Pine Creek
Dickinson County T41N R30W Sections 1,2, 11-13,23,24,35, & 36
Pine Creek Watershed, 2021

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Environment

Pine Creek is a popular trout stream located entirely in Dickinson County. The total length of Pine Creek is 23 miles (Figure 1). The original headwaters of Pine Creek were located in the west central portion of Dickinson County and were described first in 1969 and again in 1975 as "swampy", shallow and warm due to extensive beaver activity (The Hannah Mining Company Groveland Land Exchange Proposal: Environmental Impact Statement 1975). The first two miles of original headwaters contained 100% silt. Suitable trout habitat was present beginning in Section 7 (T41N R29W, N45.961619 -87.983808) due to several coldwater springs, increased gravel and no beaver activity (where East and South Ponds are located today).

During the mid to late 1970s, construction was completed on additional tailings ponds (settling ponds for mine waste and water storage) needed for the Groveland Mine operations which replaced the headwaters of Pine Creek. Currently, the beginning of Pine Creek is at the outlet of South Pond (Figures 1 and 2). From there Pine Creek flows southeast ~20 miles to the confluence of the Sturgeon River which then flows into the Menominee River and into Green Bay. Anglers have multiple access points along the creek with the most popular locations at road crossings.

The Pine Creek Watershed encompasses 48,000 acres which is dominated by forest land (~75%). Other land types include old agricultural fields and residential properties. Land cover is predominately aspen and upland deciduous supplemented by conifers (namely red pine, lowland cedar, black spruce, and balsam fir). The area contains abundant wildlife including whitetail deer, woodcock, black bear, ruffed grouse, hare, and ducks.

The northern portion of the watershed is largely owned by the State of Michigan with a few private ownerships intermixed. Beginning north of the town of Norway, ownership becomes mainly private.
Bedrock geology is comprised of several formations including Archean Granite & Gneissic, Michigamme, Menominee & Chocolay and Munising groups. Surficial geology includes sandy glacial till, glacial till and glacial lake plain. The surficial deposits are mainly sandy which is evident in the watershed. The topography has unique features that include high elevations with numerous rock outcrops, rolling hills transitioning into low wet areas. Soils identified include Pemene-Emmet-Rock Outcrop and Pemene-Emmet-Cathro. There are some ground water influences in the upper portion of the watershed, particularly where Pine Creek crosses the Sportsmen's Club Road. Most groundwater influences come from the southwestern side of Pine Creek while there is little to no groundwater influence on the northeastern side (Figure 2).

Pine Creek is classified as a warm transitional stream beginning at the Groveland Mines until ~0.5 miles south of the Merriman Truck Trail crossing. Downstream from there, groundwater influences result in classification to change to a coldwater stream, along with tributaries that flow from the

western side of the watershed. Tributaries that flow in from the eastern side of the watershed have no groundwater inputs, and therefore classified as warm transitional streams (Figures 1 and 2). There are several lakes within the Pine Creek Watershed that include the Groveland Mine Ponds, Lost Lake, Scott Lake, Rock Lake, Lake 29, Carney Lake, Benton Lake, and Pine Creek Lake. Major tributaries to Pine Creek include Mounty's Creek, Steel Creek, Lost Lake Creek, Hosking Creek, Harding Creek, Seiberts Creek, Browns Creek, Fern Creek, and Waterworks Creek.

Pine Creek was important during the logging era of the late 1800s to early 1900s. Impacts from mining (namely the creation of the additional Groveland Mine Ponds) began in the mid-1970s and are still present today, although the ponds now function in a recreational capacity. Previous agricultural practices also impacted Pine Creek by water withdrawal and sedimentation from animal use. Pine Creek is a locally popular trout stream that currently has Type 1 Trout Regulations (Brook Trout 7" minimum size limit and daily possession limit of 5) along with its tributaries.

History

Stocking

Pine Creek was historically stocked with Brook Trout from 1933-2005, Brown Trout from 1933-1968, and Rainbow Trout from 1935-1967 with most of those fish being adult size. No records could be found regarding the decision to discontinue stocking Brown or Rainbow Trout. Brook Trout stocking was discontinued due to lack of survival of stocked fish with most Brook Trout present being from natural reproduction.

Habitat Management

A 1954 watershed description report (author not given) described most of Pine Creek and its tributaries as considered favorable for trout. Pine Creek's average width and depth were 25ft. and 12in., respectively. The middle portion of Pine Creek (~8,580 linear feet) had considerable bank erosion and no stream cover due to agricultural activities at the time. Lack of best management practices in nearby agricultural areas were contributing large quantities of sediment into the stream. Consequently, sand made up 70% of the stream bottom. There were two areas where rubble, gravel, and bedrock were the predominate sediment type: 1) an area above Carney Lake Road and 2) downstream from Pine Creek Lake to the confluence of the Sturgeon River. A major habitat restoration effort by the Michigan Department of Conservation and local landowners was conducted in 1955 in the lower portion of the watershed (Figure 1). Stream fish habitat improvement structures were installed to increase fish cover, improve the pool-riffle relationship, reduce stream temperatures and to increase fishing opportunities. Specific actions included stream bank stabilization using rock riprap, graded slopes, stream side fencing to keep cattle out of the stream, and 12,500 spruce and red pine were planted for shade and erosion control.

In 1987 two sediment traps were excavated- one located on a private landowner's property (i.e., the lower sediment trap) and one below Rock Dam (i.e., the upper sediment trap; Figures 1 and 3). The lower sediment trap was 240 feet in length by 20 feet wide and 4 feet deep. The upper sediment trap was 260 feet in length, 22 feet wide and 4 feet deep. The objective was to mitigate detrimental impacts to the Brook Trout population by removing excess sediment bedloads from the system. The overall

goal of the project was to increase Brook Trout population density and improve the size structure. Artificial spawning riffles were added below the two sediment traps in order to increase Brook Trout reproduction. Re-excavations of the two traps were likely done around 1996, although no records were found to confirm this. Records only show a permit was issued and bids for the excavation were sent in to the DNR. Full evaluation of these efforts is difficult because of the paucity of pre- and post- survey data at the two sediment trap locations. The lower sediment trap did not have a survey conducted in that location until 2007, nearly 20 years after the original excavation. The upper sediment trap had more surveys conducted; however, with the natural variability in Brook Trout populations there was not enough data collected to fully evaluate of pre- and post- excavation fish populations. Pre-sediment trap surveys were conducted in 1985 and 1986. Post-sediment trap surveys occurred in 1991, 2007 and 2020.

In 1995 the Dickinson County Conservation District developed the "Pine Creek Watershed Plan", which listed specific sources of non-point sediment sources impacting the watershed. Outside funding allowed for an intensive restoration effort between 1999-2004 (Figure 1). The overall goal was to "Control non-point source pollution by the implementation of best management practices according to priorities set forth in the Pine Creek Watershed Management Plan (approved by Michigan Department of Environmental Quality in 1999). Sedimentation was considered the primary non-point source pollutant with the main source being ineffectual gravel road crossings. The project achieved:

1. Upgrades to a total of nine road crossings, 1 closed road,
2. Bank stabilization through riprap, timber cribs, brush bundles or vegetation plantings,
3. Access roads graded,
4. Livestock exclusion fences were installed, and
5. A foot bridge

Fisheries Management

Creel surveys were conducted during various months between 1951-1960. These were not intensive surveys and did not have standard methods. In general, fishing effort was light, and most anglers caught between 0-5 Brook Trout.

Multiple sites throughout Pine Creek have been surveyed since the early 1960s. Each site will be described separately, beginning in the upper section of the watershed.

Original Headwater Area (Figure 3):

On June 12, 1969, a survey was conducted by the Michigan Department of Conservation located in the original headwater area (41N 30W Sections 2 & 11). The total survey length was 2,640 feet. No Brook Trout were observed or captured during the survey effort (Table 1). However, Blacknose Dace, Common White Sucker, Redbelly Dace, Pearl Dace, and Brook Stickleback were observed. The sediment was mainly silt and sand with very little rock. Cover was reported as deep holes, undercut banks and overhanging brush. The average stream width was 4.5 feet and depth ranged from 6 inches to 3 feet.

On June 17, 1969, a survey was conducted by the Michigan Department of Conservation located in the original headwater area downstream of an unnamed forestry bridge (41N 29W Sec 7). Today the location would be near the East and South Groveland Mine Ponds. The total survey length was 2,100 feet. Fish species captured included Brook Trout (Table 1; N=4, 6-11" length range), Common White Sucker (N=20, 4-9" length range), Creek Chub (N=15, 2-5" length range), Blacknose Dace (N=6, 2-4" length range), Redbelly Dace (N=1, 2" length), and Pearl Dace (N=40, 2-5" length range). The average stream width was 10 feet. Water temperature was recorded at 59°F. Habitat was described as sand (80%), rock and gravel (10%) and silt (10%). Immediate riparian area consisted of marsh grass and willow trees.

On June 17, 1969, a survey was conducted by the Michigan Department of Conservation located in the original headwater area upstream of an unnamed forestry bridge (41N 29W Sec 7). The total survey length was 450 feet. Fish species captured included Brook Trout (Table 1; N=10, 2-8" length range), Common White Sucker (N=22, 2-8" length range), Creek Chub (N=18, 1-4" length range), Blacknose Dace (N=15, 2-4" length range), Pearl Dace (N=37, 2-4" length range), and Mottled Sculpin (N=4, 2-4" length range). Stream habitat consisted of sand (90%) and silt (10%).

Below South Pond (Groveland Mine Pond #4):

During a visual inspection of the South Pond outlet MDNR employees were concerned the tailings ponds were impacting water quality of Pine Creek. Consequently, on September 4, 1986, the MDNR placed Brook Trout collected from the same reach into minnow traps in Mountys Creek and Pine Creek, just above their confluence. Employees monitored the traps daily for mortalities until September 8th. No mortalities of Brook Trout were observed in either waterbody. Pine Creek was described as having very low flows, shallow (3-5 inches of depth) and a sand-silt bottom.

Merriman Truck Trail (Figure 3):

On October 8, 1961 a survey was conducted by the Michigan Department of Conservation from the Merriman Truck Trail bridge upstream 250 feet (41N 29W Sec 19). Fish captured included Brook Trout (Table 1; N=4, 3"-6" length range), Common White Sucker (N=6, 2-7" length range), Creek Chub (N=6, 1-5" length range), Blacknose Dace (N=23, 1-4" length range), Pearl Dace (N=2, 2" length), Fathead Minnow (N=10, 2" length), Central Mudminnow (N=1, 3" length), Mottled Sculpin (N=13, 1-4" length range) and Brook Stickleback (N=1, 2" length). The average width was 20 feet and average depth was 20 inches. Habitat was described as silt (25%), silty-sand (25%), gravel (25%) and rubble (25%). Cover was "fair" with overhanging tag alders and deep holes. Available food included stoneflies and caddisflies. There was no observed evidence of mine pollution.

On June 17, 1968, a survey was conducted by the Michigan Department of Conservation upstream and downstream of the Merriman Truck Trail bridge (41N 29W Sec 19). The total steam reach surveyed was 400 feet. Fish captured included Brook Trout (Table 1; N=5, 6-7" length range), Common White Sucker (N=15, 3-5" length range), Creek Chub (N=23, 2-7" length range), Blacknose Dace (N=21, 2-4" length range), Central Mudminnow (N=2, 2-4" length range), Mottled Sculpin (N=7, 2-3" length range), and Brook Stickleback (N=1, 2" length). The average width was 11 feet and water depth ranged from 6 inches to 4 feet. Habitat was described as sand (80%) and rubble (20%). Cover was only a few

undercut banks and deep holes. Water temperature was recorded at 60°F. The surveyors also noted the shocking equipment wasn't working optimally.

On June 17, 1969, a survey was conducted by the Michigan Department of Conservation (41N 29W Sec 19 & 30). The total survey length was 1,050 feet. Fish captured included Brook Trout (Table 1, N=33, length not recorded), Common White Sucker (N=7, 6-7" length range), Creek Chub (N=12, 2-5" length range), Blacknose Dace (N=65, 2-4" length range), Pearl Dace (N=2, 2-5" length range), Redbelly Dace (N=1, 2" length), Brassy Minnow (N=1, no length recorded), and Mottled Sculpin (N=13, 2-4" length range). The average stream width was 15 feet and maximum depth was 4 feet (minimum not recorded). Substrate was described as gravel (20%), silt (10%), and sand (70%). Cover was described as deep holes, brush and undercut banks.

On August 28, 1985, a survey was conducted by the Michigan Department of Natural Resources (MDNR, 41N 29W Sec 19) approximately 0.5 miles upstream of the bridge crossing. The total survey length was 550 feet. No Brook Trout were captured during the survey effort (Table 1). Stream habitat was considered very poor and consisted of shifting sand and silt. Water temperature was recorded at 59°F. The average stream width was 20 feet and average depth was 8 inches.

On August 30, 1985, a survey was conducted by the MDNR downstream of the bridge crossing to evaluate the Brook Trout population (41N 29W Sec 19). The total survey length was 575 ft. Brook Trout (Table 1; N=9) ranged from 3-7 inches in length and averaged 5.4 inches. Stream habitat was considered "very poor" with very few pools and little cover. However, the riparian area was described as well-shaded by stream bank vegetation. Sediment was mostly sand with some rock and gravel. Sparse amounts of woody debris were present in the stream reach. The average stream width was 19 feet and average depth was 6 inches. Water temperature was recorded at 59°F.

Carney Lake Road (Figure 3):

On June 17, 1968, a survey was conducted by the Michigan Department of Conservation (41N 29W Sec 30). The total survey length was 500 feet. Fish captured included Brook Trout (Table 1; N=9, 1-9" length range), Creek Chub (N=11, 1-4" length range), Blacknose Dace (N=50, 1-4" length range), Common Shiner (N=4, 2" length), Bluntnose Minnow (N=4, 2" length), Central Mudminnow (N=6, 2" length), and Mottled Sculpin (N=1, 2" length). The average stream width was 9 feet and depth ranged from 6 inches to 3 feet. Substrate was described as gravel (60%) and sand (40%). There were undercut banks and some deep holes for cover. It was also noted the shocking equipment was not working adequately due to hard rains.

On June 18, 1969, a survey was conducted by the Michigan Department of Conservation upstream of the Carney Lake Road bridge crossing (41 N 29W Sec 30). The total survey length was 600 feet. Fish captured included Brook Trout (Table 1; N=35, 2-7" length range), Common White Sucker (N=1, 5" length), Creek Chub (N=26, 2-5" length range), Blacknose Dace (N=76, 1-4" length range), Redbelly Dace (N=3, 2-3" length range), Central Mudminnow (N=2, 2-3" length range), Mottled Sculpin (N=12, 2-4" length range), Brook Stickleback (N=1, 2" length), and Brassy Minnow (N=5, 3" length). Only one legal sized Brook Trout (7" minimum size limit) was captured. Heavy angler use was evident by a number of paths created to Pine Creek and surveyors postulated anglers were keeping trout as soon as they reached the legal size. The stream habitat was described as sand (60%), gravel-rubble (35%) and

silt (5%). Cover was described as excellent with woody debris, tag alder branches, undercut banks and deep pools. The average stream width was 13 feet and depth ranged from 0-40 inches.

On August 13, 1981, a survey was conducted by the MDNR to evaluate the Brook Trout population, including clipped stocked Brook Trout. The total survey length was 528 feet upstream of the Carney Lake Road bridge crossing (41N 29W Sec 30). Fish captured included Brook Trout (Table 1; N=74, 2-13" length range, 5" average), Common White Sucker (N=3), Creek Chub (N=21), Bluntnose Minnow (N=6), Blacknose Dace (N=98), Pearl Dace (N=1), Central Mudminnow (N=1), and Mottled Sculpin (N=26). Water temperature was recorded at 61.5°F. Stream sediment was mostly sand with some silt and gravel. The average stream width was 15.5 feet and average stream depth was 29 inches. In 1980, 1,200 clipped Brook Trout were stocked near this location. Results of the survey showed no clipped Brook Trout were captured.

Upper Sediment Trap Area (Figure 3):

On October 8, 1961, a survey was conducted by the Michigan Department of Conservation. The survey area was approximately 0.25 mile below rock dam (45.901007 -87.981205) and totaled 300 feet in length. Fish species captured included Brook Trout (Table 1; N=14, 3-7" length range), Common White Sucker (N=9, 3-4" length range), native lamprey (N=21, 1 adult, 19 larvae), Creek Chub (N=6, 1-4" length range), Blacknose Dace (N=1-3" length range), Longnose Dace (N=2, 2-3" length range), Pearl Dace (N=1, 2.5" length), Central Mudminnow (N=1, 3" length), Johnny Darter (N=3, 2-3" length range), and Mottled Sculpin (N=34, 1-3" length range). Stream sediment contained sand (35%), gravel (40%), and silt (25%). The average stream width was 15 feet and depth was 0-2 feet. Cover was considered fair with tag alders and brush present.

On June 18, 1968, a survey was conducted by the Michigan Department of Conservation. The survey area was just below Rock Dam and totaled 750 feet in length. Fish species captured included Brook Trout (Table 1; N=14, 1-7" length range), Common White Sucker (N=22, 3-11" length range), Creek Chub (N=4, 2-4" length range), Blacknose Dace (N=36, 2-4" length range), Common Shiner (N=1, 2" length), Bluntnose Minnow (N=1, 2" length), Central Mudminnow (N=1, 2" length), Johnny Darter (N=1, 2" length), Mottled Sculpin (N=8, 2-3" length range), Brook Stickleback (N=1, 2" length), and Northern Brook Lamprey (N=3, 4" length). Stream sediment contained sand (20%), gravel (60%), and rubble (20%). The average stream width was 9 feet and depth ranged from 1-5 feet. Deep holes were noted in the survey as available to Brook Trout.

On June 18, 1969, a survey was conducted by the Michigan Department of Conservation. The survey area was just below Rock Dam and totaled 780 feet in length. Fish Species captured included Brook Trout (Table 1; N=57, 1-11" length range), Common White Sucker (N=21), Creek Chub (N=8, 2-4" length range), Blacknose Dace (N=20, 2-3" length range), Redbelly Dace (N=2, 2" length), Common Shiner (N=7, 3-4" length range), Central Mudminnow (N=2, 2-3" length range), and Johnny Darter (N=6, 2-3" length range). Stream sediment contained gravel (40%), sand (50%) and silt (10%). The average stream width was 15 feet and depth ranged from 0-4 feet. Cover consisted of overhanging brush and debris and adequate deep holes available. Water temperature was recorded at 65°F.

On August 13, 1981, a survey was conducted by the MDNR which began in the SE1/4 of SW1/4 of 41N 29W Section 31 and ended 844 feet upstream. According to records, the main goal of the survey

was to evaluate clipped Brook Trout that were stocked earlier in the year. However, no records were found of Brook Trout being stocked at this particular location. Fish species captured included Brook Trout (Table 1; N=28, 2-9" length range), Black Bullhead (N=2, 5" length), Creek Chub (N=25), Mottled Sculpin (N=31), Northern Redbelly Dace (N=15), Blacknose Dace (N=119), Longnose Dace (N=6), Pearl Dace (N=1), Common Shiner (N=29), Central Mudminnow (N=4), and Black Sided Darter (N=5). No clipped Brook Trout were captured during the survey. Water temperature was recorded at 64°F. Stream sediment was described are mostly sand with some gravel. The average stream width was 19 feet and average depth was 17 inches.

On July 29, 1985, a survey was conducted by the MDNR which began in the SE1/4 of the NE1/4 of 40N 30W Sec 3, approximately ½ mile below the future location of the upper sediment trap location. The total stream reach surveyed was 2,000 feet (mark and recap). Only Brook Trout were captured and recorded. Although Creek Chub, Common Shiner, Longnose Dace, and Mottled Sculpin were observed during the survey efforts. Brook Trout (N=119) ranged from 2-13 inches in length. A population estimate was calculated at 330 Brook Trout per acre (Table 1). Water temperature was recorded at 65°F. The average stream width was 15.5ft and average depth was 0.7ft.

On August 5 and 20, 1986, surveys were conducted by the MDNR in the same location as in the 1985 survey. The total stream reach surveyed was 2,000 feet (mark and recap). Only Brook Trout were captured and recorded. Although Common Shiners, Creek Chub and Mottled Sculpin were observed during the survey efforts. Brook Trout (Table 1; N=112) ranged from 2-9 inches in length and averaged 4.4 inches. A population estimate was calculated at 243 Brook Trout per acre. Water temperature was recorded at 66°F (Aug. 5th) and 58°F (Aug. 20th). The average steam width was 20 feet and the stream depth ranged from 3-30 inches. Habitat was described as willow and tag alder near the banks, a few submerged logs and undercut banks. However, the general cover was considered poor.

On July 11, 1991, a biological survey was conducted by the Surface Water Quality Division of the MDNR (Michigan Department of Natural Resources Surface Water Quality Division 1992). The biological survey was conducted upstream and downstream of the upper sediment trap that was installed in 1987 below Rock Dam. Fish and aquatic macroinvertebrates were collected following the Great Lakes and Environmental Assessment Section Procedure 51. Results showed 44% more fish in the downstream section, however both stations were determined to be "good" based on the fish metric evaluation. Brook Trout collected upstream and downstream of the sediment trap were relatively similar in size structure (Figure 4). Brook Trout captured upstream (N=35) ranged from 2-8 inches in length with an average of 5.8 inches. Brook Trout captured downstream (N=43) ranged from 2-9 inches in length with an average length of 6.2 inches. Habitat upstream was categorized as "poor" compared to the downstream category of "good".

Bluffview Crossing/Trepanier's Property (Figure 3):

On June 18, 1968, a fisheries survey was conducted by the Michigan Department of Conservation. The survey began ¼ mile upstream from a private landowner's bridge (Trepanier's). The total survey reach was 150 feet and was cut short due to high water levels. However, surveyors did record Brook Trout (N=1, 2.0" length; Table 1), Bluntnose Minnow (N=1, 2.5" length), Johnny Darter (N=1, 1.5" length), Mottled Sculpin (N=6, 2-4" length range), and Northern Brook Lamprey (N=1).

On June 18, 1969, a fisheries survey was conducted by the Michigan Department of Conservation. The survey began ¼ mile downstream from Trepanier's bridge. The total survey reach was 1,080 feet. Fish species captured and recorded included Brook Trout (N=11, 2.5-9.0" length range; Table 1), White Sucker (N=35, 5.5-16.0" length range), Creek Chub (N=3, 3.5-5.0" length range), Blacknose Dace (N=44, 3.0"-4.0" length range), Longnose Dace (N=13, 2.0-5.0" length range), Common Shiner (N=9, 4.0-5.0" length range), Red Shiner (N=3, 5.0-6.5" length range), Brassy Minnow (N=3, 2.5-3.0" length range), Central Mudminnow (N=4, 3.0-4.0" length range), Johnny Darter (N=1, 2.5"), Blackside Darter (N=1, 3.0"), and Slimy Sculpin (N=19, 2.5-5.5" length range). Stream sediment was comprised of 60% sand and 40% gravel. Instream cover was described as good with rock, brush, debris and undercut bank cover. The average stream width was 18 feet and the depth range was 0-4 feet.

On June 18, 1969, a fisheries survey was conducted by the Michigan Department of Conservation. The survey was adjacent to the Trepanier's potato farm. The total survey reach was 225 feet. Fish species captured and recorded included Brown Trout (N=1, 9.6"), White Sucker (N=2, 10.5-12.0" length range), Creek Chub (N=1, 2.0"), Common Shiner (N=1, 3.0"), and Mottled Sculpin (N=8, 2.0-4.0" length range). Stream sediment was described as sands with rocks. Deep water with cover along the shoreline was noted. However, it was considered too deep to shock effectively. Water depth ranged from 2-5 feet. The average stream width was 25 feet.

On August 3, 1981, a fisheries survey was conducted by the MDNR in order to determine the survival of 1,200 fin clipped Brook Trout stocked in 1980. The actual location of the 1980 stocking event is unclear because fish stocking records incorrectly label the location in an adjacent township and range. The probable location of the 1980 stocking event was below Trepanier's bridge. The survey was located downstream from Trepanier's Bridge, approximately in the center of 40N 30W Section 13. The total survey reach was 850 feet. Fish species captured and recorded included Brook Trout (N=18, 3.0"-10.0" length range, 6.8" average; Table 1), Common Shiner (N=15), Creek Chub (N=14), Blacknose Dace (N=28), Longnose Dace (N=4), Johnny Darter (N=2), Iowa Darter (N=1), Mottled Sculpin (N=23), and White Sucker (N=8). No fin-clipped brook trout were captured. In-stream sediment was described as mostly sand with some gravel, cobble, and boulder.

On July 30, 1985, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population. The survey reach began 30 feet upstream from Trepanier's bridge and totaled 547 feet. A total of four Brook Trout were captured that ranged from 3-14 inches in length and averaged 10 inches (Table 1). Stream sediment was described as mostly sand and silt with a small area of rock. The stream channel was saucer-shaped with significant sand bedload. A large irrigation pump was drawing water out of Pine Creek about halfway up the survey reach.

On August 4, 1986, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population and evaluate suitability for a long-term index station. The total survey reach was 340 feet and began above Trepanier's bridge. Brook Trout (N=26, 4 recaps; Table 1) ranged from 5-14 inches in length. The average stream width was 28 feet and average depth was 1.25 feet. It was determined this location was not a suitable site for an index station due to the deep water limiting the length of the shocking area.

District 5 Road (Figure 3):

On August 3, 1981, a fisheries survey was conducted by the MDNR to evaluate the 1980 stocking of clipped Brook Trout. The survey began upstream of the District 5 Road Bridge and totaled 698 feet. Two brook trout were captured with lengths of 5 and 8 inches (Table 1). Neither fish was clipped. Other species captured included White Sucker (N=21), Creek Chub (N=4), Blacknose Dace (N=1), Longnose Dace (N=8), Mottled Sculpin (N=8), Logperch (N=3), and Trout-perch (N=1). The stream sediment was described as mostly sand with some large rock and cobble-size stones. The average width was 30 feet and average depth was 2 feet.

On July 31, 1985, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population and a previous stocking event that occurred in June of that year. However, stocked Brook Trout were not clipped. The survey began upstream of the District 5 Road Bridge and totaled 1,102 feet. Brook Trout (Table 1; N=21, 2-12" length range, 6.7" average). Other fish species captured but not counted included White Sucker, Longnose Dace, Blacknose Dace, Logperch, redhorse sucker species, Common Shiner, Creek Chub and Mottled Sculpin. Since stocked Brook Trout were not specifically marked, full analysis of stocking success was difficult. It was noted there was a fair amount of cover present in the form of old stream improvements from the 1950s, undercut banks and rocks.

Lower Pine Creek (Figure 3):

On June 18, 1969, a fisheries survey was conducted by the Michigan Department of Conservation (T39N R29W Sec. 3). A total of 630 feet were surveyed in the stream reach. Fish captured and recorded included Brook Trout (Table 1; N=22, 2.0-14.0" length range), Creek Chub (N=1, 5.0"), Blacknose Dace (N=1, 3.5"), Longnose Dace (N=24, 3.5-5.5" length range), Common Shiner (N=1, 5.5"), Blackside Darter (N=2, 3.5"), and Mottled Sculpin (N=6, 3.0-4.4" length range). Stream depth ranged between 0-5 feet and the average stream width was 50 feet. The stream sediment was described as 60% rock rubble and 40% sand. The stream reach was difficult to survey due to the slightly high water, rapid velocity, and large boulders.

On August 3, 1981, a fisheries survey was conducted by the MDNR to evaluate the 1981 stocking of clipped Brook Trout. The survey began upstream of the County Road 573 Bridge and totaled 600 feet in length. Fish species captured included Brook Trout (Table 1; N=10, 2-9" length range inches), Common Shiner (N=2), Creek Chub (N=1), Longnose Dace (N=74), Horney Head Chub (N=3), Johnny Darter (N=1), Iowa Darter (N=4), Logperch (N=17), and Mottled Sculpin (N=21). One Brook Trout with a right pectoral clip was captured but this was not the fin that was clipped from the 1981 stockings. The stream averaged 43 feet in width and 16 inches in depth. The stream sediment was mostly rock and boulders.

Temperature loggers

Mean July water temperature is one of the most critical habitat variables that influence the composition of fish communities in Michigan streams and rivers (Zorn et al. 2009). Stream survey and temperature data from around Michigan have shown that abundance and biomass of trout declines rapidly once mean July water temperature reaches and exceeds 68°F. To evaluate suitable stream temperatures for Brook Trout, multiple temperature loggers were deployed at various locations and years along Pine Creek (Table 2; Hobo Water Temp Pro). Downstream of the Carney Lake Road stream crossing

temperature loggers were deployed in 2004-2006, 2017, 2019 and 2020. The average July temperatures for the Carney Lake Road location ranged from 57°F in 2004 to 70°F in 2020. The second location was located along a private landowner's property (Trapanier's property) in 2017 and 2019 with July averages of 64°F and 66°F. The third location was above the County Road 573 crossing from 2003-2005 with average July temperatures of 65°F, 62°F, and 68°F, respectively.

Current Status

Merriman Truck Trail (Figure 3):

On August 14, 2002, a survey was conducted by the MDNR upstream of the bridge crossing to evaluate the Brook Trout population (41N 29W Sec 19). The total survey effort was 1,200 feet. Brook Trout (Table 1; N=61) ranged from 2-12 inches in length and averaged 5.6 inches. Stream habitat consisted of deep holes up to 5 feet deep and tag alders were abundant. Sediment was sand and silt for the first 600 feet then changed to mostly cobble with some sand the last 600 feet. Blacknose Dace were abundant and Sculpins were commonly observed during survey efforts.

On August 15, 2002, a survey was conducted by the MDNR downstream of the bridge crossing. The survey began halfway between the Merriman and Carney Lake Road crossings and totaled 600 feet in length. Brook Trout (Table 1; N=111) ranged from 1-9 inches in length and averaged 5.1 inches. Other fish species observed but not captured included Blacknose Dace, Sculpins, Sticklebacks, and White Suckers.

Carney Lake Road (Figure 3):

On August 14 and 15, 2002, a survey was conducted by the MDNR (41N 29W Sec 30). The total survey length was 1,700 feet (marking and recapture run). Only Brook Trout were captured and recorded (Table 1; N=410, 1-10" length range, 4" average). The estimated Brook Trout population was calculated at 1,902 per acre. Approximately 7% of the captured Brook Trout were legal size (≥ 7 inches).

On August 6 and 14, 2003, fisheries surveys and habitat analyses were conducted by the MDNR (41N 29W Sec 30). The total survey length was 1,000 feet. Only Brook Trout were captured and recorded. Brook Trout (Table 1; N=191) averaged 4.8 inches and ranged from 2-9 inches in length with 11.5% of the catch meeting or exceeding the legal minimum size for harvest (≥7 inches). The average stream width was 15.5 feet and had pool (7%), riffle (14%) and run (78%) habitats. The substrate was composed of silt (13%), sand (26%), gravel (30%) and small cobble (31%). The average stream velocity was 0.33 feet per second. Riparian habitat consisted of grassland/forb (39%), large coniferous trees (4%), small deciduous trees (11%), and tag alders (46%). Bank stability was rated as 57% good (<25% of streambank is bare soil), 29% fair (25-50% of streambank is bare soil), 11% poor (50-75% of streambank is bare soil), and 3% very poor (>75% of streambank is bare soil). Water temperature was recorded at 65°F. Conductivity was 320 mS/cm and woody debris was present consisting of mostly smaller pieces.

On July 28, 2004, a survey was conducted by the MDNR. Survey length was not recorded but field notes state it was cut short due to equipment malfunction. Blacknose Dace, Mottled Sculpin, Creek Chubs, and Redbelly Dace were observed but not captured during the survey. Brook Trout (Table 1; N=149) averaged 4.2 inches and ranged from 2-9 inches in length with 5% of the catch meeting or exceeding the legal size of harvest (≥7 inches). Managers determined naturally reproduced Brook Trout constituted most of the resident population which led to the decision to discontinue Brook Trout stocking.

On August 13, 2007, a survey was conducted by the MDNR to evaluate recent stocking efforts of Brook Trout. The total survey effort was 850 feet. Water temperature was recorded at 58°F and water depth ranged from 0-3 feet. Cover was recorded as tag alders and undercut banks. Blacknose Dace, Longnose Dace, Sculpins, and native crayfish were observed but not recorded. Brook Trout (Table 1; N=565) averaged 3.4 inches and ranged from 2-9 inches in length with 2% of the catch meeting or exceeding the legal size of harvest (≥7 inches).

Upper Sediment Trap Area (Figure 3):

On August 13, 2007, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population located at the upper sediment trap. The total survey effort was 1,000 feet and began above the upper sediment trap. Brook Trout (N=55; Table 1) ranged from 2-10 inches in length and averaged 5 inches. Water temperature was 66°F.

On August 19, 2020, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population. The total survey effort was 1,000 feet and began above the upper sediment trap. This survey was originally scheduled to have mark-recapture methods; however, the generator on the electrofishing barge was not functioning and prevented the crew from completing the recapture effort. A total of 159 fish were captured during the August effort. The in-stream water temperature was recorded at 59°F. Brook Trout (N=66) averaged 6.5 inches in length and ranged from 1-12 inches with 35% of the catch meeting or exceeding the legal minimum size for harvest (≥7 inches; Table 1). Ages 0-3 were observed during the survey and a calculated mean growth index was 0.6 inches below state average. Other fish species captured included Blacknose Dace (N=21), Bluegill (N=1), Common Shiner (N=1), Creek Chub (N=18), Green Sunfish (N=7), Hornyhead Chub (N=2), Hybrid Sunfish (N=3), Johnny Darter (N=1), Mottled Sculpin (N=28), Pumpkinseed (N=1), and White Sucker (N=10). There were also native non-parasitic lamprey observed but not identified to species.

Lower Sediment Trap (Figure 3):

On August 16, 2007, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population upstream of the lower sand trap. The total survey effort was 500 feet in length. Brook Trout (N=114; Table 1) ranged from 2-10 inches in length and averaged 4.1 inches. Water temperature was recorded at 64°F.

Bluffview Crossing/Trepanier's Property (Figure 3):

On August 16, 2002, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population. The survey reach was located adjacent to agricultural potato fields. A total of 990 feet was surveyed and captured Brook Trout (N=76; Table 1) that ranged from 1-12 inches in length and an average of 7.5 inches. Other fish species observed but not collected included Bluntnose Minnow, Blacknose Dace, Sculpins and White Suckers. A Northern Pike was also captured that was 8 inches in length.

On August 16, 2007, a fisheries survey was conducted by the MDNR to evaluate the Brook Trout population. The survey reach began above Trepanier's Bridge and totaled 500 feet. Browns Creek, a tributary to Pine Creek was also surveyed for 50 feet. Fish species captured included Brook Trout (N=119, 2"-13", 6.7" average), Pumpkinseed (N=2), and Yellow Perch (N=1). Separating the survey efforts resulted in 37 Brook Trout in Browns Creek and 82 Brook Trout in Pine Creek (Table 1).

District 5 Road (Figure 3):

On July 13, 2010, a fisheries survey was conducted by Michigan State University and Lake Superior State University to collect data in support of stream classification and the water withdrawal assessment tool. The survey began upstream of the District 5 Road Bridge and totaled 800 feet. Fish species captured and recorded included Brook Trout (Table 1; N=9, 5"-10" length range, 8.4" average), Black Bullhead (N=1), Blacknose Dace (N=4), Creek Chub (N=1), Common Shiner (N=11), White Sucker (N=22), Hornyhead Chub (N=25), Johnny Darter (N=4), Longnose Dace (N=17), Mottled Sculpin (N=85), and Yellow Perch (N=2).

Lower Pine Creek (Figure 3):

On August 19, 2002, a fisheries survey was conducted by the MDNR. The survey began below the County Road 573 Bridge and totaled 250 feet in length. Brook Trout (Table 1; N=232) ranged from 2-12 inches in length and averaged 6.9 inches. Other fish species present but not recorded included Longnose Dace, Blacknose Dace, Common Shiners, White Suckers, and Sculpins.

Upper Sediment Trap Area (Figure 3):

A fisheries survey was completed at the Upper Sediment Trap Area (Figure 3) on July 20-21, 2021, by staff from the NLMMU to evaluate the Brook Trout population. The marking survey was completed on July 20, 2021, and the recapture survey was completed on July 21, 2021. A total of 2,000 feet were electrofished (i.e., 1,000-foot station twice). Only gamefish were captured and recorded. A total of 170 fish were captured during the July effort. Brook Trout (N=169) averaged 6.6 inches and ranged from 2-12 inches in length with 43.2% of the catch meeting or exceeding the legal minimum size for harvest (≥7 inches). The estimated Brook Trout population was calculated at 784 per acre (Table 1). One Northern Pike was collected that was 7.5 inches long. In stream water temperature 63°F for both survey days.

Analysis and Discussion

Certain habitats need to be present to be considered a top-quality stream suitable for trout. Stable flows with consistent groundwater inputs, productive aquatic insect communities, sufficient number of riffle, run, pool complexities, abundance of clean gravel, and large woody debris are all critical components

for trout habitat (Zorn et al. 2018). Trout populations can vary year-to-year due to numerous factors. For example, age-0 Brook Trout survival, water temperatures, prey availability, availability of suitable complex habitat, competition with and predation by other fish and angling pressure all can have positive or negative effects on adult Brook Trout numbers (Zorn and Nuhfer 2007). Utilizing the data available, the Pine Creek Brook Trout population is following the typical pattern of high year-to-year variability (Table 1).

Mean July water temperature is one of the most critical habitat variables that influences the composition of fish communities in Michigan streams and rivers (Zorn et al. 2009). Stream survey and temperature data from around Michigan have shown that abundance and biomass of trout declines rapidly once mean July temperatures reach and exceed 68°F. Average July water temperatures have been generally increasing with some years above that temperature threshold (Table 2). Groundwater does influence Pine Creek's water temperatures (Figure 2). However, it is limited to mainly the tributaries flowing in from the western portion of the watershed. These tributaries should be free flowing to not only provide consistent water temperatures to the main branch, but to provide a mid-summer sanctuary for Brook Trout seeking cooler water. Lastly, with the potential impacts from climate change, periodically monitoring stream temperature is recommended.

Pine Creek has an extensive history that includes substantial impacts from historical logging, mining, and poor agricultural practices that were exacerbated by the sandy soil type that dominates that watershed. The plethora of habitat projects that have occurred likely have mitigated many of those impacts, namely through bank stabilization and road crossing improvement projects. Currently, Pine Creek is handling the sediment load that's naturally occurring in the system. The sediment traps installed may have helped capture the excess sediment load before and during the habitat projects; however, as a standalone habitat project they would have little impact to Pine Creek. A recent analysis of sediment traps in Michigan showed any change in habitat (e.g., increase in depth or exposure to coarse sediments) was variable and localized to the area upstream and downstream of the sediment trap and did not improve habitat on a large scale (Hessenauer et al. 2019). Furthermore, the data that is available for Pine Creek suggests any observed ecological benefits (e.g., increased macroinvertebrate diversity) was localized to the area immediately downstream of the sediment trap and didn't necessarily translate to more or larger trout (Figure 4) or necessarily to a system-wide improvement. The sediment traps have not been functioning on Pine Creek for well over 20 years. However, the Brook Trout population at the Upper Sand Trap location continues to be self-sustaining with multiple age classes and good growth rates which suggests there is suitable habitat already available. Continued maintenance on a sediment trap with no data to support its effectiveness (i.e., bigger and more trout) is not a wise use of limited resources. A more practical approach is to ensure the trout continue to have access to diverse habitats and coldwater tributaries throughout the year.

Management Direction

Currently, Pine Creek provides a reliable trout fishery for anglers to target. The NLMMU's goal should be long-term monitoring which is necessary to document any potential changes in trout numbers or size structure. Monitoring should include fisheries surveys, habitat evaluations and stream temperatures. Consideration should be given towards establishing a Fixed Status and Trends Site at the Upper Sediment Trap location. A potential obstacle in obtaining this goal would be limited staff and funds available to conduct surveys. In order to meet goals and objectives on Pine Creek, the NLMMU will engage partners and seek funding opportunities that support monitoring.

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Tables

Table 1: Numbers, average length, length ranges, Brook Trout population estimates, level of effort and survey notes for locations along Pine Creek, Dickinson County Michigan, between the years 1961-2021. Data from DNR Fisheries Division records.

			Brook Trout					
Pine Creek Locations	**Year**	**Month**	**Number**	**Average Length (in.)**	**Range (in.)**	**BKT/acre**	**Effort (ft.)**	**Notes**
Original Headwaters	1969	June	0	-	-	-	2,640	
	1969	June	4	-	6-11	-	2,100	Location near East and South Groveland Mine Ponds
	1969	June	10	-	2-8	-	450	
Merriman Truck Trail	1961	October	4	-	3-6	-	250	upstream
	1968	June	5	-	6-7	-	400	shocker not working well
	1969	June	33	-	-	-	1,050	lengths not recorded
	1985	August	0	-	-	-	550	0.5 mile upstream of bridge
	1985	August	9	5.4	3-7	-	575	downstream
	2002	August	61	5.6	2-12	-	1,200	upstream of bridge
	2002	August	111	5.1	1-9	-	600	halfway between Merriman and Carney Lake Road crossings
Carney Lake Road	1968	June	9	-	1-9	-	500	hard rain, shocker not running well
	1969	June	35	-	2-7	-	600	upstream
	1981	August	74	5	2-13	-	528	upstream
	2002	August	410	4	1-10	1,902	1,700	downstream
	2003	August	191	4.8	2-9	-	1000	downstream
	2004	July	149	4.2	2-9	-	-	cut short due to shocker not working
	2007	August	565	3.4	2-9	-	850	downstream, most were 2-3 inch range
Upper Sediment Trap	1961	October	14	-	3-7	-	300	
Below Rock Dam	1968	June	14	-	1-7	-	750	
	1969	June	57	-	1-11	-	780	
	1981	August	28	5.9	2-9	-	844	No fin clipped BKT captured
	1985	July	119	3.9	2-13	330	2,000	Downstream of future sediment trap
	1986	August	112	4.1	2-9	243	2,000	Downstream of future sediment trap

	1991	July	35	5.8	2-8	-	1,000	GLEAS P-51 MDEQ Survey: Upstream of sediment trap
	1991	July	43	6.2	2-9	-	1,000	GLEAS P-51 MDEQ Survey: Downstream of sand trap
	2007	August	55	5	2-10	-	1,000	Above sediment trap where bundles were installed
	2020	August	66	6.5	1-12	-	1,000	generator broke, couldn't complete PE. Ages 0-3 present
	2021	July	169	6.6	2-12	784	2,000	
Lower Sediment Trap	2007	August	114	4.1	2-10	-	500	above sediment trap
Bluffview Crossing/	1968	June	1	-	2	-	20 min.	water too high to shock effectively
Trepanier's bridge	1969	June	11	-	2.5-9.0	-	1,080	downstream of Trepanier's Bridge
	1969	June	0	-	-	-	225	adjacent to Trepanier's potato farm, too deep to shock
	1981	August	18	6.8	3-10	-	850	downstream of culvert in center of Sec 13 & No BKT clipped
	1985	July	4	10	3-14	-	547	upstream of bridge
	1986	August	26	7.3	5-14		340	upstream of bridge, deep water shocking difficult
	2002	August	76	7.5	1-12	-	990	upstream
	2007	August	82	8.3	2-13	-	990	upstream
District 5 Road	1981	August	2	7	5-8	-	698	upstream of bridge
	1985	July	21	6.7	2-12	-	1102	upstream of bridge * BKT planted in June
	2010	July	9	8.4	5-10	-	800	
Lower Pine Creek	1969	June	22	-	2-14	-	630	
	1981	August	10	5.7	2-9	-	600	upstream of 573 bridge
	2002	August	232	6.9	2-12	-	250	downstream of 573 bridge

Table 2: Average July temperatures (°F) from 2003-2020 at various locations along Pine Creek. Data taken from DNR Fisheries Division records.

Location	Date	Average July Temperature (°F)
Downstream of Carney Lake Road	2004	57
	2005	57
	2006	67
	2017	65
	2019	67
	2020	70
Trapanier's Property	2017	64*
	2019	66
Above County Road 573	2003	65
	2004	62
	2005	68

*Average July temperature only calculated from July 1-16 because of suspect data the second half of the month

Figures

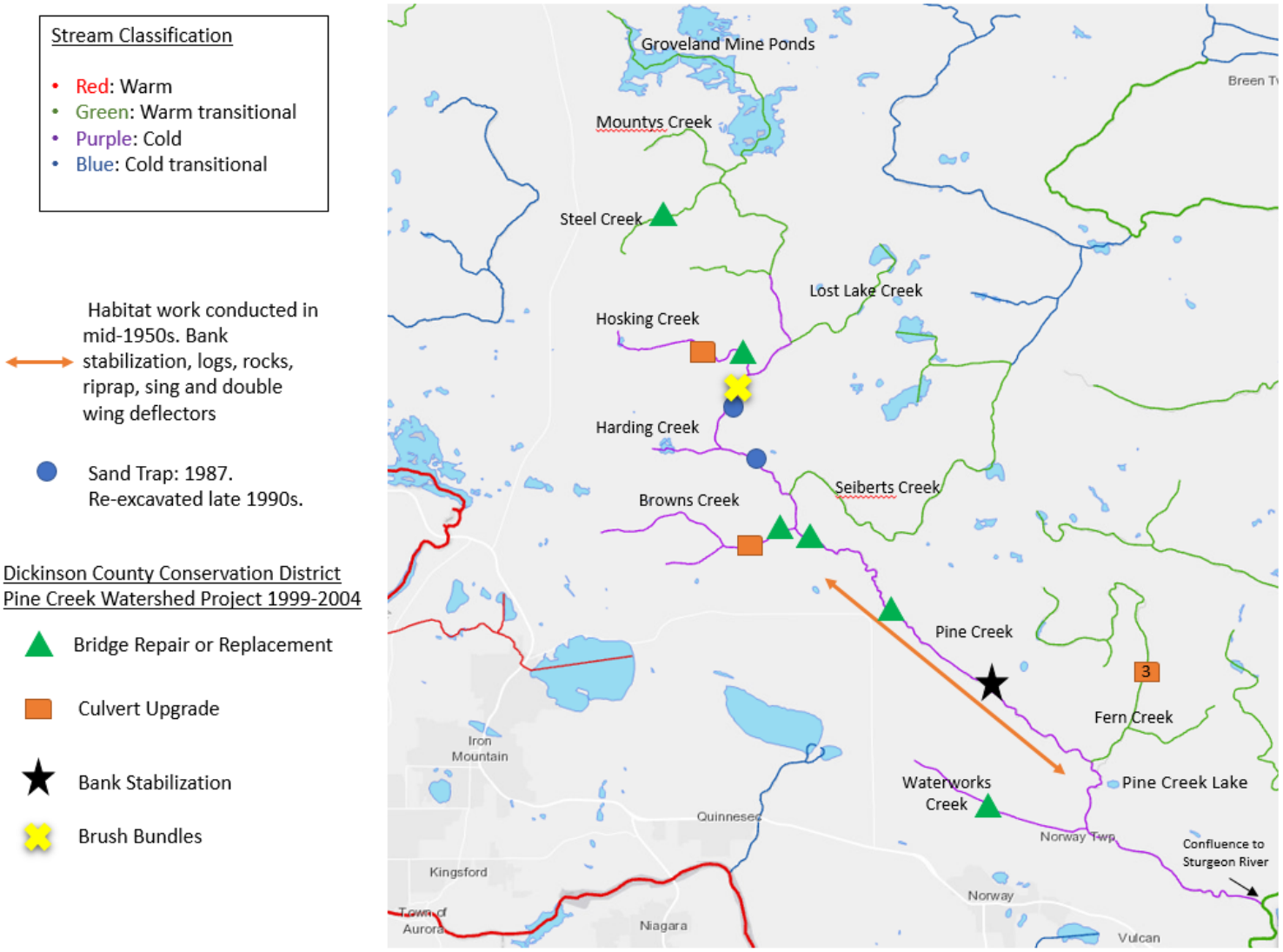

Figure 1: Overview of the Pine Creek Watershed, Dickinson County, including stream classification and habitat work locations.

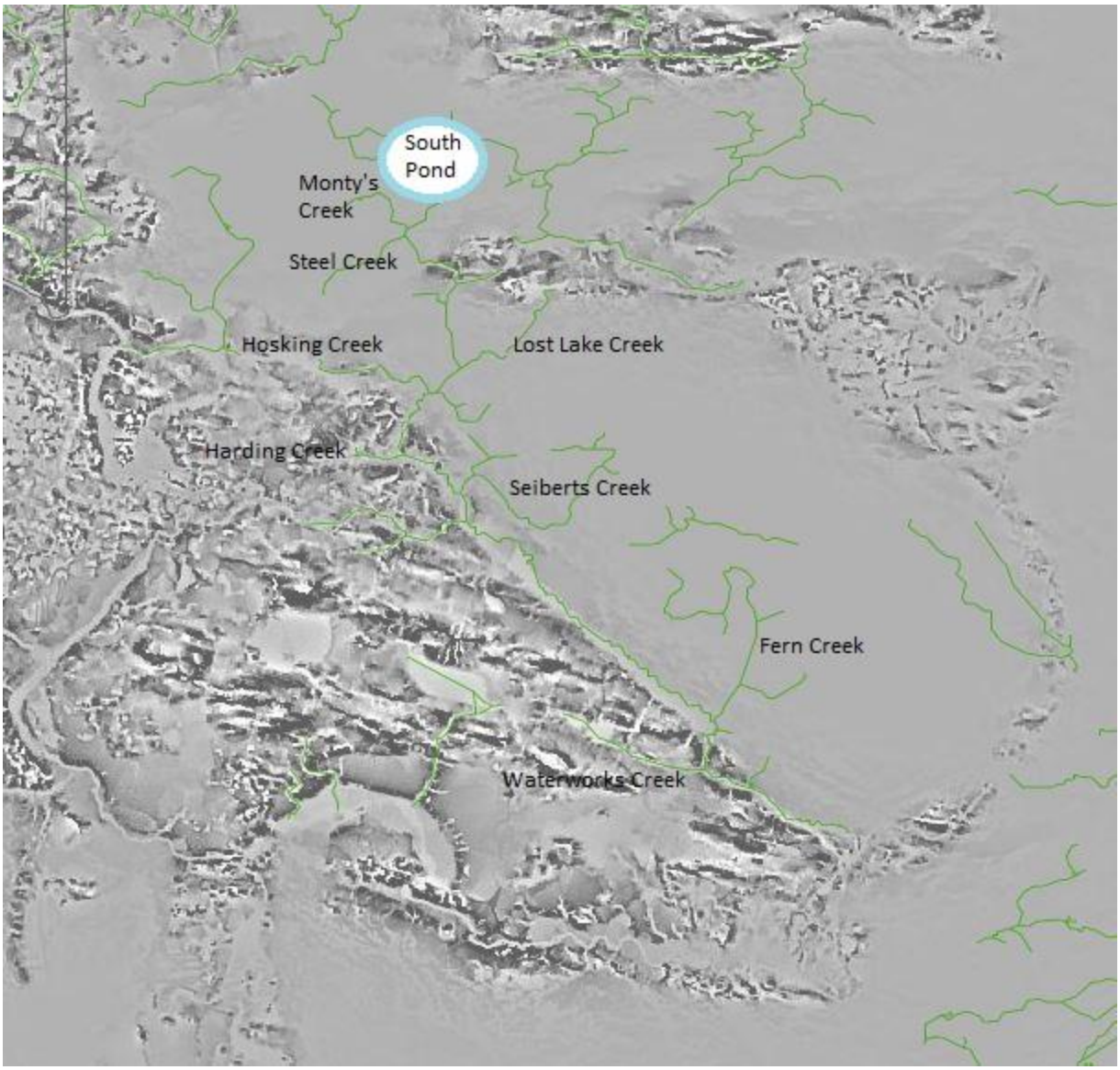

Figure 2: Groundwater influences of the Pine Creek Watershed. Darker areas indicated more substantial groundwater inputs to Pine Creek.

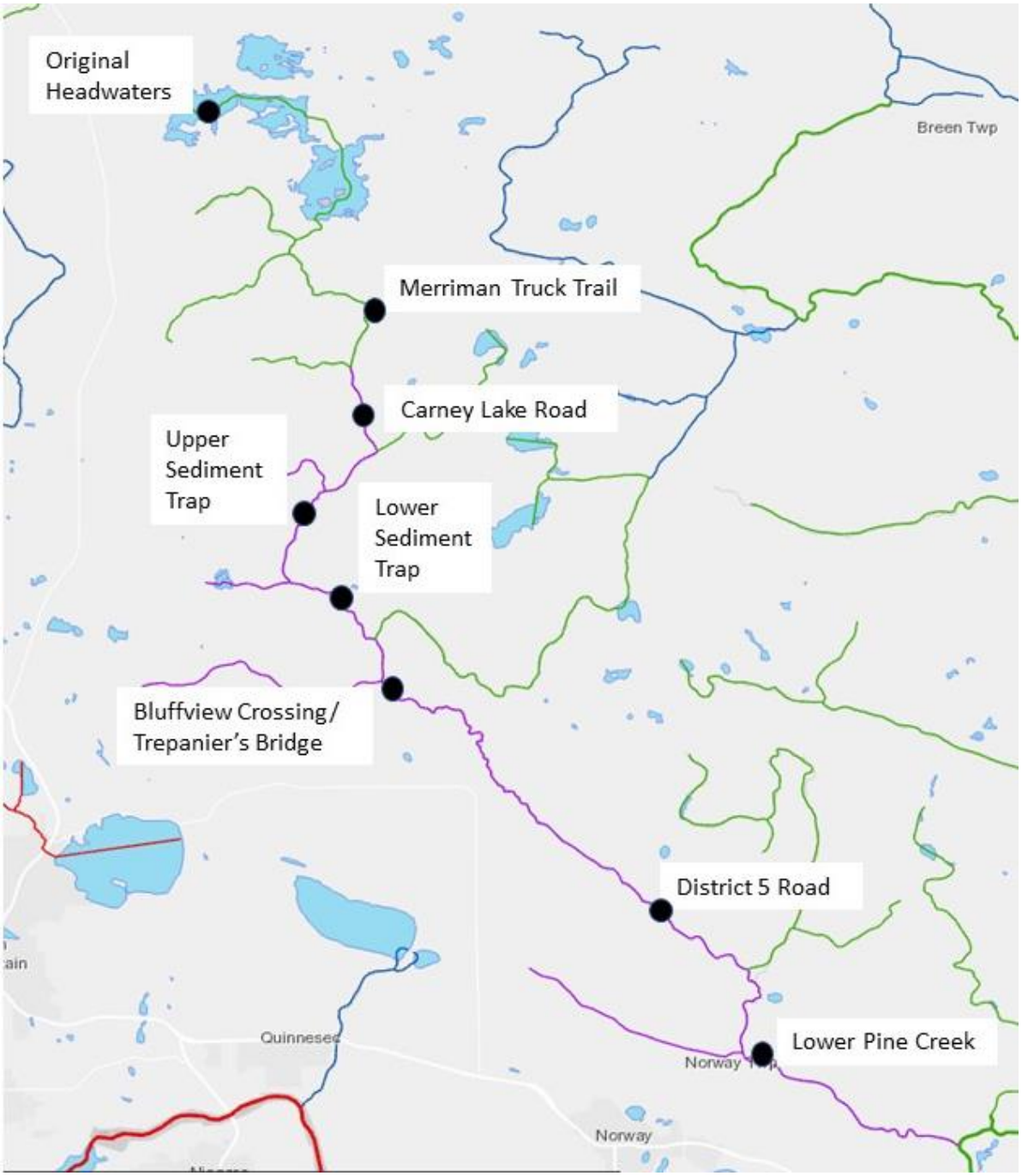

Figure 3: Map overview of the survey locations conducted on Pine Creek, Dickinson County.

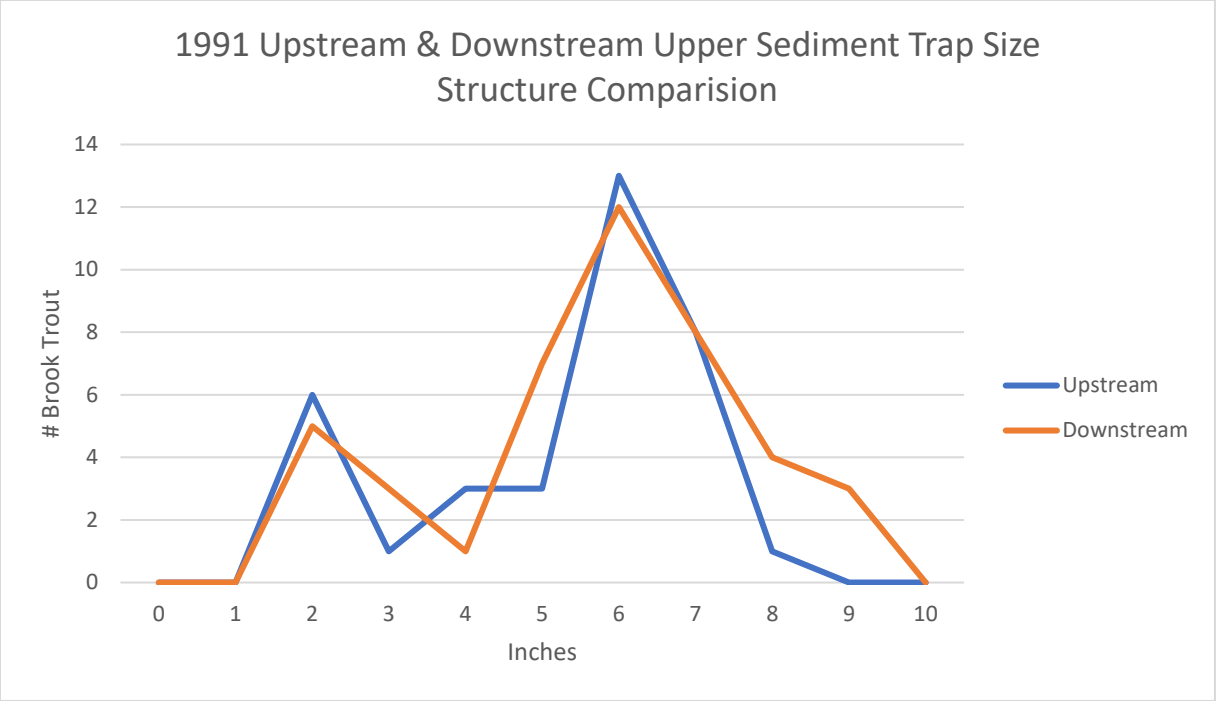

Figure 4:Size structure of Brook Trout captured during a Michigan DNR fisheries survey. Surveyors sampled upstream and downstream of the sand trap to compare size structure of Brook Trout at each location. Data taken from MDNR Surface Water Quality Division Staff Report MI/DNR/SWQ-92/039.

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