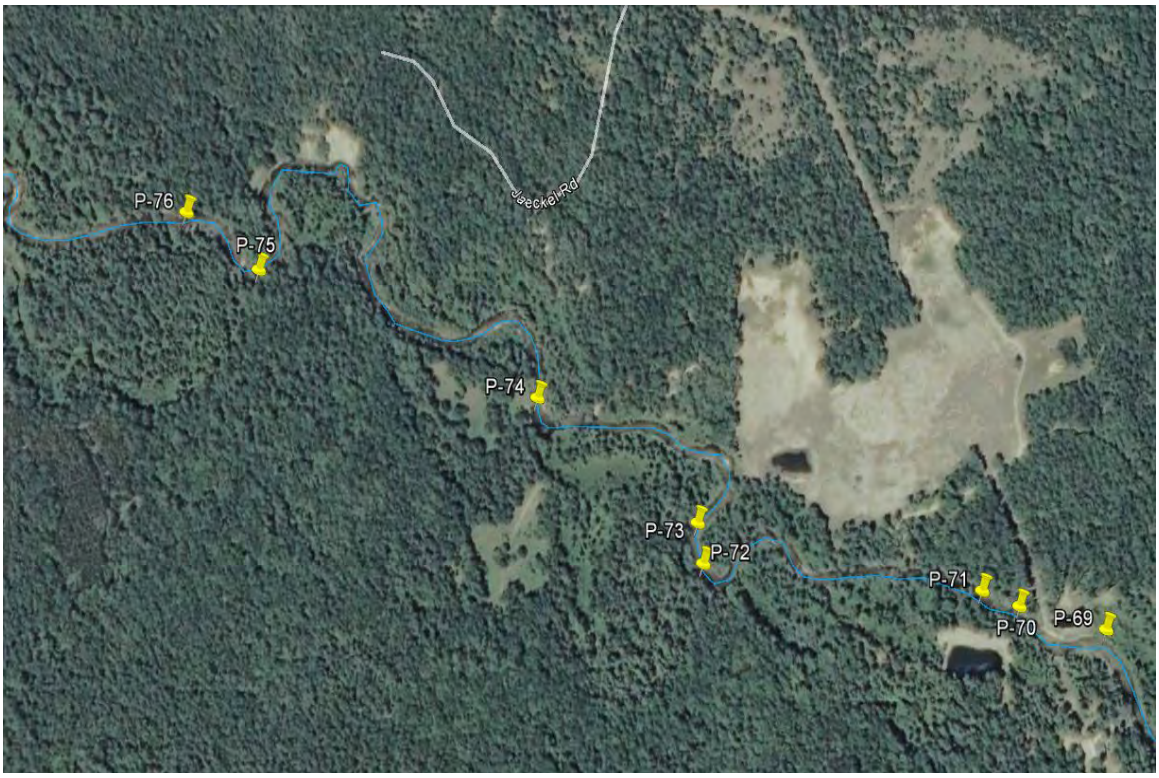

Horseshoe Lake
Wile Lake
Coon Lake
P-36
P-37
P-34
P-35
P-33
P-32
P-31
P-30
P-29
P-28
P-27

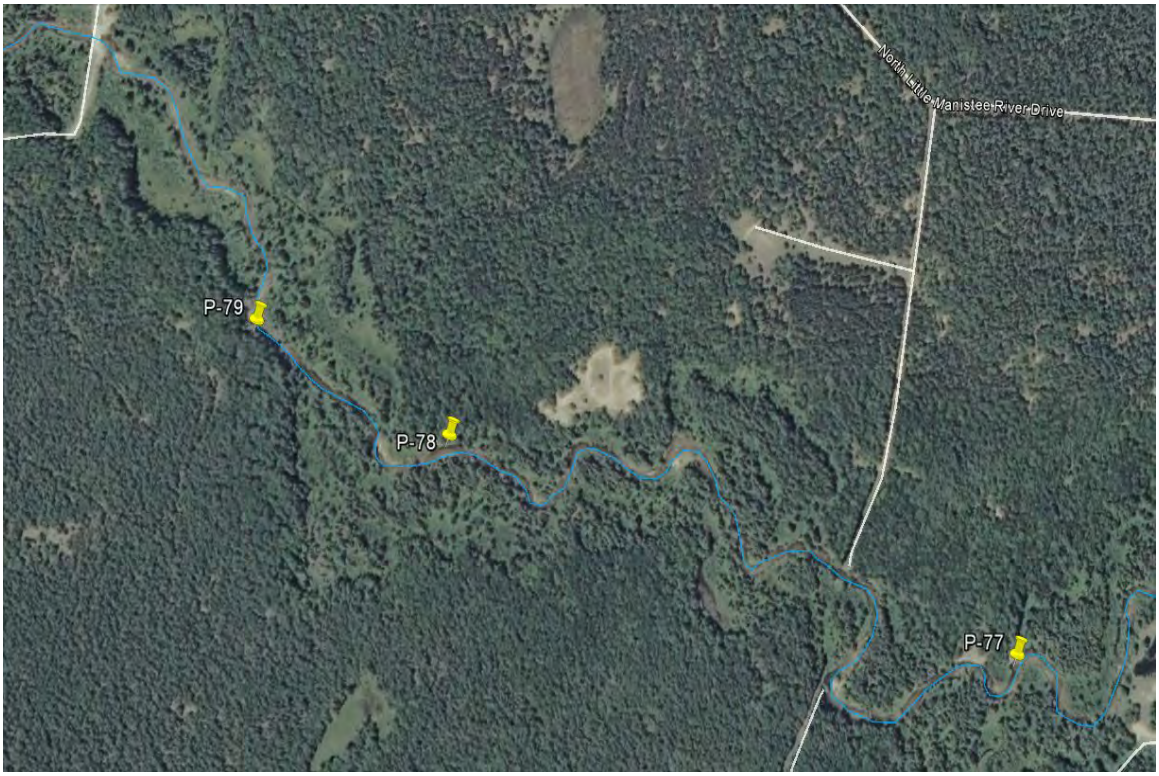

Beaver Lake
P-41
P-42
P-40
Buckwheat Lake
List Lake
Walton Lake
Pomeroy Lakes
Indian Lake
P-39


P-49
White Pine Dr
Pine Dr
P-48
Chaconon Dr
Frd 504
P-47
P-46
P-45
P-44
P-43
Riverside Dr


P-51
P-50
P-52
S-County-Line-Rd


Red-Arrow-Rd
9-Mile-Bridge-Rd
P-59
P-58
P-54
P-53
P-61
P-60
P-62
P-68
P-64
P-63
P-65
P-57
P-55
P-56
P-67
P-66


P-76
P-75
Jaeckel Rd
P-74
P-73
P-72
P-71
P-70
P-69


North Little Manistee River Drive
P-79
P-78
P-77


Stronach Rd
P-82
Little River Rd
P-81
P-80
Carty Rd


55
37
US-Highway 31