Michigan Department of Natural Resources

Remedial Action Plan for Manistique

DNR

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Remedial Action Plan

for

MANISTIQUE RIVER

Area of Concern

October 27, 1987

Michigan Department of Natural Resources
Surface Water Quality Division
Great Lakes and Environmental Assessment Section
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ACKNOWLEDGMENT

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1. EXECUTIVE SUMMARY

The Manistique River is located in Schoolcraft County in Michigan's central upper peninsula. The river flows from the northeast and discharges into Lake Michigan at the City of Manistique. The upstream boundary of the Area of Concern begins at the dam in Manistique and extends downstream to the Manistique Harbor, a total length of approximately 2.7 km (1.7 miles).

The problems within the Area of Concern as identified in the 1985 Report on Great Lakes Water Quality are sediments contaminated with polychlorinated biphenyls (PCBs) and heavy metals, a fish consumption advisory, and impacted biota (49).

Impacts to the biota were first noted in the mid-fifties. These impacts were attributed primarily to deposits of wood fibers and organic waste from sawmill and papermill operations, and sanitary waste from the City of Manistique. Later studies also identified chemical wastes as contributing to the degradation. There have been no recent (since 1978) studies to evaluate benthic communities in the Manistique River or harbor.

PCB and heavy metal contamination of the sediments within the Area of Concern were first identified in the mid-seventies. Carp collected from the Manistique River within the Area of Concern were found to have tissue concentrations of PCBs that exceeded the Food and Drug Administration (FDA) and Michigan Department of Public Health (MDPH) 2 mg/kg action level. A consumption advisory is currently in effect for carp caught below the dam in Manistique warning people not to eat these fish due to elevated levels of PCBs in the tissue.

Although numerous types of industry have been located within the Manistique River Area of Concern in the past (ie, sawmills, chemical companies), there currently are only two point source discharges- Manistique Papers, Inc. and the Manistique Wastewater Treatment Plant. Both facilities possess NPDES permits.

Over the past 15 to 20 years a number of actions have taken place that have resulted in improvements within the Area of Concern. In 1977, the Manistique WWTP upgraded to secondary treatment. Manistique Papers also upgraded its wastewater treatment facilities to provide secondary treatment of process wastewater from its paper making operations. These improvements have greatly reduced oxygen demanding loads to the Manistique River and also reduced or eliminated the discharge of toxicants (metal and organic) and materials such as wood fibers and paper. In 1986, at the request of the Michigan Department of Natural Resources, Manistique Papers placed a temporary erosion barrier over soils in the vicinity of an old deinking-wastewater settling lagoon suspected to be a major source of PCBs to the Manistique River.

Ongoing studies are necessary in order to determine the effects of past remedial actions and those actions yet to be initiated. Recommended remedial actions include additional analysis of the sediments and water

within and around the Manistique Area of Concern, collection of Manistique River fish for contaminant analysis, and a study of the benthic communities in the river and harbor.

2. INTRODUCTION

2.1 Background

The lower Manistique River and harbor have been targeted as an Area of Concern (AOC) by the International Joint Commission (IJC), the Great Lakes National Program Office (GLNPO), and the State of Michigan. Areas of Concern are waters in which the (1) designated uses of the water or biota are adversely affected and (2) environmental quality is degraded The Manistique River AOC is located in Schoolcraft County in Michigan's central upper peninsula.

The Manistique River is designated and protected for the following uses by the Michigan Water Quality Standards:

a) agriculture b) navigation c) industrial water supply d) public water supply at the point at water intake e) warmwater and coldwater fish f) other indigenous aquatic life and wildlife g) total body contact recreation

The use that is impaired within the Manistique River AOC is the fishery due to elevated levels of polychlorinated biphenyls (PCBs) in carp. A public health advisory is currently in effect warning people not to eat carp caught in the affected area of the Manistique River. The sources of PCBs to the fishery are in part, from PCB contaminated sediments in the Manistique River and harbor.

Another possible use impairment within the Manistique River AOC is protection of other indigenous aquatic life. Studies of the Manistique River and harbor in the mid-seventies showed a reduction in numbers and variety of bottom dwelling organisms in the AOC as compared to an area upstream of the AOC. This reduction was attributed to chemical and/or physical degradation of benthic habitat due to toxic levels of contaminants in the sediments (ie., heavy metals, PCB) and deposition of undesirable materials on the river and harbor substrates. No recent studies have been done to confirm whether these conditions still exist, therefore this possible use impairment will be investigated as part of the Remedial Action Plan (RAP).

2.1.1 Great Lakes Water Quality Management

The Great Lakes Water Quality Board (GLWQB) was created as part of the Great Lakes Water Quality Agreement of 1978, signed by Canada and the United States. The Board is responsible for reporting water quality research activities and the environmental quality of the Great Lakes to the IJC. In order to track and measure the progress of the 42 identified Areas of Concern, the GLWQB adopted a system of six categories. These categories represent a logical sequence for problem solving and resolution; they identify the status of the information base, programs which are underway to fill the information gaps, and the status of remedial efforts. According to the Board, a site can be deleted as an AOC when evidence is presented verifying that the full complement of uses has been restored (49). The six categories are:

Category	Explanation
1	Causative factors are unknown and there is no investigative program underway to identify causes.
2	Causative factors are unknown and an investigative program is underway to identify causes.
3	Causative factors are known, but a Remedial Action Plan is not developed and remedial measures are not implemented
4	Causative factors are known and a Remedial Action Plan developed, but remedial measures are not fully implemented.
5	Causative factors are known, a Remedial Action Plan is developed, and all remedial measures identified in the Plan have been implemented.
6	Confirmation that uses have been restored and deletion as an Area of Concern.

The Manistique River is currently a Category 2 Area of Concern.

2.2 Purpose

The purpose of the Remedial Action Plan (RAP) process is to provide a coordinated approach to environmental management that will ultimately lead to the successful rehabilitation of the Great Lakes. The purpose of this plan is to focus the data gathering and data synthesis to resolve the immediate problems which impair the AOC designated uses. Recommendations for restoring the impaired use(s) and maintaining other designated uses are based on currently available data and current agency programs and priorities.

2.3 Public Participation

Public participation is an integral part of the remedial action planning process. Two public meetings have been held to date to describe the problems within the AOC, describe the Remedial Action Plan, solicit comments and suggestions for development of the RAP, and answer questions relevant to the AOC.

2.4 Intended Use

This RAP is intended as a technical management document providing a platform for future analyses and decision making. It is a detailed review and synthesis of data and/or information relevant to the impaired designated uses on the Area of Concern. Every attempt has been made to identify the major documents that relate to the critical environmental

issues affecting the Manistique River AOC. Remedial action planning is an interactive process and suggestions and additions are welcome.

3. ENVIRONMENTAL SETTING

3.1 Location

The Manistique River flows through Schoolcraft County which is located in Michigan's central upper peninsula (Figure 3-1). The river flows from the northeast and discharges into Lake Michigan at the City of Manistique.

The AOC, which is shown in detail in Figure 3-2, extends from the dam in the City of Manistique to the mouth of the Manistique Harbor in Lake Michigan, a distance of approximately 2.7 km (1.7 miles).

3.2 Natural Features

3.2.1 Hydrology

The Manistique River basin drains the majority of Schoolcraft County and portions of Luce, Mackinac, Alger and Delta Counties, a total area of 3756 km^2 (1450 mi^2) (Figure 3-3) (8). The AOC comprises approximately 0.5 km^2 (0.2 mi^2) of the entire Manistique River drainage basin.

The Manistique River rises in Manistique Lake in Luce County and flows 117 km (73 miles) southwestward across Schoolcraft County to Manistique, where it empties into Lake Michigan (Figure 3-4)(44). Most of the river's major tributaries flow southeastward across the county until they join the main stream. The largest tributary, Indian River, flows eastward into Indian Lake and then to the Manistique River just north of Manistique (44).

The Manistique River is impounded 2.4 km (1.4 miles) above Lake Michigan. The dam was built in 1919 to provide water to Manistique Papers, Inc. for creating hydroelectric power. Water is diverted to Manistique Papers via a 914 meter (1000 yards) long concrete flume (50) Further downstream, the river is diverted into three channels (channels C, D, and E)(Figure 3-5). These channels were created in the early 1900s as boat channels.

In 1967 one of the boat channels, previously located between channels B and C (Figure 3-5), was diked at the upper and lower portions and used as a lagoon for settling wastewater created during the deinking process at Manistique Papers. By 1972, the lagoon was no longer in use and was later dredged and filled. The slope of the Manistique River from its origin to Manistique is very gradual. The only significant change in river slope is through Manistique where the river bed elevation drops 26 feet. (50)

The Manistique River at the mouth flows at an average rate of 47.5 m^3/s (1679 ft^3/s). The maximum average flow during the year is 124 m^3/s (4380 ft^3/s) in April, and the minimum average flow is 25 m^3/s (890 ft^3/s) in August. (66)

FIGURE 3-1 MICHIGAN COUNTIES

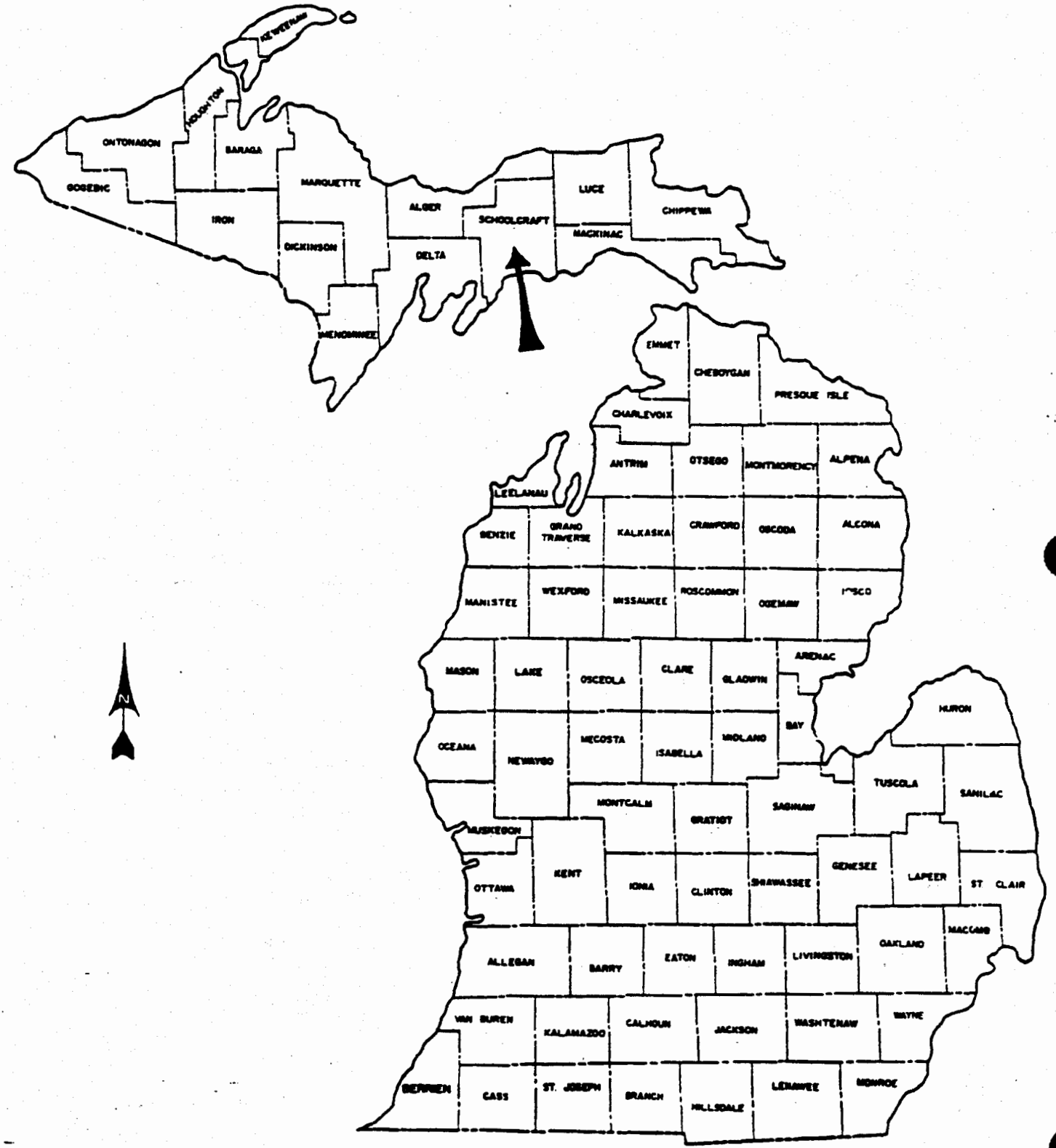


FIGURE 3-2 MANISTIQUE RIVER AREA OF CONCERN

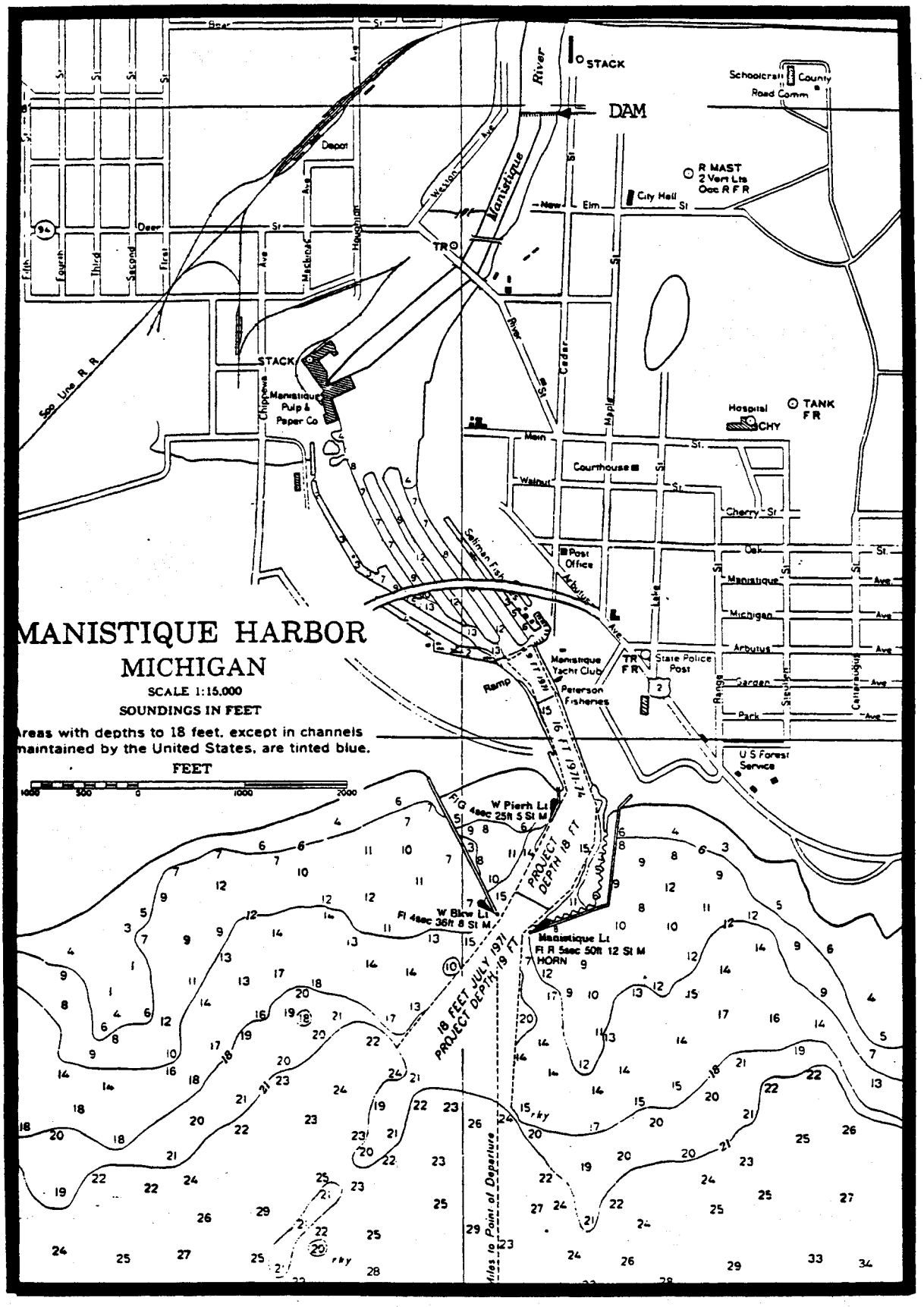


FIGURE 3-3 THE MANISTIQUE RIVER DRAINAGE BASIN

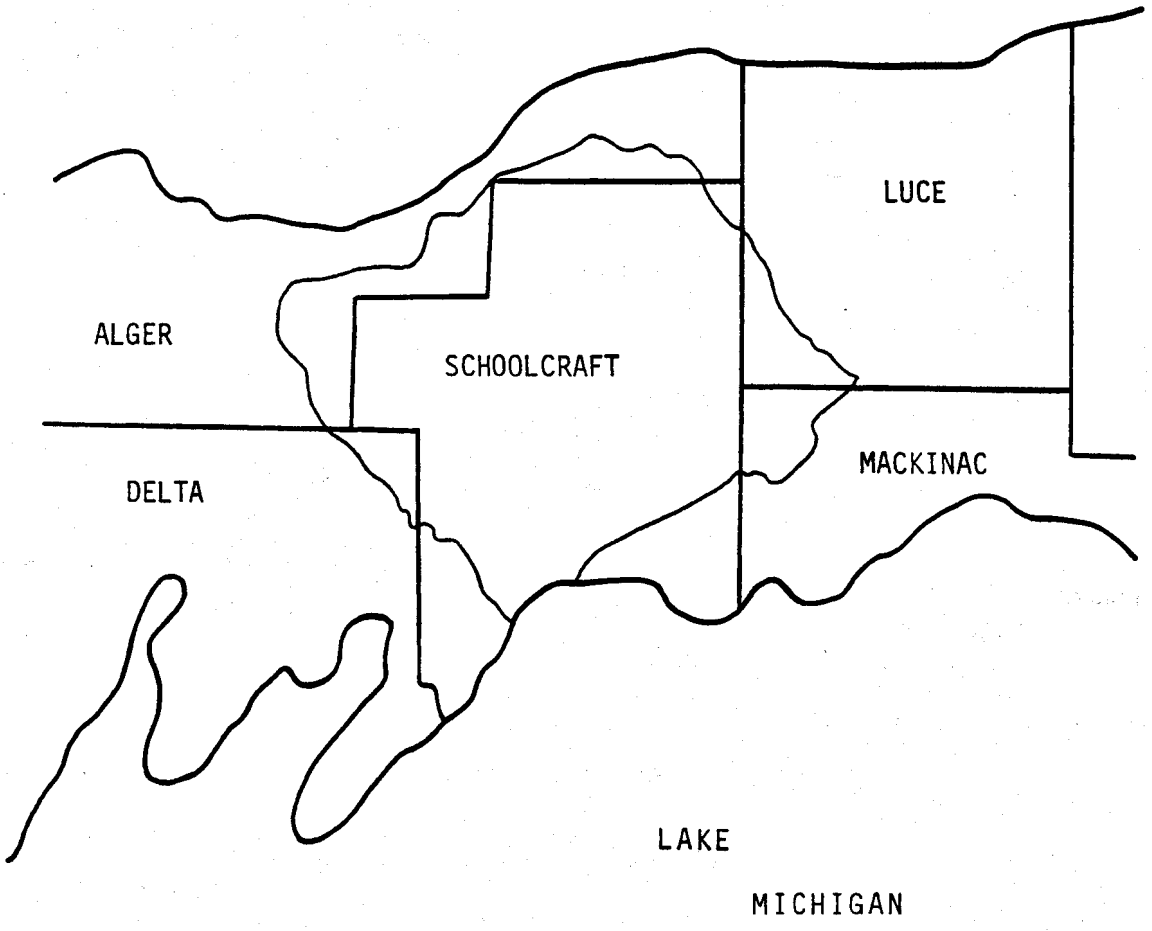


FIGURE 3-4 SCHOOLCRAFT COUNTY

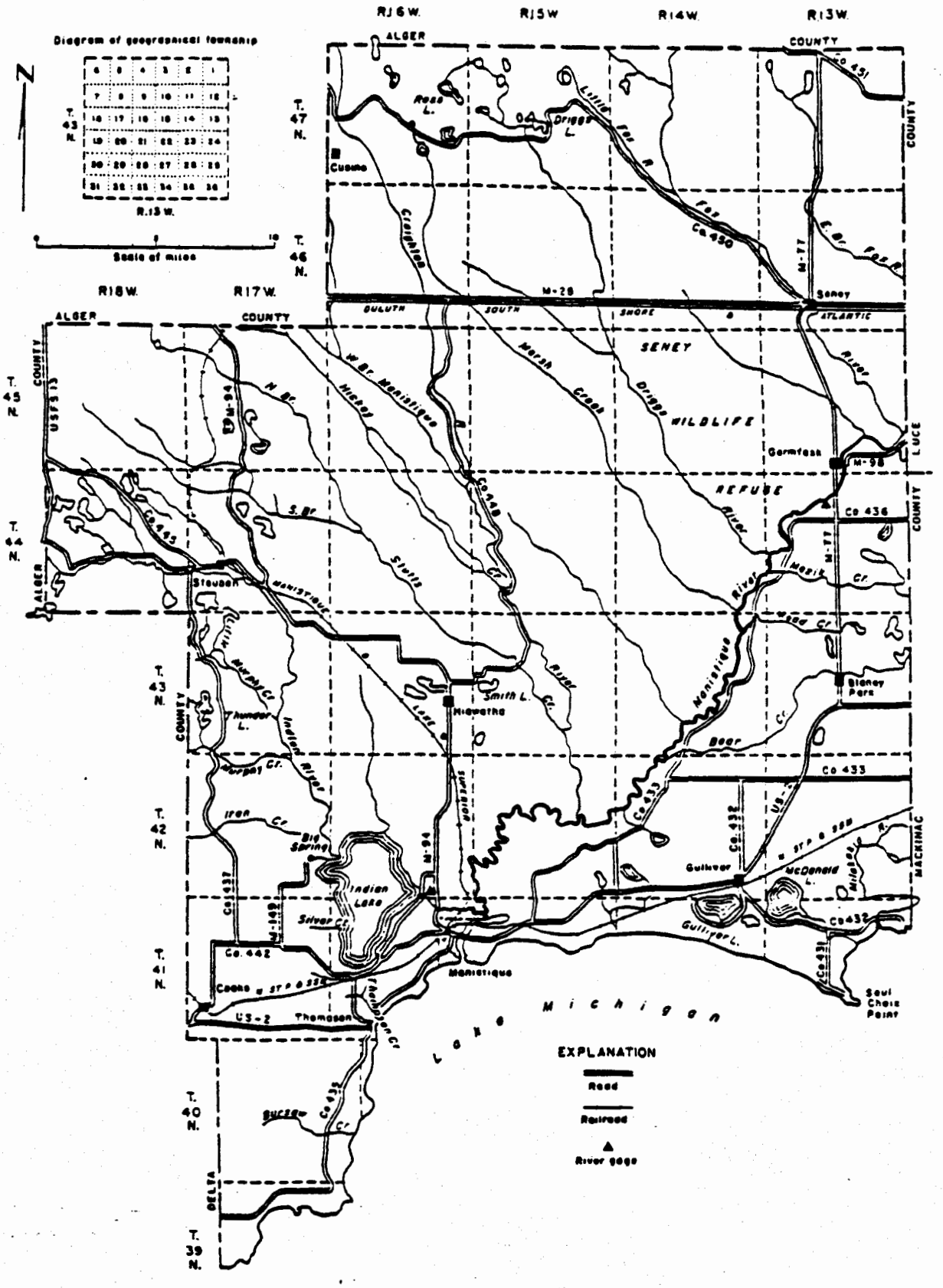
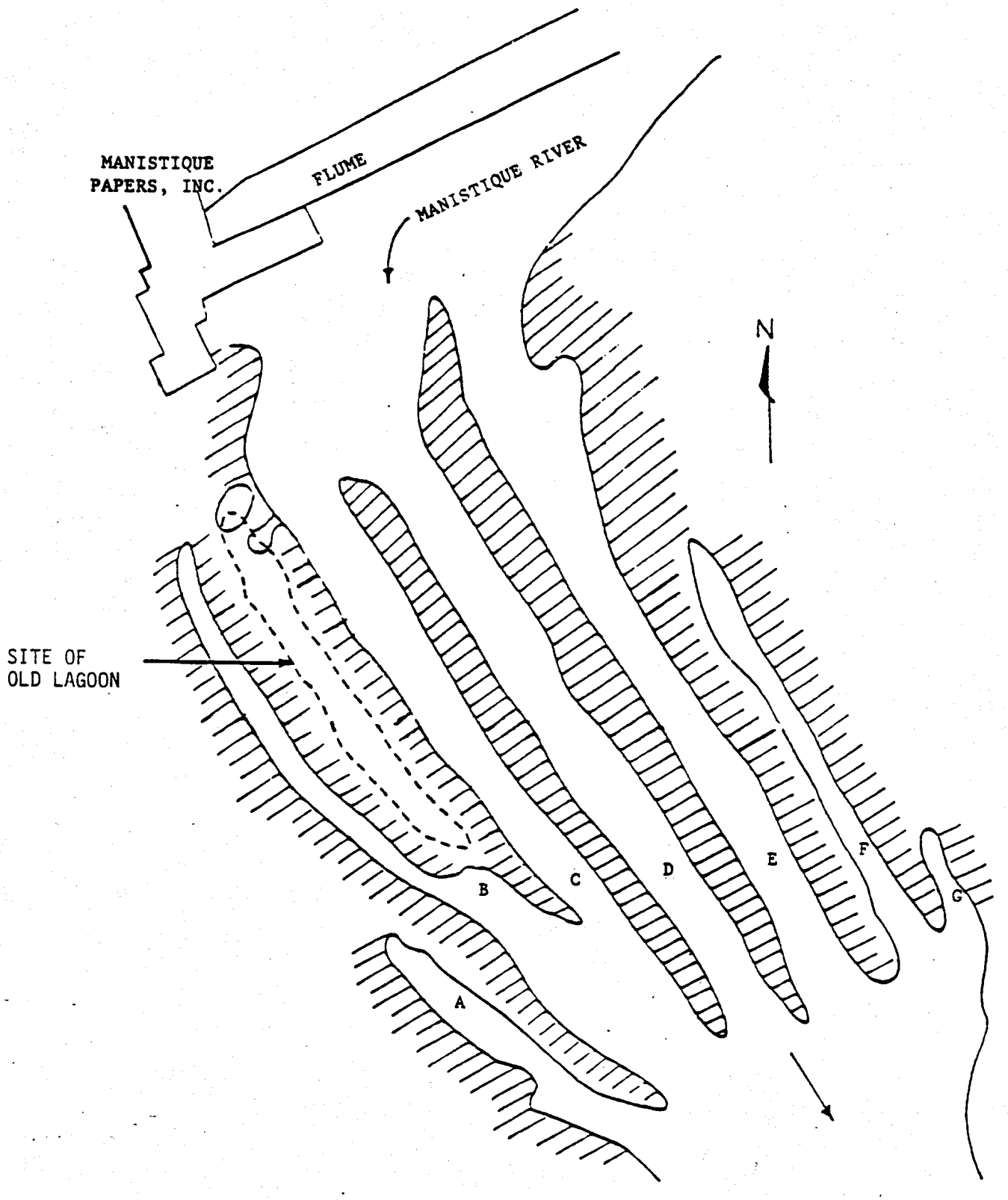


FIGURE 3-5 MANISTIQUE RIVER CHANNELS A - G



3.2.2 Topography

The region of Schoolcraft County along the Lake Michigan shoreline and including the AOC is fairly level and characterized by low sandy or gravely ridges alternating with swales and swamps (Figure 3-6)(53).

3.2.3 Soils, Runoff, Erosion

The soils surrounding the AOC are primarily sand underlain by limestone and sandstone (53). Soil erosion within the AOC has occurred along the Lake Michigan shoreline and at the mouth of the Manistique River due to elevated Lake Michigan water levels and the effect of wave action due to southerly winds.

3.2.4 Limnology

During the summer of 1976, the Michigan Department of Natural Resources performed a limnological study of 16 nearshore Lake Michigan areas (2). The sixteen locations sampled are shown in Figure 3-7. The Manistique River is represented by location 13. Assessments consisted of water and sediment chemistry and benthic macroinvertebrate community structure. The water and sediment chemistry data are presented in Appendix A. Figure 3-8 illustrates the sampling array for the nearshore area of the Manistique River.

The study showed that the nearshore area of the Manistique River was one of five Lake Michigan locations (including Naubinway, the Betsie Lake outlet, Manistee River and Pere Marquette Rivers) with the greatest water clarity as indicated by secchi disk readings, suspended solids and turbidity. The water at these locations also had the lowest phytoplankton productivity (chlorophyll a) and the least nutrients (nitrogen, phosphorus and silica) as compared to the other locations sampled.

Analysis of the Lake Michigan sediments revealed elevated concentrations of PCBs, heavy metals (particularly zinc and lead), total phosphorus, chemical oxygen demand (COD), total organic carbon (TOC), and total kjeldahl nitrogen (TKN) and oil-hexane extractables within the Manistique Harbor (stations 8, 9 and 19) as compared to stations at the 15 m contour and beyond (stations 2-7). Elevated concentrations of some parameters, ie. COD and lead, were detected at the 6 m contour (Station 1) located approximately 457 m (1500 feet) off the harbor mouth. PCBs were not detected in the sediments outside the harbor.

The substrate of Lake Michigan beyond the Manistique Harbor is primarily gravel and coarse sand at the harbor mouth (station 1), coarse to medium sand at the 15 m contour (stations 2 through 4) and medium to fine sand at the 30 m contour (stations 5 through 7). Within the harbor (stations 8 through 10), the substrate is primarily wood fibers, a relic of the lumbering era on the Manistique River.

Water chemistry data from stations 3 and 6 were analyzed to assess the trophic status of Lake Michigan near the Manistique River. The Manistique River location was classified as oligotrophic (2).

FIGURE 3-6 SOILS AND TOPOGRAPHY OF SCHOOLCRAFT COUNTY

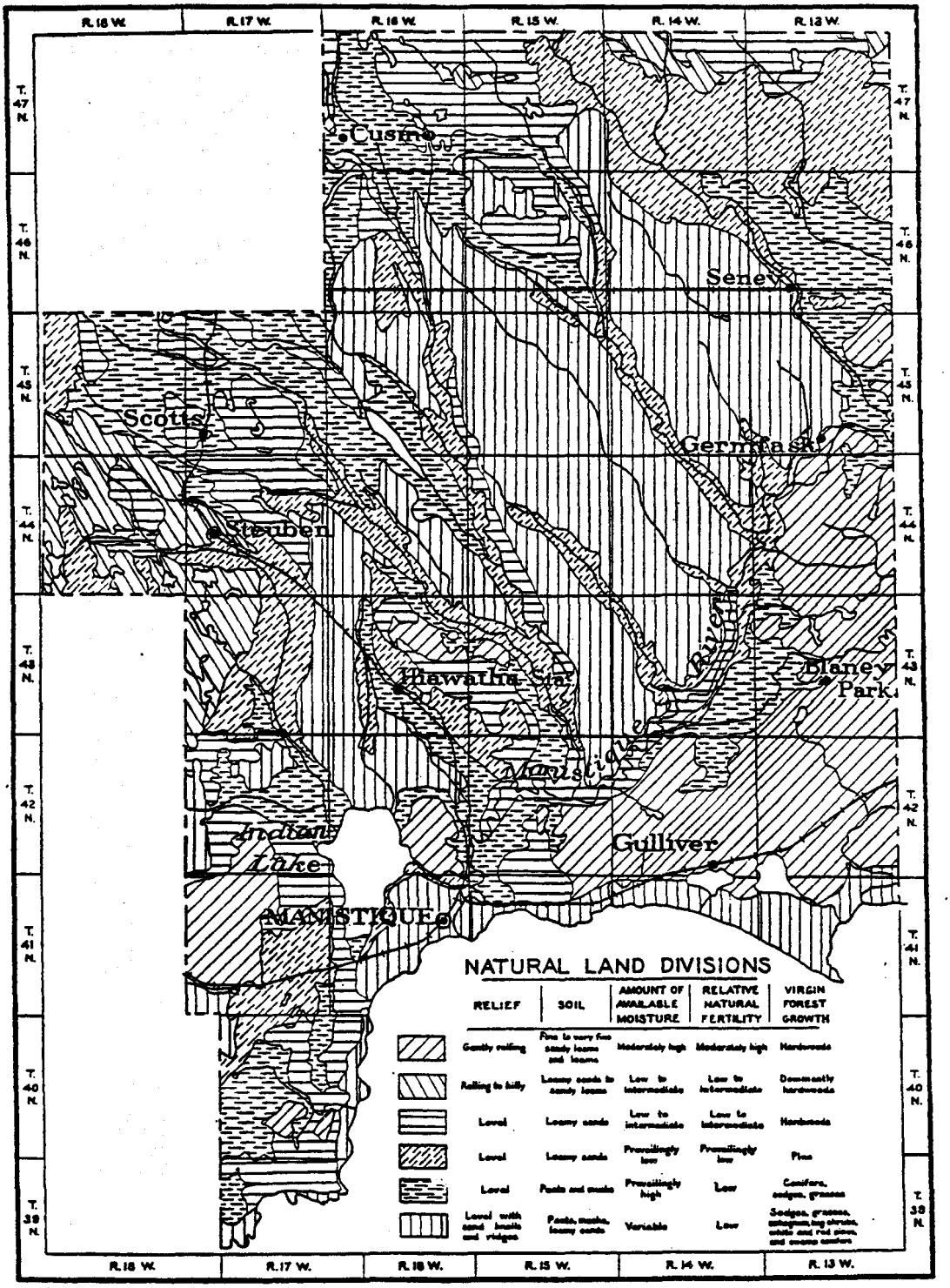


FIGURE 3-7 SAMPLING LOCATIONS IN NEARSHORE WATERS, LAKE MICHIGAN, 1976

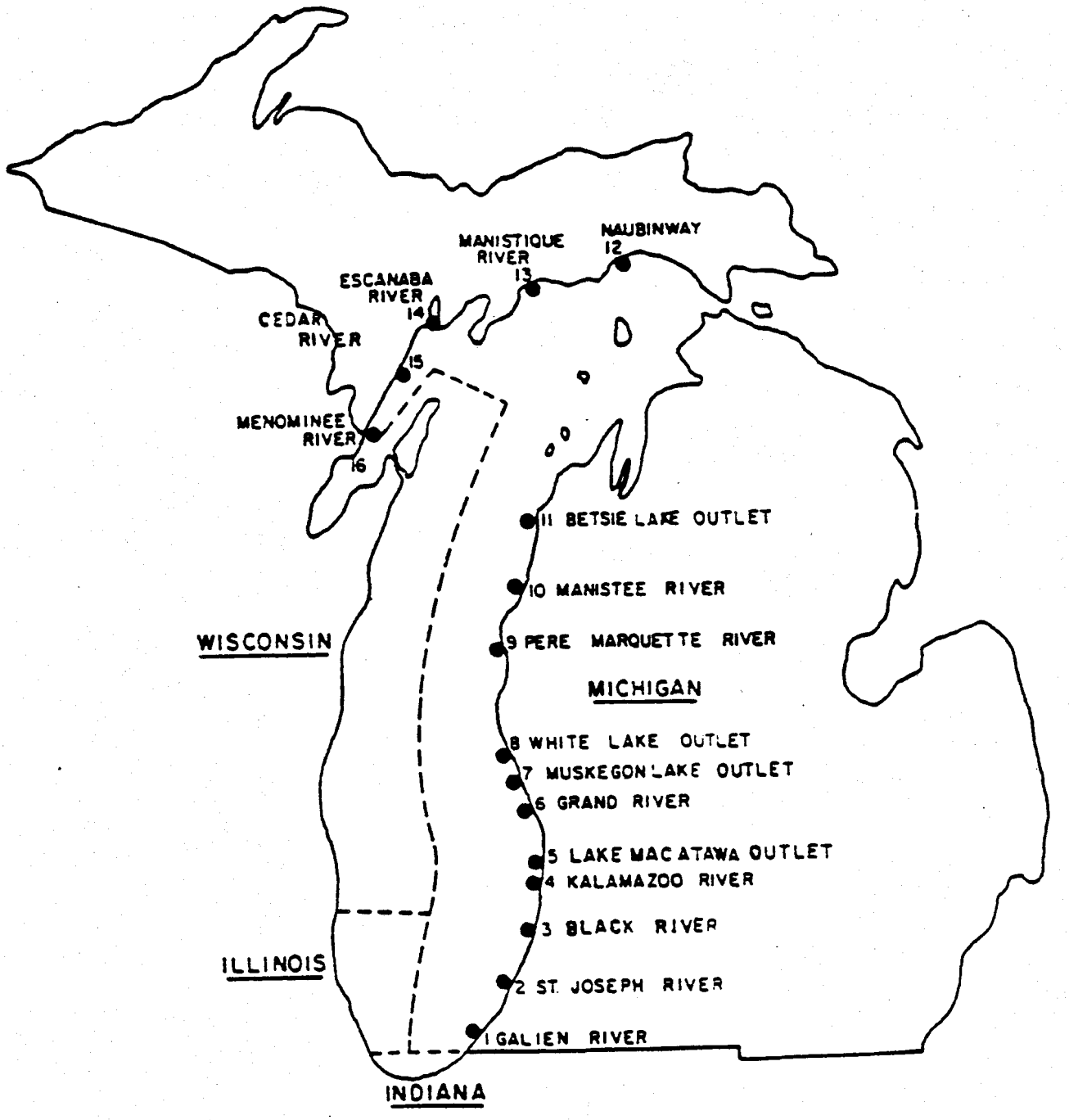
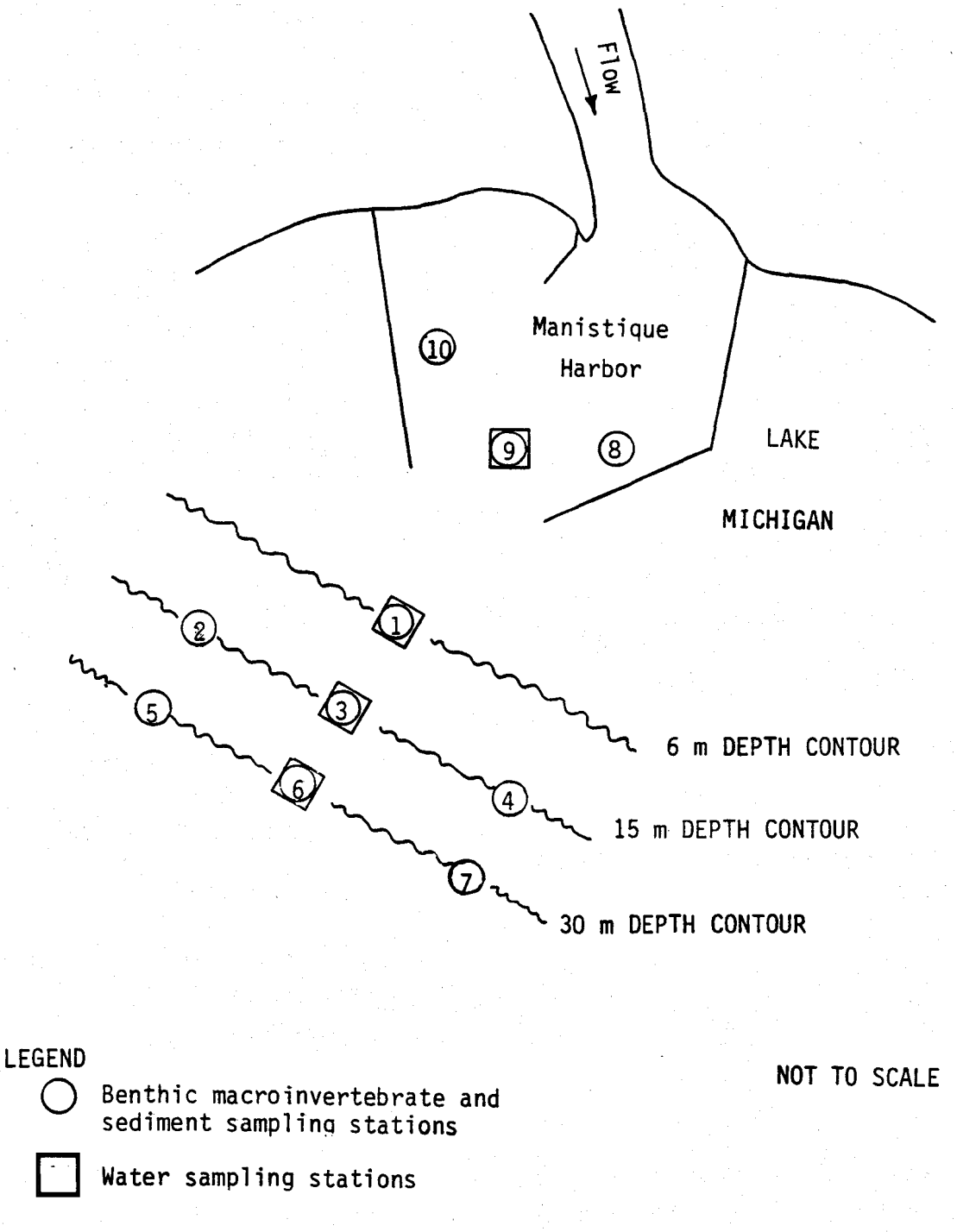


FIGURE 3-8 SAMPLING ARRAY FOR THE NEARSHORE WATERS OF LAKE MICHIGAN IN THE VICINITY OF MANISTIQUE, 1976



3.3 Land Uses

3.3.1 Urban/Suburban/Residential

Schoolcraft County at 3183 km^2 (1229 mi^2) is the second largest county in the State of Michigan in land area. The majority of the county land area (98%) is undeveloped (ie., forest, wetland) with the remainder residential/commercial/institutional (.3 percent), industrial (0.01 percent), extractive (0.15 percent), and agricultural (1.7 percent) (9). More than 50% of the land in Schoolcraft County is owned by state and federal governments. The economy of the county is centered around the City of Manistique (9).

3.3.2 Sewered Areas

The Manistique WWTP is the only municipal treatment plant within the Manistique River watershed (Figure 3-9). The WWTP discharges treated sanitary waste to the Manistique River and is permitted under the National Pollutant Discharge Elimination System (NPDES) permit program. The sanitary service area covers approximately 2.3 km^2 (580 acres) and serves approximately 5,000 people. The City's sanitary sewage is entirely from residential dwellings and small plants and businesses (8).

Prior to 1959, there was no treatment of municipal wastes in Manistique. Storm water and sanitary wastes were discharged directly to the Manistique River via combined sewers. In 1959, the Manistique WWTP was constructed to provide primary treatment of sanitary waste (43). In 1979, the system was upgraded to secondary treatment. Three combined sewer overflows (CSOs) still exist. These are identified on Figure 3-9. During wet weather periods when the hydraulic capacity of the Manistique WWTP is exceeded, stormwater and untreated sanitary waste are discharged directly to the Manistique River and Lake Michigan. The City of Manistique has no immediate plans to eliminate the CSOs.

3.3.3 Unsewered Areas

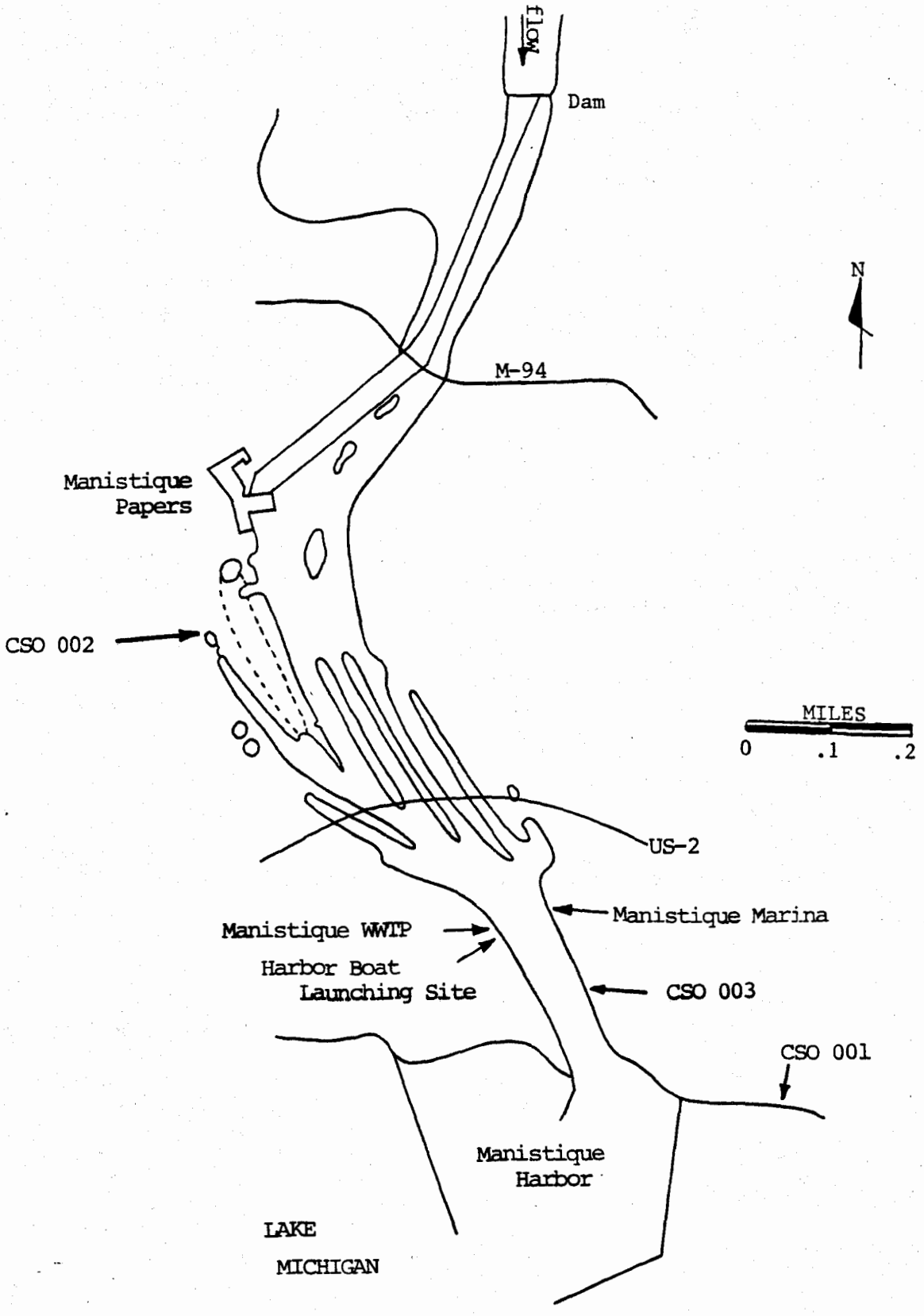
There are a number of unsewered areas within the Manistique River watershed that are of suspected of causing local water quality problems.

Indian Lake (Figure 3-4) is a popular recreational area with many summer and full-time residences. The soils in the southeast portion of the lake are poorly drained and as a result, sewage waste flows directly to the groundwater and Indian Lake with little or no treatment (8). Other potential problem areas within the Manistique River watershed include Germfask and Seney in the vicinity of the Fox River due to problems with onsite subsurface disposal systems, and McDonald and Gulliver Lakes due to nutrient enrichment (8). These areas are not expected to impact the AOC.

3.3.4 Industrial Land Uses

Manistique Papers, Inc. is the only industry located within the Area of Concern or within the Manistique River watershed (Figure 3-9). The plant discharges treated paper process wastewater to the Manistique River and is permitted under the NPDES permit program.

FIGURE 3-9 LOCATIONS OF MANISTIQUE PAPERS, THE MANISITIQUE WWTP, MANISTIQUE MARINA, AND PUBLIC BOAT LAUNCH WITHIN THE MANISTIQUE RIVER AREA OF CONCERN



Manistique Papers, Inc. produces specialty paper for use as newsprint, novel newsprint, computer printout paper, magazine inserts and other similar types of paper. Recycled paper accounts for 100% of the raw material.

Process wastewaters generated from the paper mill receive secondary waste treatment prior to discharge to the Manistique River.

3.3.5 Landfills

Table 3-1 shows the three domestic and industrial waste landfills located within the Manistique River Basin: (1) Manistique Papers, Inc. landfill (2) City of Manistique landfill and (3) Schoolcraft County Landfill. The Schoolcraft County Landfill is no longer active. These sites were identified and screened under Michigan's Public Act 307 (Michigan Environmental Response Act). Screening scores for these sites were low and therefore, these sites were not ranked for response priority under Act 307. The City of Manistique landfill accepts domestic waste only; the Manistique Papers, Inc. landfill accepts wastes from the paper company. The Schoolcraft County landfill has been closed for approximately seven years. This landfill received domestic waste only.

3.3.6 Recreational Land Uses

There are few recreational land uses in the immediate vicinity of the AOC. There is a publicly owned boat launch on the west shore of the Manistique River (Figure 3-9). A small picnic and sunbathing area and the Manistique Marina are located on the eastern shore.

3.3.7 Agricultural Land Uses

Agricultural activities in Schoolcraft County are confined to areas near the towns of Cooks and Gulliver located west and east of Manistique, respectively (8). Due to the limited agricultural practices in the county, agriculture is not considered to have a major impact on the AOC.

3.3.8 Wildlife Habitat/Open Space

Approximately 97 percent of Schoolcraft County is undeveloped, consisting primarily of forest and wetland. The Seney National Wildlife Refuge, Lake Superior State Forest and Hiawatha National Forest occupy the majority of Schoolcraft County.

There is little available wildlife habitat bordering the AOC since most of the AOC lies within the City of Manistique and the shoreline and nearby areas are developed.

TABLE 3-1. WASTE DISPOSAL SITE IN THE MANISTIQUE RIVER WATERSHED

Name	Location	Description
Manistique Papers, Inc. (Facility owned landfill)	T43N-R16W-Sec 36	The primary material disposed of at this site is sludge resulting from wastewater treatment
City of Manistique Landfill	T43N-R16W-Sec 26	Accepts domestic waste only
Schoolcraft County Landfill	T41N-R16W-Sec 1	Accepted domestic waste only

3.4 Water Uses (Manistique River)

3.4.1 Fish and Wildlife Habitat

A variety of fish habitats are present within the AOC. The Manistique River substrate is primarily rock and cobble in the faster flowing stretches ie., along the Manistique Papers, Inc. flume. Below Manistique Papers, the substrate in the flowing channels is primarily sand (Channels C, D, E - Figure 3-5), while the substrate in the dead end channels (channels A, B, F, G) is primarily silt. Channel B also contains deposits of fine particulates, such as clay, resulting from the discharge of Manistique Papers treated process water to this location until 1986. The substrate below the channels is a combination of sand and silt with some gravel, cobble and slab wood.

Studies in 1969 and 1976-78 reported the presence of paper fibers and wood debris (chips, sawdust) on the substrate in channels C and D and continuing into the harbor (20, 62). The presence of these materials was attributed to Manistique Papers and sawmills that operated on the lower Manistique River. With the closing of the sawmills, and improved wastewater treatment at Manistique Papers, the discharge of these materials was eliminated.

Wildlife habitat, particularly for waterfowl, is available primarily on the eastern shore of the river near U.S.-2. The dead end channel creates a marsh-like habitat. Waterfowl have also been observed along the river shoreline and around the islands created by the boat channels.

3.4.2 Water Supply

There are no public water supply intakes within the AOC. The City of Manistique draws its water supply from the Indian River.

Manistique Papers, Inc. diverts a portion of the Manistique River for use in power generation.

3.4.3 Commercial and Sport Fishing

No commercial fishing occurs in the AOC. However, a commercial fishery, located next to the Manistique Marina on the Manistique River, harvests fish from the Great Lakes.

The Manistique River supports a diverse sports fishery. Sports fish that can be found below the dam during various times of the year include northern pike, yellow perch, smallmouth bass, rockbass, walleye, chinook salmon, coho salmon, pink salmon, brown trout and steelhead trout (63, 65).

Since 1974, MDNR has planted more than 400,000 chinook salmon and 57,000 steelhead trout in the Manistique River below the dam (64). The spring and fall spawning runs of steelhead trout and fall runs of chinook salmon attract many fishermen to the Manistique River and nearshore areas during these times of the year.

3.4.4 Contact Recreation

The Manistique River AOC has limited potential for contact recreational uses ie., swimming, wading, due to limited access and the shallow, rocky nature of the river.

3.4.5 Commercial Navigation

There is no commercial navigation in the Manistique River

3.4.6 Drainage

This topic is covered in Section 3.2.1 under hydrology

3.4.7 Waste Disposal

The Manistique WWTP, Manistique Papers, Inc. and 2 combined sewer overflows are the only current discharges to the Manistique River within the AOC. The Manistique WWTP discharges treated domestic water. Manistique Papers discharges treated paper process wastewater.

Historically, a variety of industry has occupied the banks of the Manistique River, including sawmills and a chemical company.

3.5 Water Uses (Near Shore Lake)

3.5.1 Fish and Wildlife Habitat

The habitat in the nearshore lake AOC is primarily sandy beach, which is used primarily by shorebirds such as seagulls. In addition, bald eagles forage along the shoreline in the vicinity of the AOC.

Surveys conducted by MDNR in 1976, 1978 and 1985 document that the substrate in the Manistique Harbor has been altered due to accumulation of sawdust and wood chips over the sandy lake bottom. These materials originated primarily from sawmills that once operated on the lower Manistique River (20, 42). Even in the absence of the sawdust accumulations, the harbor would not be considered an important area for fish propagation. (74)

3.5.2 Water Supply

There are no public water supply intakes from the nearshore AOC.

3.5.3 Commercial and Sport Fishing

There are no commercial fisheries located within the near shore lake AOC. Sport fishermen fish from boats and the harbor breakwall primarily during spring and fall steelhead trout and salmon spawning runs.

3.5.4 Contact Recreation

There are no public beaches within the near shore lake AOC.

3.5.5 Commercial Navigation

Commercial navigation within the Manistique Harbor is virtually nonexistent. Only one deep draft vessel (the Calcite II) is known to have entered the harbor in the last 5 years. This vessel was delivering coal to the coal dock at the mouth of the Manistique River (54).

3.5.6 Waste Disposal

There is no waste disposal to the nearshore AOC.

3.6 Water Quality Standards

Table 3-2 summarizes the Michigan Water Quality Standards applicable to the AOC. In general, designated uses for all waters within the State of Michigan as defined by the water quality standards consist of, at a minimum, protection for agricultural uses, navigation, industrial water supply, public water supply at the point of intake, warm water fish, total body contact recreation from May 1 to October 31, and other indigenous aquatic life and wildlife. The Manistique River below the dam and Lake Michigan is, in addition, protected for coldwater fish.

3.7 Summary

The Manistique River is located in Schoolcraft County in Michigan's central upper peninsula. The Manistique River Area of Concern lies primarily within the City of Manistique, beginning at the dam and extending through the Manistique Harbor in Lake Michigan.

The land surrounding the AOC is fairly level and characterized by sandy soils and shallow bedrock.

There are two NPDES permitted dischargers to the AOC: The Manistique WWTP and Manistique Papers.

Recreational uses of the Manistique River within the AOC include boating, and fishing for walleye, smallmouth bass, perch, chinook salmon and steelhead trout.

TABLE 3-2 MICHIGAN WATER QUALITY STANDARDS, NOVEMBER 1986
WHICH APPLY TO MANISTIQUE RIVER AOC

Parameter	Limit
Total Dissolved Solids (TDS)	Not to exceed a concentration of 500 mg/l as a monthly average and no greater than 750 mg/l at any time
Hydrogen Ion Concentration (pH)	pH shall be maintained within the range of 6.5 to 9.0
Phosphorus	Controlled from point source discharges to achieve 1 mg/l of total phosphorus as a maximum monthly average effluent concentration
Fecal Coliform	Shall not contain more than 200 fecal coliforms per 100 milliliters
Dissolved Oxygen (DO)	A minimum of 7 mg/l
Temperature	No increase of temperature in receiving waters at the edge of the mixing zone more than 2°F above existing natural water temperature and no increases greater than the following temperatures
Toxic Substances	Allowable levels of toxic substances shall be determined by the commission using appropriate scientific data

J	F	M	A	M	J	J	A	S	O	N	D
38	38	43	54	65	68	68	68	63	56	48	40

4. DEFINITION OF THE PROBLEM

4.1 Impaired Uses, Use Attainability, and Specific Concerns

The designated uses of the Manistique River within the AOC are that it be protected for cold water fish, warm water fish, total body contact recreation, agriculture, navigation, industrial water supply, public water supply at the point of intake and other indigenous aquatic life and wildlife. The impaired designated use that has been identified in the AOC by the IJC and the State of Michigan is the fishery. A public health advisory is currently in effect for carp due to the presence of PCBs in carp tissue at levels exceeding the FDA and MDPH action level of 2.0 mg/kg total PCBs. Other indigenous aquatic life may also be an impaired designated use within the AOC based on past study data. However, there are no recent studies to verify this.

The problem within the Manistique River AOC that is contributing to impairment of the fishery is contamination of river and harbor sediments with PCBs.

The objective of this Remedial Action Plan is to restore the impaired designated use(s). The goal is to reduce the concentration of PCBs in carp to less than the 2 mg/kg MDPH and FDA action level.

4.1.1 Eutrophication/Impacts

The near shore lake AOC has been identified as being oligotrophic (2). Water quality conditions for the near shore area are discussed in Section 3.2.6. There is no current information describing the trophic status of the Manistique River.

4.1.2 Sports Fishing/Impacts

There are no reported problems with the sport fishery in the AOC. However, sediment contamination within the AOC may contribute to a reduction in the sport fishery potential.

4.1.3 Public Health Advisories

A public health advisory is currently in effect warning fishermen not to eat carp caught from the Manistique River below M-94 (Figure 4-1).

4.1.4 Beach Closings

There are no beaches within the AOC

4.1.5 Aesthetic Impacts

There are currently no aesthetic problems within the AOC.

FIGURE 4-1 1987 FISH CONSUMPTION ADVISORY FOR THE MANISTIQUE RIVER AREA OF CONCERN

MICHIGAN FISHING GUIDE 1987

DNR

Rules Apply April 1, 1987 Through March 31, 1988

YES M!CH!GAN

A celebration of what was and will be.

PUBLIC HEALTH ADVISORY

You should be aware that some fish from some locations contain one or more chemical contaminants at levels of public health concern. Mercury, PCB, PBB, DDT, Dieldrin, Chlordane, Toxaphene and Dioxin are among the list of such contaminants. It should not be assumed that fish from waters which are not listed below are contaminant-free. Many lakes and streams have not yet been tested. Even in the locations listed, not all of the fish species in the waterway have been tested in some cases.

As an eating precaution, it is advised that fish be skinned, trimmed, and filleted to remove fatty portions and cooked by baking, barbecuing or broiling on a rack to reduce the level of contaminants.

Based on available monitoring data, the following additional precautions are advised:

1. DO NOT EAT ANY FISH caught from: Deer Lake, Carp River and Carp Creek (Marquette County); Pine River (downstream from St. Louis, Gratiot and Midland Counties); South Branch Shiawassee River (M-59 to Byron Rd.)
2. DO NOT EAT LISTED SPECIES caught from: Lake Michigan* (Applies to Michigan, Indiana, Illinois, and Wisconsin waters): brown trout over 23", lake trout over 23", chinook salmon over 32", carp, and catfish; Green Bay (Wisconsin waters south of Marinette/Menominee): rainbow trout over 22", chinook salmon over 25", brown trout over 12", brook trout over 15", splake over 16", northern pike over 28", walleye over 20", white suckers, white bass, and carp; Lake Superior (Applies to Michigan, Minnesota and Wisconsin Waters): lake trout over 30"; Lake Erie (Applies to Michigan, Ohio, and Pennsylvania waters): carp and catfish; Lake St. Clair (Applies to Michigan and Ontario waters): largemouth bass over 14", muskie and sturgeon; St. Clair River (Applies to Michigan and Ontario waters): gizzard shad over 10"; Saginaw River and Saginaw Bay: carp and catfish; Rouge River (Wayne County): carp; Detroit River: carp; Kalamazoo River (downstream from city of Battle Creek to Morrow Pond Dam, Kalamazoo County): carp; Kalamazoo River (downstream from Morrow Pond Dam to Lake Michigan) and Portage Creek (downstream from Monarch Millpond Dam): carp, suckers, catfish, and largemouth bass; Torch Lake (Houghton County): walleye and sauger; Langford Lake (Gogebic County): walleye over 23"; Shiawassee River (Byron Road to Owosso): carp; Cass River (downstream from Bridgeport): catfish; Tittabawassee River (downstream from Midland): carp and catfish; Lake Macatawa (Ottawa County): carp; Hersey River (downstream from Reed City): bullheads and brown trout; St. Joseph River (downstream from Berrien Springs Dam): carp; Manistique River (downstream from M-94/Old US-2): carp; River Raisin (downstream from Winchester Bridge, Monroe): carp.
3. RESTRICT CONSUMPTION. Michigan recommends no more than one meal per week of the following fish: Lake Michigan* (Applies to Michigan, Indiana, Illinois and Wisconsin waters): lake trout 20-23", coho salmon over 26", chinook salmon 21-32", and brown trout up to 23"; Green Bay (Wisconsin waters south of Marinette/Menominee): splake up to 16"; Lake Superior: lake trout up to 30"; Lake Huron*: rainbow trout, lake trout and brown trout; Lake St. Clair (Applies to Michigan and Ontario waters): walleye over 18", white bass over 14", smallmouth bass over 14"; yellow perch over 12", carp over 22", rockbass over 8", black crappie over 10", largemouth bass 12-14", bluegill and pumpkinseed over 8", freshwater drum over 12", carpsucker over 18", brown bullhead over 10", catfish over 22", and northern pike; Saginaw Bay*: rainbow trout, lake trout, and brown trout; Kalamazoo River (downstream from Morrow Pond Dam to Lake Michigan) and Portage Creek (downstream from Monarch Millpond Dam): all species except those listed in category 2 above for these same waters; Chicagon Lake (Iron County): walleye over 18"; Lake Michigamme, Michigamme Reservoir, Peavy Pond, Paint River Pond, and the Michigamme River system to its junction with the Menominee River: rock bass over 9", northern pike, walleye, smallmouth bass and muskie; Langford Lake (Gogebic County): walleye 15-23", northern pike over 22"; Duck Lake (Gogebic County): walleye over 16"; Caribou Lake (Chippewa County): walleye over 18" and rock bass over 10"; Cass River (downstream from Bridgeport): carp; Grand River (Clinton County): carp; White Lake (Muskegon County): carp;

*Advisory also applies to listed species migrating into streams tributary to these waters.

NOTE: NURSING MOTHERS, PREGNANT WOMEN, WOMEN WHO ANTICIPATE BEARING CHILDREN, FEMALE CHILDREN OF ANY AGE, AND MALE CHILDREN AGE 15 OR UNDER SHOULD NOT EAT THE FISH LISTED IN ANY OF THE CATEGORIES LISTED ABOVE.

For further information, call the Center for Environmental Health Sciences at 1-800-648-6942.

4.1.6 Biota Impairments

There is no current information on biota impairments other than a public health advisory (see 4.1.3), within the AOC. In 1978, aquatic insects and other bottom dwelling organisms were collected by MDNR from the Manistique River above and below the dam in Manistique (20). Data (Table 4-1) indicated that there was a lower average density of organisms downstream from Manistique Papers (Stations 3 and 4) compared to locations sampled above the dam at Station 1 (Figure 4-2). The data also indicated fewer different types of organisms downstream from Manistique Papers and the Manistique WWTP (Stations 3 and 6) as compared to above the dam. The sample location in the Manistique Papers clarifier effluent channel (Station 4) was completed devoid of organisms, which was most likely due to the flocculant nature of the substrate (20). The composition of organisms found within the AOC was dominated by pollution tolerant organisms (Oligocheta, Diptera) indicating degradation of the substrate and possible water quality impacts.

4.2 Major Pollutants of Concern

4.2.1 Water Contamination

PCBs in Manistique River water were documented in a 1984 study. From 1980-1981, water samples collected near the river mouth on four occasions over a nine month period, had an average concentration of 19 ng/l total PCBs (range = 7.16 to 29.1 ng/l) (60). This concentration was found to be only slightly higher than the average for rivers that receive PCBs only through atmospheric deposition and subsequent runoff.

During a 1985 study, PCBs were detected at a concentration of 24 ng/l in a ponded area below a combined sewer overflow at the head of channel B (Figure 3-5)(42) PCBs were not detected (<10 ng/l in ambient river samples) above the dam, immediately below Manistique Papers, in channel E, or in Weston Creek, which enters the Manistique River near M-94 (Figure 4-2).

Table 4-2 summarizes heavy metal concentrations in the Manistique River water from 1983 to 1986.

4.2.2 Sediment Contamination

Sediments in the AOC are contaminated with PCBs and heavy metals (2,20,42,46). In 1976 and 1978, MDNR conducted a survey to investigate sediment contamination in the Manistique River and harbor area. Data from this survey are summarized in Table 4-3. The sediments collected below the dam at stations 3 through 11 (Figure 4-2) contained elevated levels of PCBs, copper, chromium, cadmium, zinc, nickel and lead as compared to sediments collected above the dam (station 1). The sediments immediately below Manistique Papers Inc. (station 3) contained the highest concentration of PCBs at 172 mg/kg. PCBs were also found at station 5 (above the Manistique WWTP) and at all 5 harbor sampling locations (stations 7 through 11). PCBs were not detected in the sediments of the channel that received treated paper process waste from Manistique Papers, Inc. and waste from a combined sewer overflow (station 4). However, the highest the concentrations of chromium, cadmium, zinc and lead were found at station 4.

TABLE 4-1 MEAN ABUNDANCE OF BENTHIC MACROINVERTEBRATES (number/m^2) COLLECTED AT SEVEN STATIONS IN THE MANISTIQUE RIVER, SCHOOLCRAFT COUNTY. Stations 1, 3, 4, and 6 sampled in 1978. Stations 9, 10, and 11 sampled in 1976. (20)

Taxa Station Number:	1	3	4	6	9	10	11
Turbellaria							
Dugesia				430			
Amphipoda							
Gammarus		287			134		77
Hyalella azteca	215						
Isopoda							
Asellus	366				892	19	
Oligochaeta	473			860		1169	173
Hirudinea							
Helobdella stagnalis						19	
Gastropoda							
Campaloma	65						
Somatogyrus	65						
Pelecypoda							
Sphaerium	22						
Ephemeroptera							
Hexagenia	280						
Diptera							
Procladius	43				77	38	
Ablabesmyia	43						
Monodiamesa					19		
Clinotanypus	22						
Psectrocladius	22						
Rheocricotopus	22						
Chironomus					58	269	
Cryptochironomus	43			1290	38	19	
Endochironomus				860			
Glyptotendipes	43						
Paralauterborniella					19		
Polypedilum	86						
Stictochironomus					19		
Cladotanytarsus					19		
Tanytarsus	452			430	38	58	
pupae	108				77		
adults	65					33	
Mean total number/m^2	2580	287	0	3870	1380	1620	269
% Diptera	37.0	0	0	67	26	26	7.
% Oligochaeta	18.5	0	0	22	64	71.8	64.
% Isopoda	14.3	0	0	0	0	1.1	0
% Amphipoda	0	100	0	0	10	0	28.
% Ephemeroptera	16.0	0	0	0	0	0	0
% Others	14.2	0	0	11	0	1.1	0
Total Number of Taxa	18	1		5	11	8	3

FIGURE 4-2 MDNR SAMPLING LOCATIONS FOR WATER, SEDIMENT, FISH AND BENTHIC MACROINVERTEBRATES IN THE MANISTIQUE RIVER, 1976

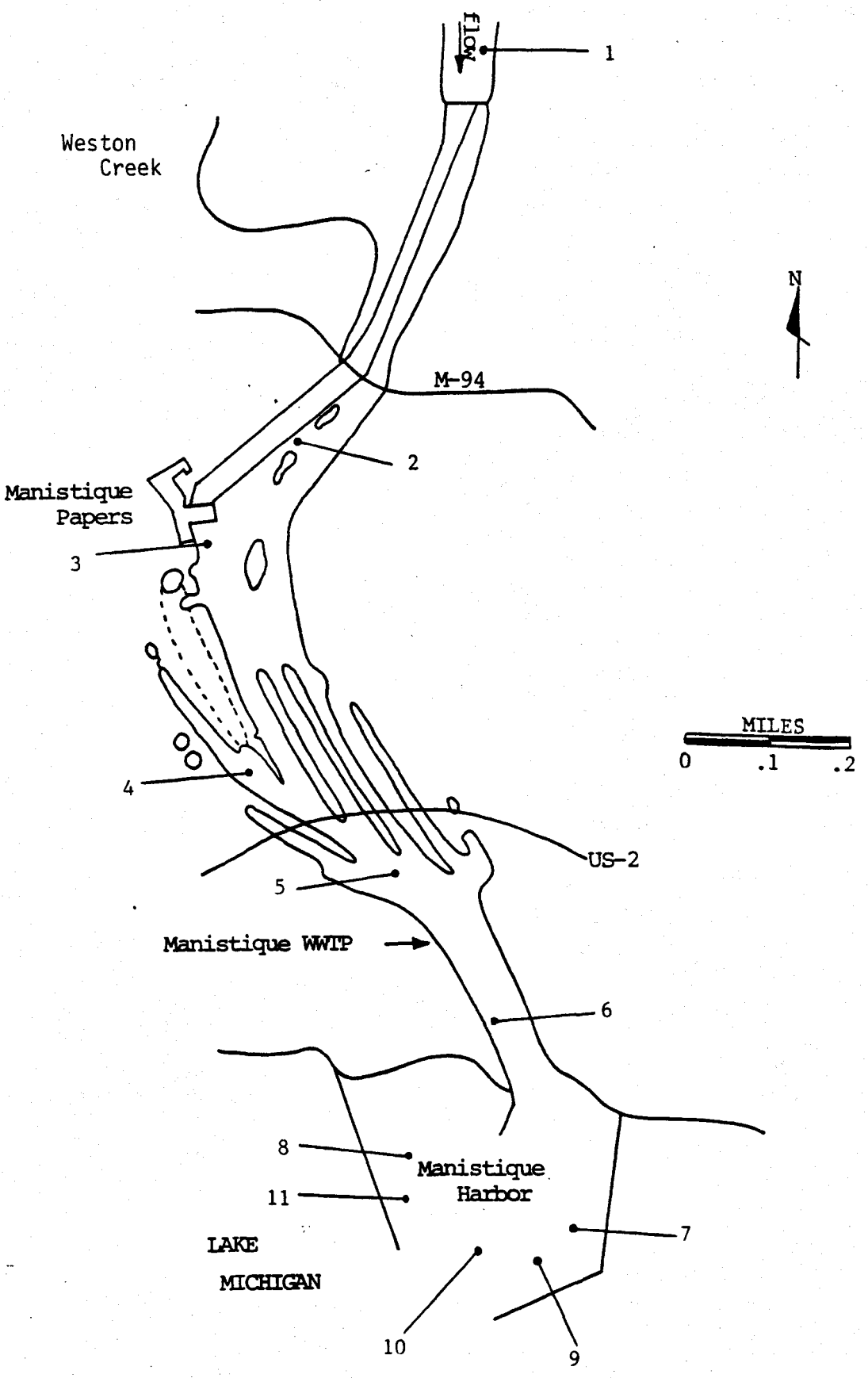


TABLE 4-2. HEAVY METAL CONCENTRATIONS IN THE MANISTIQUE RIVER AT THE MOUTH, SCHOOLCRAFT COUNTY.

DATE	CADMIUM UG/L	CHROMIUM UG/L	COPPER UG/L	LEAD UG/L	NICKEL UG/L
11/08/83	0.2	< 2	3	2	
12/06/83	0.3	< 4	3.2	6	
01/10/84	0.6	1	2.7	2.5	
02/14/84	0.2	< 5	2.1	2.8	< 4
03/20/84	< 0.2	1.4	2.6	< 2	< 4
04/17/84	0.3	< 1	3.1	2.5	< 4
05/08/84	< 0.2	< 2	5.2	< 2	< 4
06/19/84	< 0.2	< 5	< 2	< 2	< 4
07/17/84	< 0.2	2	< 2	2	< 4
08/21/84	< 0.2	< 1	< 1	1	< 4
09/25/84	< 0.2	2	1.5	< 2	< 4
10/16/84	< 0.2	< 1	1.3	< 2	< 4
11/06/84	< 0.2	< 1	2	2	< 4
12/18/84	< 0.2	< 2	1.5	< 2	< 4
01/15/85	0.2	< 2	1	< 2	< 4
02/13/85	0.6	< 1	2.8	< 2	< 4
03/12/85	< 0.2	< 4	2.1	2.8	< 4
04/16/85	2.7	< 2	4.3	< 2	< 4
05/21/85	< 0.2	< 3	< 1	1	2
06/25/85	< 0.2	< 3	2.1	1.4	< 4
07/30/85	< 0.2	< 3	2	< 1	8
08/20/85	< 0.2	< 3	1.9	2.1	< 4
09/24/85	< 0.2	< 3	2.8	3.3	< 4
10/15/85	0.2	< 3	2.7	1.3	< 4
11/05/85	< 0.2	< 3	2.9	4.1	< 4
12/10/85	0.3	< 3	2	1.3	< 4
01/13/86	< 0.2	< 3	1.8	1.6	< 4
02/18/86	0.2	< 3	< 1	< 1	< 4
03/18/86	< 0.2	< 3	2.1	1.2	< 4
04/29/86	0.2	< 3	4	2.8	< 4
05/20/86	< 0.2	< 3	3	2.2	< 4
06/24/86	0.5	< 3	1.6	< 1	< 4
07/29/86	0.2	0.2	< 3	3.1	1.6
08/19/86	< 0.2	< 3	< 1	< 1	< 4
09/28/86	< 0.2	< 3	< 1	2	< 4
10/21/86	0.2	< 3	4	2	< 4
11/17/86	0.3	< 3	4	2	< 4
12/16/86	0.2	< 3	1	2	< 4
01/20/87	0.8	< 3	2	3	< 4
02/18/87	< 0.2	< 3	2	4.5	< 4
03/24/87	0.35	< 3	2	2.5	< 4
04/28/87	< 0.2	< 3	2	1	< 4
05/19/87	< 0.2	< 3	2	2	< 4

TABLE 4-3 . CONCENTRATIONS OF PCB, COD, PHENOL, TOTAL SOLIDS AND VARIOUS HEAVY METALS IN MANISTIQUE RIVER SEDIMENTS AT MANISTIQUE, SCHOOLCRAFT COUNTY, MICHIGAN, 1976-1978 (20). Results in mg/kg dry weight.

STATION NUMBER	DATE SAMPLED	PCBs AROCLOR 1242	PCBs AROCLOR 1254	PCBs AROCLOR 1260	PCBs TOTAL PCB	TOTAL SOLIDS (%)
1	5/78	< 0.2	< 0.2	< 0.2	< 0.2	67.4
2		Not sampled due to rock bottom				
3	12/77	150	12	10	172	16
4	5/78	< 0.2	< 0.2	< 0.2	< 0.2	10.9
5	12/77	0.68	< 0.5	< 0.2	0.68	-
6	5/78	-	-	-	-	34.1
7	12/77	< 0.5	1.2	< 0.5	1.2	-
8	12/77	< 1	17	< 1	17	-
9	8/76	5.07	5.1	< 0.5	10.17	32
10	8/76	2.64	0.66	< 0.5	3.3	32
11	8/76	17.5	7.83	< 0.5	25.33	62

STATION NUMBER	DATE SAMPLED	TOTAL ZINC	TOTAL NICKEL	TOTAL LEAD	PHENOL	COD
1	5/78	4.5	1.5	< 0.8	0.7	-
2			Not sampled due to rock bottom			
3	12/77	75	5	43	3.4	-
4	5/78	280	11	190	3.7	-
5	12/77	-	-	-	-	-
6	5/78	47	3.5	31	1	-
7	12/77	-	-	-	-	-
8	12/77	-	-	-	-	-
9	8/76	52	11	14	-	53000
10	8/76	66	8.4	46	-	24000
11	8/76	28	3.2	5.7	-	25000

STATION NUMBER	DATE SAMPLED	TOTAL COPPER	TOTAL CHROMIUM	TOTAL CADMIUM	TOTAL IRON	TOTAL MANGANESE
1	5/78	0.6	10	0.2	2300	47
2				Not sampled due to rock bottom.		
3	12/77	30	36	0.6	5200	44
4	5/78	6.4	66	180	8100	31
5	12/77	-	-	-	-	-
6	5/78	13	24	0.3	3900	47
7	12/77	-	-	-	-	-
8	12/77	-	-	-	-	-
9	8/76	1.6	3.2	< 0.2	7000	72
10	8/76	1.8	4.6	< 0.2	5700	92
11	8/76	3.5	2.4	< 0.1	3600	53

Another sediment survey was conducted in 1981 by the Environmental Protection Agency (EPA) (46). Samples were collected from a total of ten stations within the Manistique River and harbor (Tables 4-4 and 4-5) (Figure 4-3). Relative to all stations, the highest concentrations of PCBs were found in the most westernly channel (stations 01, 02) and the main channel of the river at the mouth (station 14). The sample collected from the most easternly channel (station 12) contained the lowest concentration of PCBs. Heavy metals, particularly chromium, copper, lead, zinc, and aluminum, were found in elevated concentrations at stations 01, 03, 04 and 14 relative to all stations sampled.

In 1982, during construction of the U.S.-2 Highway, Michigan Department of Transportation (MDOT) collected sediment samples from the Manistique River in a transect at the bridge crossing site (Figure 4-4). Samples were analyzed by MDNR. PCBs were detected at 5 of the 30 locations sampled (Table 4-6). PCBs were detected at all 3 locations sampled in channel A at concentrations ranging from 1 to 4 mg/kg total PCBs. PCBs were detected at 0.6 and 120 mg/kg in channel C (67).

Sediments removed during bridge construction were stockpiled at 3 locations near the western bridge abutment. In response to concern over disposal of the sediments due to possible PCB contamination, 7 core samples were collected from each stockpile. The core samples from each stockpile were composited and analyzed for PCBs. Total PCB concentrations of 0.0005, <0.0001 and 0.0002 mg/kg were detected in stockpiles A, B and C, respectively (68). The soils were left on-site and incorporated into the bridge abutment.

The most recent sediment survey was conducted by MDNR in 1985. During this survey, MDNR sampled a total of 19 stations in the Manistique River, harbor, and tributaries (Figure 4-5). The highest concentrations of PCBs were found in the sediments along the northern portion of the old Manistique Papers deinking wastewater settling lagoon, ranging from 4.3 to 66 mg/kg total PCBs (Table 4-7)(42). The 1976 and 1978 study also documented elevated PCB concentrations in the sediments at this vicinity (20). PCBs were not detected above the dam in Manistique. PCBs were detected in the Manistique River harbor at stations 1 and 2 at concentrations of 28 and 8.4 mg/kg, respectively (Table 4-7)(42).

4.2.3 Biota Contamination

In a 1978 Manistique River study, fish were collected from above and below the dam in Manistique for PCB analysis (20). As shown in Table 4-8, PCBs were not detected in any fish species collected avove the dam, while all species collected below the dam had detectable concentrations of PCBs. In particular, the levels of PCBs in carp and white suckers exceeded the FDA and MDPH action level of 2 mg/kg.

In 1984, white suckers, walleye and a red sucker were collected from below the dam for PCB analysis. The concentration of PCBs was below the 2.0 mg/kg action level in all fish collected. Therefore, the consumption advisory for white suckers was dropped.

FIGURE 4-3 EPA SAMPLING LOCATIONS IN THE MANISTIQUE RIVER, 1981

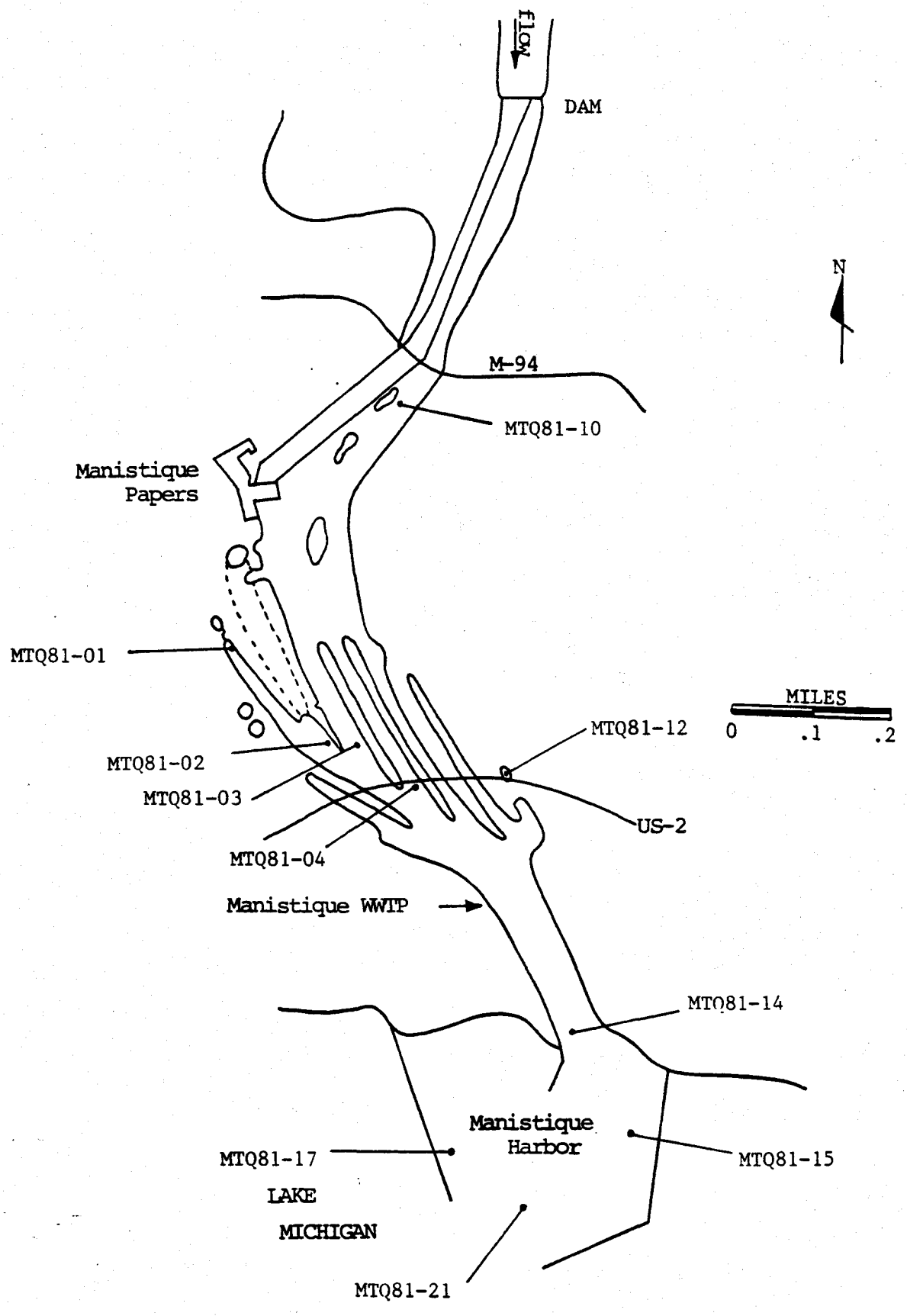


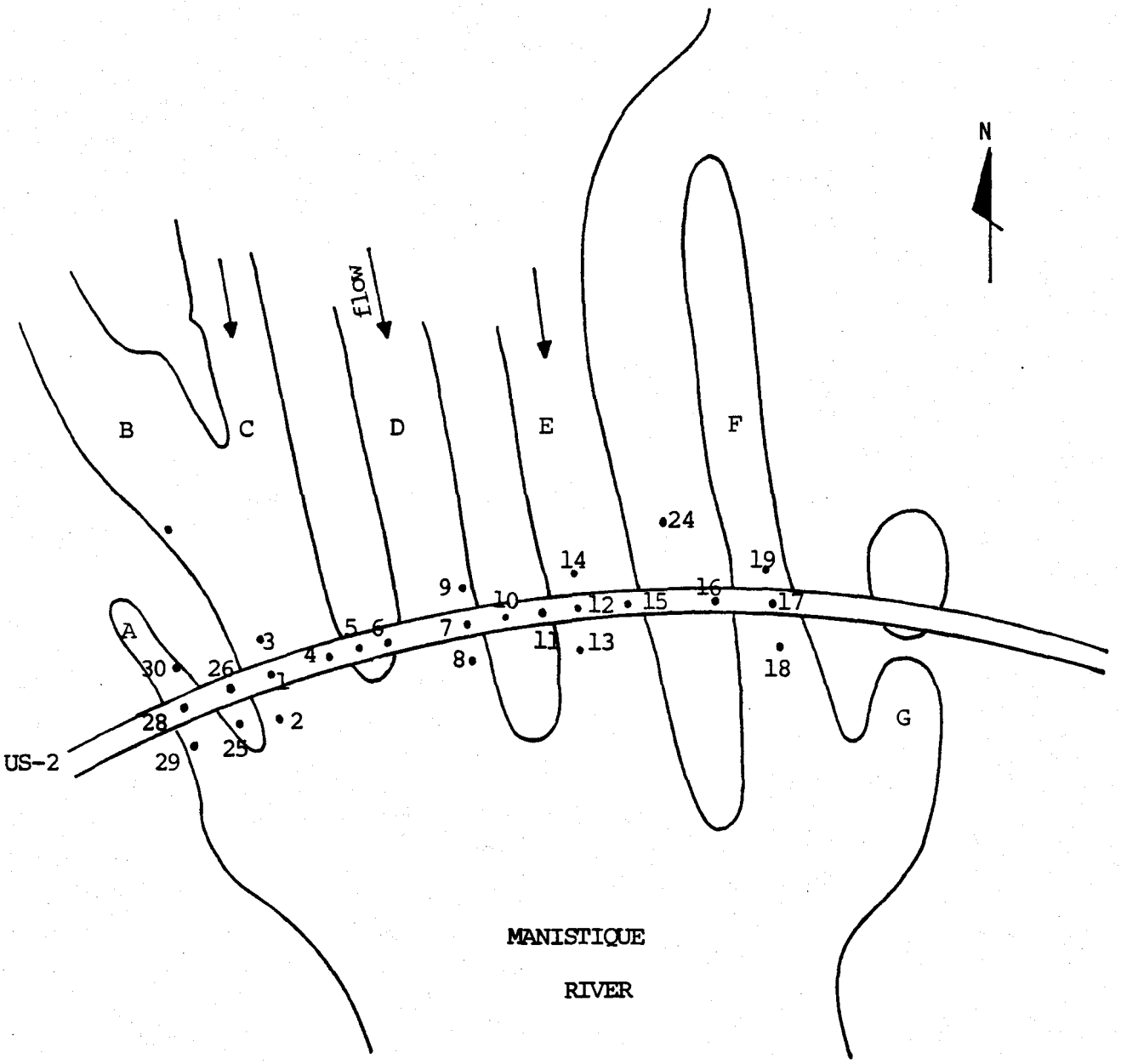
Table 4-4 Concentrations of PCBs in Manistique River and Manistique Harbor Sediment Samples Collected by the U.S. Environmental Protection Agency (May 27, 1981). All values are in mg/kg dry weight. (46)

	STATION									
	MTQ81-01	MTQ81-02	MTQ81-03	MTQ81-04	MTQ81-10	MTQ81-12	MTQ81-14	MTQ81-15	MTQ81-17	MTQ81-21
PCB 1248	2.239	2.280	0.675	0.751	0.122	0.055	2.130	0.088	0.144	1.255
PCB 1254	1.472	1.181	0.439	0.490	0.202	0.077	1.313	0.032	0.071	1.037
PCB 1260	0.579	0.293	0.208	0.191	0.138	0.032	2.264	0.012	0.021	0.371
TOTAL PCBS	4.290	3.754	1.322	1.432	0.462	0.164	5.707	0.132	0.236	2.663

TABLE 4-5 CONCENTRATIONS OF HEAVY METALS IN MANISTIQUE RIVER AND MANISTIQUE HARBOR SEDIMENTS SAMPLES COLLECTED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY (May 27, 1981)(46)

METAL (mg/kg dry wt)	STATION									
	MTQ81-01	MTQ81-02	MTQ82-03	MTQ81-04	MTQ81-10	MTQ81-12	MTQ81-14	MTQ81-15	MTQ81-17	MRQ81-21
Aluminum	13000.0	1000.0	24000.0	6600.0	1800.0	1100.0	2100.0	600.0	800.0	1100.0
Cadmium	1.0	0.0	1.0	43.0	0.2	0.2	0.2	0.2	19.0	0.2
Chromium	56.0	3.0	18.0	120.0	4.3	2.3	20.0	1.3	2.0	2.8
Copper	76.0	5.0	47.0	55.0	23.0	23.0	15.0	0.9	1.6	3.1
Lead	240.0	16.0	60.0	590.0	11.0	16.0	120.0	7.0	8.0	12.0
Nickel	9.8	2.6	6.8	3.0	2.2	5.0	29.0	3.0	1.0	10.0
Silver	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Zinc	440.0	32.0	340.0	240.0	17.0	31.0	89.0	9.0	9.2	19.0

FIGURE 4-4. MICHIGAN DEPARTMENT OF TRANSPORTATION SEDIMENT SAMPLING LOCATIONS IN THE MANISITIQUE RIVER IN THE VICINITY OF US-2, AUGUST 17-18, 1982.



Not to scale

TABLE 4-6 PCB CONCENTRATIONS IN MANISTIQUE RIVER SEDIMENTS IN THE VICINITY OF US-2, AUGUST 17-18, 1982. All values in mg/kg (67)

Station	PCB Aroclor 1242	1254	1260	Total PCBs
1	46.0	74.0	<1.0	120.0
2	0.6	<0.1	<0.1	0.6
3	<0.1	<0.1	<0.1	<0.1
4	<0.1	<0.1	<0.1	<0.1
5	<0.1	<0.1	<0.1	<0.1
6	<0.1	<0.1	<0.1	<0.1
7	<0.1	<0.1	<0.1	<0.1
8	<0.1	<0.1	<0.1	<0.1
9	<0.1	<0.1	<0.1	<0.1
10	<0.1	<0.1	<0.1	<0.1
11	<0.1	<0.1	<0.1	<0.1
12	<0.1	<0.1	<0.1	<0.1
13	<0.1	<0.1	<0.1	<0.1
14	<0.1	<0.1	<0.1	<0.1
15	<0.1	<0.1	<0.1	<0.1
16	<0.1	<0.1	<0.1	<0.1
17	<0.1	<0.1	<0.1	<0.1
18	<0.1	<0.1	<0.1	<0.1
19	<0.1	<0.1	<0.1	<0.1
24	<0.1	<0.1	<0.1	<0.1
25	<0.1	<0.1	<0.1	<0.1
26	<0.1	<0.1	<0.1	<0.1
27	<0.1	<0.1	<0.1	<0.1
28	3.2	<0.1	<0.1	3.2
29	4.0	<0.1	<0.1	4.0
30	1.0	<0.1	<0.1	1.0

FIGURE 4-5 PCB Sampling Locations - Sediment, Manistique River, 1985 (43)

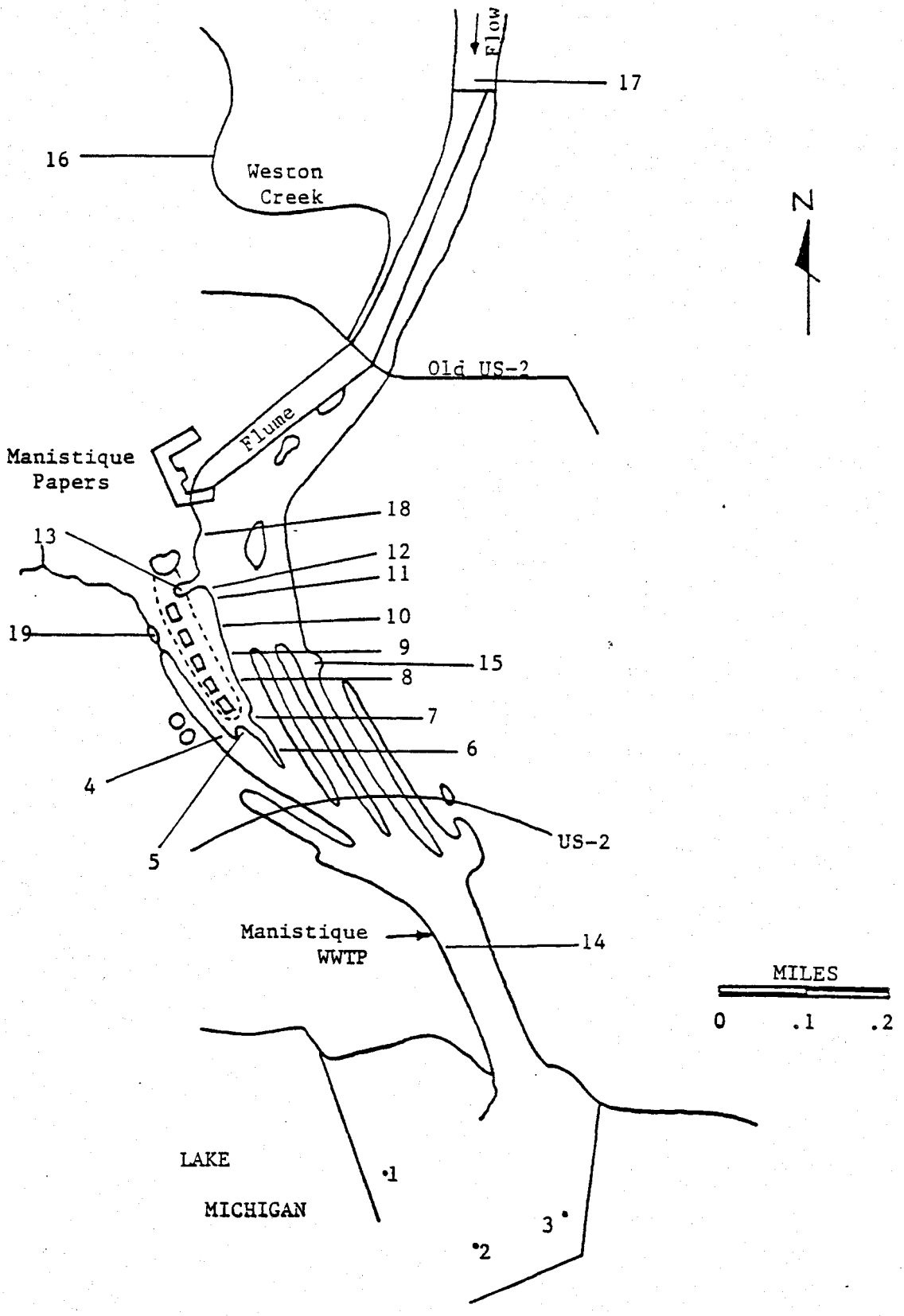


TABLE 4-7. SEDIMENT PCB CONCENTRATIONS, MANISTIQUE RIVER, 1985 (43)
All values in mg/kg dry weight

Station	Total PCBs
1	28.00
2	8.40
3	< 0.69
4	< 4.20
5	< 3.20
6	< 0.76
7	1.70
8	< 0.78
9	< 0.93
10	4.30
11	57.00
12	66.00
13	5.50
14	< 0.72
15	< 0.93
16	< 0.76
17	< 1.50
18	< 0.72
19	< 1.30

TABLE 4-8 PCB LEVELS IN EDIBLE PORTIONS OF FISH COLLECTED FROM THE MANISTIQUE RIVER (mg/kg)

Location	Date	Species	MDNR Sample ID	PCB Isomer 1242	1248	1254	1260	Total PCBs	Ref.
Above dam	8/78	White Sucker	-		<0.1	<0.1	<0.1	<0.1	(20)
		Walleye	-		<0.1	<0.1	<0.1	<0.1	
		Nothern Pike	-		<0.1	<0.1	<0.1	<0.1	
		Rock Bass	-		<0.1	<0.1	<0.1	<0.1	
		Smallmouth Bass	-		<0.1	<0.1	<0.1	<0.1	
			-						
Below dam	8/78	White Sucker	-		1.6	1.0	<0.5	2.6*	
		Walleye	-		<0.1	0.34	<0.1	0.34	
		Nothern Pike	-		<0.1	0.62	<0.1	0.62	
		Rock Bass	-		<0.1	0.55	<0.1	0.55	
		Smallmouth Bass	-		0.2	0.78	0.15	1.1	
		Carp	-		2.9	3.4	0.5	6.8*	
Below dam	10/84	White Sucker	MR-1			1.56			(70)
			MR-2			0.47			
			MR-3			1.40			
			MR-4			1.11			
			MR-6			1.57			
			MR-25			0.82			
			MR-28			0.88			
		Red Sucker	MR-27			0.80			
		Walleye	MR-29			0.82			
			MR-30			1.15			
			MR-8			0.71			
			MR-9			0.25			
			MR-11			0.48			
			MR-15			0.16			
			MR-16			0.11			
			MR-17			0.17			
			MR-18			0.20			
Below dam	6/85	Carp	1A			8.98*			(69)
			2A		7.66*				
			3A			1.34			
			4A			0.95			
			5A			3.24*			
			6A			2.68*			
			7A			8.00*			
			8A			2.46*			
			9A			1.83			
			10A			2.84*			
		Largemouth Bass	11A		0.46	0.26		0.72	
		Walleye	12A			0.115			
			13A			0.062			
			14A			0.198			
			15A			0.323			
			16A			0.238			

TABLE 4-8 (continued) PCB LEVELS IN EDIBLE PORTIONS OF FISH COLLECTED FROM THE MANISTIQUE RIVER (mg/kg)

Location	Date	Species	MDNR Sample ID	PCB Isomer 1242	1248	1254	1260	Total PCBs	Ref.
			17A			0.183			
			18A			0.068			
			19A			0.178			
Below dam	7/86	Walleye	86035-3	0.051		0.28	0.066	0.397	(71)
			86035-4	0.17		1.1	0.14	1.41	
			86035-5	0.045		0.35	0.1	0.495	
			86035-6	0.047		0.38	0.086	0.513	
			86035-7	0.042		0.36	0.078	0.48	
		Carp	86035-8	0.093		4.9	0.88	5.873*	
			86035-9	0.53		7.3	1.55	9.38 *	
			86035-10	0.075		2.5	0.73	3.305*	
			86035-11	0.15		0.88	0.3	1.33	
			86035-12	0.047		0.78	0.31	1.137	

* exceeds the Michigan Department of Public Health and the Federal Food and Drug Administration 2.0 ppm action level

** carp have not been found above the dam in Manistique

In 1985, carp, largemouth bass and walleye were collected and analyzed for PCBs. Tissue PCB concentrations in largemouth bass and walleye were less than the 2.0 mg/kg action level. PCB concentrations in 7 of 10 carp, however, exceeded 2.0 mg/kg. Therefore, the consumption advisory for carp remains in effect.

In 1986, walleye and carp were collected and analyzed for PCBs and heavy metals. The levels of PCBs in walleye were below the 2.0 mg/kg action level. However, 3 of the 5 carp collected had levels of PCB exceeding the action level. Therefore, the public health advisory will continue to remain in effect for carp. The only heavy metal for which a MDPH or FDA action level has been developed is mercury. The MDPH and FDA mercury action levels are 0.5 mg/kg and 1.0 mg/kg, respectively, which were not exceeded in any fish collected (Table 4-9)

In 1982, flow-through and caged fish studies with fathead minnows and a 48-hour static test with Daphnia magna were conducted in treated paper process wastewater from Manistique Papers, Inc (17). The effluent was not acutely toxic to any of the test organisms and no obvious stress was apparent at any time during the test.

To date, there have been no studies conducted to measure the uptake of contaminants from the AOC by fish or other aquatic life.

4.3 Summary

The designated use(s) that are impaired within the Manistique AOC are the fishery, due to accumulation of PCBs at levels that exceed the FDA and MDPH 2.0 mg/kg action level, and possibly other aquatic life due to habitat degradation. The problem contributing to the fishery use impairment is sediments contaminated with PCBs. Problems potentially contributing to use impairment of other aquatic life are sediments contaminated with PCBs and heavy metals, and substrate alteration from deposition of wood fibers.

Table 4-9 Heavy Metal Levels in Edible Portions of Fish Collected from the Manistique River below the Dam in Manistique, July, 1986. All values in mg/kg (71).

Species	MDNR Sample ID	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Walleye	86035-3	< 0.010	< 0.10	< 0.4	< 0.10	0.149	9.1	0.35
	86035-4	< 0.010	< 0.10	0.5	< 0.10	0.115	11.4	0.30
	86035-5	< 0.010	< 0.10	< 0.4	< 0.10	< 0.100	8.3	0.33
	86035-6	< 0.010	< 0.10	< 0.4	< 0.10	< 0.100	8.0	0.30
	86035-7	< 0.010	< 0.10	< 0.4	< 0.10	< 0.100	8.3	0.31
Carp	86035-8	< 0.018	< 0.10	0.5	< 0.10	< 0.100	6.0	0.14
	86035-9	0.011	< 0.10	< 0.4	< 0.10	< 0.100	16.2	0.15
	86035-10	< 0.010	-	0.7	< 0.10	< 0.100	8.3	0.29
	86035-11	< 0.010	< 0.10	< 0.4	< 0.10	< 0.100	14.9	0.15
	86035-12	< 0.010	< 0.10	0.9	< 0.10	< 0.100	9.2	0.16

5. POLLUTANT SOURCES AND LOADINGS

5.1 Point Sources

There are only two continuous point source discharges within the AOC: The Manistique WWTP and Manistique Papers, Inc. Three combined sewers are associated with the Manistique WWTP, two that discharge to the AOC. There are no NPDES permitted point source dischargers within the Manistique River watershed outside of the AOC.

5.1.1 Domestic Sources

The Manistique WWTP is the only municipal treatment plant in the AOC or within the Manistique River watershed. The plant discharges an average of 1.5 MGD to the Manistique River via Outfall 001 (Figure 5-1). The Manistique WWTP was built in 1959 to provide primary treatment of wastewater from combined sanitary and storm sewers and was upgraded in 1979 to secondary treatment. Sludge is disposed of in the Manistique City landfill, or used as a soil conditioner at the Wyman State Nursery near Manistique.

Since the Manistique WWTP does not receive the discharge of any type or quantity of substance which may cause interference with the operations of the treatment works, it is not required to immediately develop an Industrial Pretreatment Program (IPP)(35). The IPP was a 1977 amendment to the federal Clean Water Act in an effort to control industrial discharges to municipal waste treatment plants (59).

Manistique WWTP wastewater and sludge monitoring data, including pollutant loadings, are summarized in Appendix B. PCBs were not detected in either the effluent or sludge from the Manistique WWTP during 1980 and 1985 MDNR compliance inspections (7, 16). Of the heavy metals analyzed in the wastewater during MDNR compliance inspections in 1980 and 1985, and in 1981 and 1986 sampling programs by the Manistique WWTP, mercury and silver have been detected at concentrations exceeding allowable levels under Rules 57(2) and 82 of the Michigan Water Quality Standards. Zinc, nickel, chromium, copper, cadmium, and lead have also been detected in the WWTP effluent, but at concentrations below allowable levels under Rules 57(2) and 82 of the Michigan Water Quality Standards. Discharge of these metals accounts for, in part, the elevated heavy metal concentrations detected in the river and harbor sediments within the AOC compared to sediments above the dam.

The Manistique WWTP current NPDES permit conditions are shown in Table 5-1. A review of two compliance inspections conducted at the Manistique WWTP by the MDNR in August 1980 and August 1985 indicated some instances of noncompliance with permit limits, including inadequate removal of phosphorus in 1980 and 1985, and elevated BOD5, suspended solids, and fecal coliforms in 1985 (7, 16).

5.1.2 Industrial Sources

Manistique Papers, Inc., is the only industrial discharger within the AOC or the entire Manistique River watershed. It produces specialty paper

FIGURE 5-1 MANISTIQUE AREA OF CONCERN POINT SOURCE DISCHARGE LOCATIONS

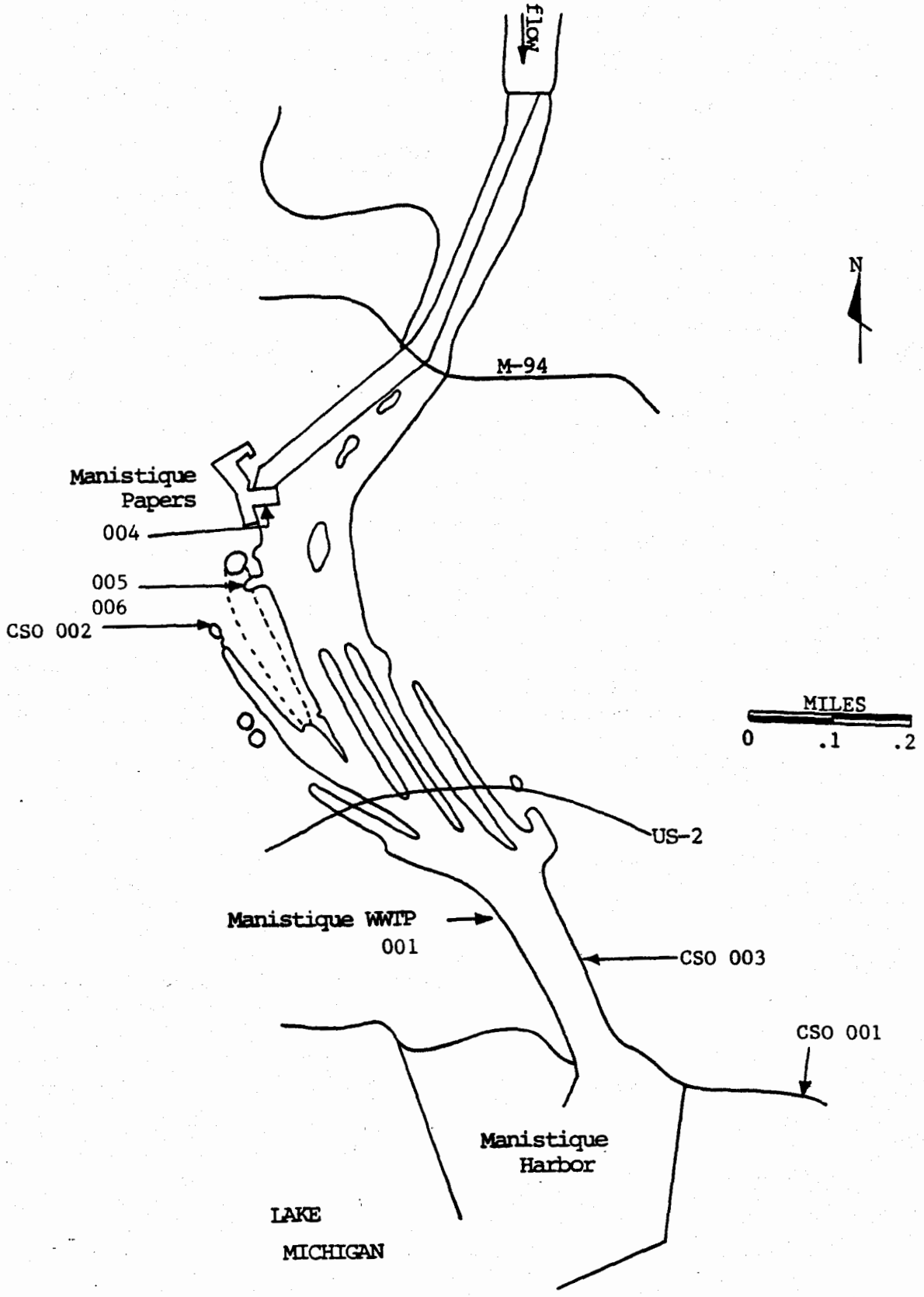


TABLE 5-1 NPDES EFFLUENT LIMITATIONS FOR THE MANISTIQUE WWTP (OUTFALL 001)

Effluent Characteristic		NPDES Permit Limitations Effective 8/25/86 - 7/31/91	
Parameter		30-DAY AVERAGE	7-DAY AVERAGE
5-Day Carbonacious BOD	(kg/day)	142	226
	(lb/day)	313	500
Suspended Solids	(kg/day)	170	255
	(lb/day)	375	563
Total Phosphorus	(mg/l)	1	-
Fecal Coliform	(cts/ml)	200/100	400/100
Mercury	(ug/l)	0.05	-
		Daily Minimum	Daily Maximum
pH	(S.U.)	6	9
Total Residual Chlorine	(mg/l)	-	0.036
Dissolved Oxygen	(mg/l)	4	-

for use as newsprint, novel newsprint, computer printout paper, magazine inserts, colored papers, and other similar types of papers. Recycled paper accounts for 100% of the raw materials.

Process wastewaters are treated by the company owned treatment system which consists of primary and secondary clarification and aeration. Treated process waste is discharged to the Manistique River via Outfall 006 (Figure 5-1) (6). Noncontact cooling water and vacuum pump seal water are discharged to the Manistique River via Outfall 004. Manistique Papers is also authorized to discharge primary treated paper mill waste from an emergency bypass lagoon via Outfall 005 when the secondary clarifier or activated sludge system are out of service (33). The lagoon is a remnant of the old deinking wastewater settling lagoon. Sludge removed from the clarifiers is disposed of at the company owned landfill.

The Manistique Papers current NPDES permit conditions are shown in Table 5-2. The facility has been in noncompliance with its NPDES permit limitations and requirements for oil and grease, BOD and pH (4,6,17,39).

Manistique Papers wastewater monitoring data is summarized in Appendix C. Lead, copper and zinc were discharged from Manistique Papers during the mid seventies at levels exceeding allowable levels under rule 57(2) of the current Michigan Water Quality Standards. Chromium and cadmium have also been detected in the wastewater from Manistique Papers, but at levels not exceeding standards. The discharge of these metals account for, in part, the elevated heavy metal concentrations detected in the river and harbor sediments within the AOC as compared to sediments above the dam.

PCBs have not been detected in either the wastewater or sludge from Manistique Papers since 1973, when MDNR first began analyzing for PCBs at Manistique Papers. In 1985 and 1986, Manistique Papers analyzed both the effluent from Outfalls 004 and 006, and waste activated sludge for PCBs as required by their NPDES permit. PCBs were not detected in any samples (Table 5-3).

5.2 Intermittent Point Sources

Two combined sewers discharge to the AOC, known as Outfalls 002 and 003 (Figure 5-1). A third CSO discharges to Lake Michigan east of the Manistique Harbor east breakwall. As an interim measure, the City of Manistique is required by their current NPDES permit to utilize, to the maximum extent practicable, available receiving sewage system transportation capabilities for the delivery of combined sewage to treatment facilities. The City will ultimately be required to attain control of combined sewer overflows.

There have been no studies done to determine what pollutants have been or may be present in the combined sewage during periods of discharge. However, in 1985, PCBs were detected in a ponded area below CSO 002 at a concentration of 0.024 ug/l.

TABLE 5.2 - NPDES EFFLUENT LIMITATIONS FOR MANISTIQUE PAPERS, INC.

Effluent Characteristic		NPDES Permit Limitations Effective 8/22/86 - 7/31/90	
Parameter		Monthly Average	Daily Maximum
Outfalls 004, 005, 006			
5-Day BOD	(kg/day) (lbs/day)	2110 (4644)	4064 (8941)
Total Suspended Solids	(kg/day) (lbs/day)	2908 (6397)	5400 11881
		Daily Minimum	
pH	(S.U.)	5.0	9.0
Outfalls 005, 006			
Total Phosphorus	(mg/l)	1.0	-
Ammonia	(mg/l)	18.0	-

TABLE 5-3 - MANISTIQUE PAPERS INC. ANALYSIS OF OUTFALLS 004, 006, AND WASTE ACTIVATED SLUDGE FOR PCB'S, 1985-1986. ALL MEASUREMENTS IN UG/L.(72)

OCTOBER 22, 1985

PARAMETER	OUTFALL 004	OUTFALL 006	WASTE ACTIVATED SLUDGE
PCB'S TOTAL	K 0.5	K 0.5	K 1
AROCHLOR 1016	K 0.5	K 0.5	K 1
AROCHLOR 1221	K 0.5	K 0.5	K 1
AROCHLOR 1232	K 0.5	K 0.5	K 1
AROCHLOR 1242	K 0.5	K 0.5	K 1
AROCHLOR 1248	K 0.5	K 0.5	K 1
AROCHLOR 1254	K 0.5	K 0.5	K 1
AROCHLOR 1260	K 0.5	K 0.5	K 1

JANUARY 9, 1986

PARAMETER	OUTFALL 004	OUTFALL 006	WASTE ACTIVATED SLUDGE
PCB'S TOTAL	K 1	K 1	K 1
AROCHLOR 1016	K 1	K 1	K 1
AROCHLOR 1221	K 1	K 1	K 1
AROCHLOR 1232	K 1	K 1	K 1
AROCHLOR 1242	K 1	K 1	K 1
AROCHLOR 1248	K 1	K 1	K 1
AROCHLOR 1254	K 1	K 1	K 1
AROCHLOR 1260	K 1	K 11	K 1

APRIL 15, 1986

PARAMETER	OUTFALL 004	OUTFALL 006	WASTE ACTIVATED SLUDGE
PCB'S TOTAL	K 1	K 1	K 1
AROCHLOR 1016	K 1	K 1	K 1
AROCHLOR 1221	K 1	K 1	K 1
AROCHLOR 1232	K 1	K .	K 1
AROCHLOR 1242	K 1	K 1	K 1
AROCHLOR 1248	K 1	K 1	K 1
AROCHLOR 1254	K 1	K 1	K 1
AROCHLOR 1260	K 1	K 1	K 1

TABLE 5-3 CONT.

JULY 14, 1986

PARAMETER	OUTFALL 004		OUTFALL 006		WASTE ACTIVATED SLUDGE	
PCB'S TOTAL	K	1	K	1	K	1
AROCHLOR 1016	K	1	K	1	K	1
AROCHLOR 1221	K	1	K	1	K	1
AROCHLOR 1232	K	1	K	1	K	1
AROCHLOR 1242	K	1	K	1	K	1
AROCHLOR 1248	K	1	K	1	K	1
AROCHLOR 1254	K	1	K	1	K	1
AROCHLOR 1260	K	1	K	1	K	1

K = LESS THAN

5.3 Nonpoint Sources

A nonpoint source assessment has not been conducted for the Manistique River watershed.

5.4 Atmospheric Deposition

There is no data available to indicate to what extent the atmosphere is a source of pollutants to the AOC.

5.5 Landfills and Dumpsites

As discussed in Section 3.3.5, there are two active landfills within the Manistique River watershed: Manistique Papers, Inc. and the City of Manistique landfills. The City of Manistique landfill receives only domestic waste. The Manistique Papers landfill receives sludge and paper waste from Manistique Papers,Inc. Both are located north of the AOC. These landfills, plus the Schoolcraft County dump and Manistique Papers old deinking wastewater settling lagoon have been listed as sites of environmental contamination under Michigan's Public Act 307 (25).

A leachate analyses of soil samples from the Manistique Papers, Inc. landfill was conducted in March, 1987 at the request of MDNR. Such a study is necessary in order for a landfill to be licensed (73). PCBs were not detected in the leachate from any samples (Table 5-4). Zinc was detected in the leachate at concentrations ranging from 41 to 17,000 ug/1, lead from < 5 to 19 ug/1, and copper from <20 to 29 ug/1. Additional studies, including groundwater analyses for heavy metals and PCBs is forthcoming.

Areas upstream of the AOC are not considered sources of PCBs and heavy metals to the AOC since these constitutents have not been detected or detected at very low concentrations, in the river sediments above the AOC.

The old lagoon on the property of Manistique Papers was originally a river slip that was blocked off in 1967 to use for settling wastewater created during the deinking process (26). This lagoon was dredged and filled in 1977. The dredged material was disposed of at the Manistique Papers landfill. The presence of elevated levels of PCBs in the river sediments in the vicinity of the old lagoon prompted a 1985 study by the MDNR to determine if the lagoon and possibly other areas were sources of PCBs to the river (42).

As part of this study, a total of 15 soil samples were collected at 6 to 12 inch depths from the banks along the perimeter of the old lagoon site. (Figure 5-2). PCBs were detected along the northeastern bank at concentrations ranging from 5.6 to approximately 400 mg/kg (Table 5-5). The bank in this vicinity appeared to contain paper sludge and was eroding into the river.

TABLE 5-4. PCBS AND HEAVY METALS IN THE LEACHATE FROM SOIL SAMPLES COLLECTED FROM THE MANISTIQUE PAPERS, INC. LANDFILL, MARCH 1987. All values in mg/l unless otherwise noted.

Sample ID	Diss. Aluminum	Diss. Cadmium	Diss. Chromium	Diss. Copper	Diss. Lead	Diss. Zinc	PCBs (ug/l)
G	<0.25	<0.01	<0.005	<0.02	<0.005	0.041	<0.5
J	<0.25	<0.01	<0.005	0.029	0.019	0.055	<0.5
K	<0.25	<0.01	<0.005	0.029	0.008	17	<0.5
L	<0.25	<0.01	<0.005	<0.02	<0.005	0.14	<0.5
M	<0.25	<0.01	<0.005	0.029	<0.005	0.27	<0.5

FIGURE 5-2 PCB SOIL SAMPLING LOCATIONS IN THE VICINITY OF THE MANISTIQUE PAPERS OLD DEINKING-WASTE SETTLING LAGOON, 1985

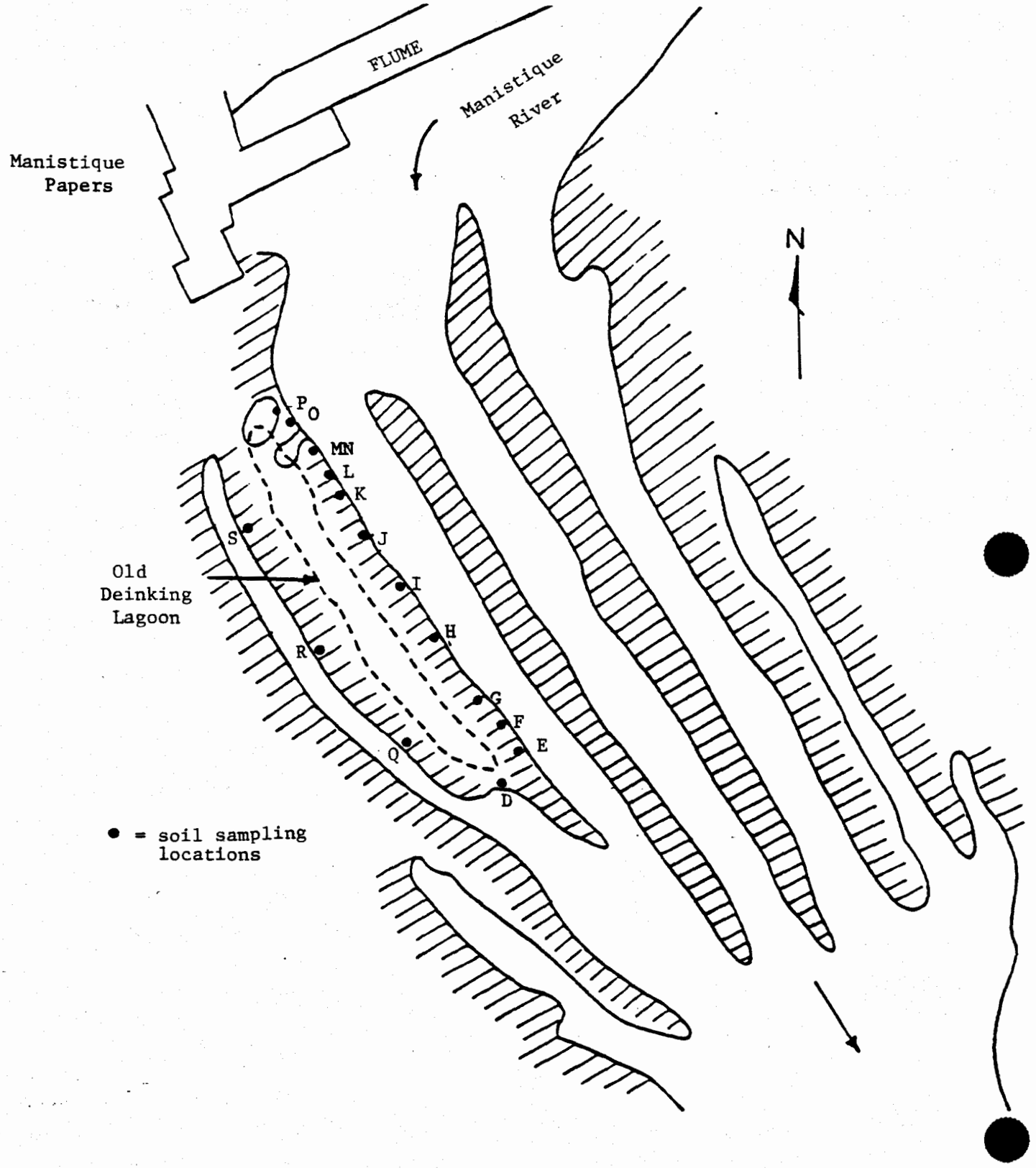


TABLE 5-5. PCB CONCENTRATIONS IN THE SOILS AROUND THE OLD DEINKING LAGOON SITE, MANISTIQUE PAPERS, INC., OCTOBER 1985 AND MAY 1986. All values in mg/kg total PCBs.

Sample Date:	October 15-16, 1985		May 12, 1986		
Laboratory:	Canton Analytical	Cory	Canton Analytical	Cory	MDNR
Station					
D	0.06				
E	< 0.04				
F	< 0.04				
G	0.55				
H	1.2				
I	0.47				
J	5.6				
K	18				
L	11				
M	33	71	19	2.6	19
N	440	350	230	410	260
O	1800, 13, 20	14	200,16	7.8, 3.1	110, 54, 47
P	0.08		31	< 0.1	< 1.9
Q	0.1				
R	0.43				
S	0.56				

In 1986, a more extensive study of PCBs in the soils at the old lagoon site was conducted by a consultant for Manistique Papers at the request of MDNR (58). Split samples were provided to MDNR for PCB analysis. A total of 48 borings from 18 sites were analyzed for PCBs. PCBs were found in the vicinity of the lagoon site at concentrations ranging from less than detection (<0.20 mg/kg) to 73 mg/kg (Figure 5-3, Table 5-6).

PCBs were found in the top 1.5 feet of soil at stations B-6 and B-7 at concentrations of 14.1 and 73 mg/kg total PCBs, respectively. Soil PCB concentrations declined with increasing depth at these locations. PCBs were detected at stations B-10 through B-13 at concentrations ranging from 44.2 to 6.7 mg/kg, generally with gradually higher concentrations found with increasing sample depth. Soils located along the periphery of the lagoon site (Stations B-14 to B-18) contained PCBs at concentrations ranging from less than detectable to 3.3 mg/kg. Locations remote from the lagoon area (B-lawn, B-2 through B-4) and station B-9 contained no detectable concentrations of PCBs.

MDNR analyzed the soil samples from 7 of the 18 boring locations for heavy metals (Table 5-7). There were good correlations between PCB concentrations in the soil and concentrations of zinc (R^2 = 0.7), lead (R^2=0.8) and chromium (R^3=0.8) suggesting a common source for the PCB and heavy metal contaminants.

It is not known at this time to what extent the old lagoon area contributes to PCB loadings in the Manistique River.

5.6 Other Sources

In the past, several establishments such as saw mills, paper companies, chemical companies, and coal companies, were located on the Manistique River banks or near the mouth of the river. A complete list of these establishments appears in Appendix E. Past dischargers may have had an impact on sediment quality in the AOC.

Contaminated sediments in the Manistique River and harbor may also be a continuing source of PCBs and heavy metals Lake Michigan.

5.7 Summary

The sources of PCBs and heavy metals within the AOC appear to have originated within the AOC rather than from upstream sources. This is concluded from the relatively low levels or absence of contaminants in the sediments above the dam as compared to below the dam, and also the lack of any industry, past or present, above the dam.

The old deinking wastewater settling lagoon on the property of Manistique Papers has been a continuing source of PCBs to the Manistique River due to erosion of bank soils. In June, 1986, the river bank was stabilized with crushed stone, which is expected to reduce erosion of contaminated soil to the Manistique River. Rainwater percolation through the contaminated soils may also be a source of PCBs to the Manistique River. The origin of the PCBs to the lagoon area is not known. However, PCBs

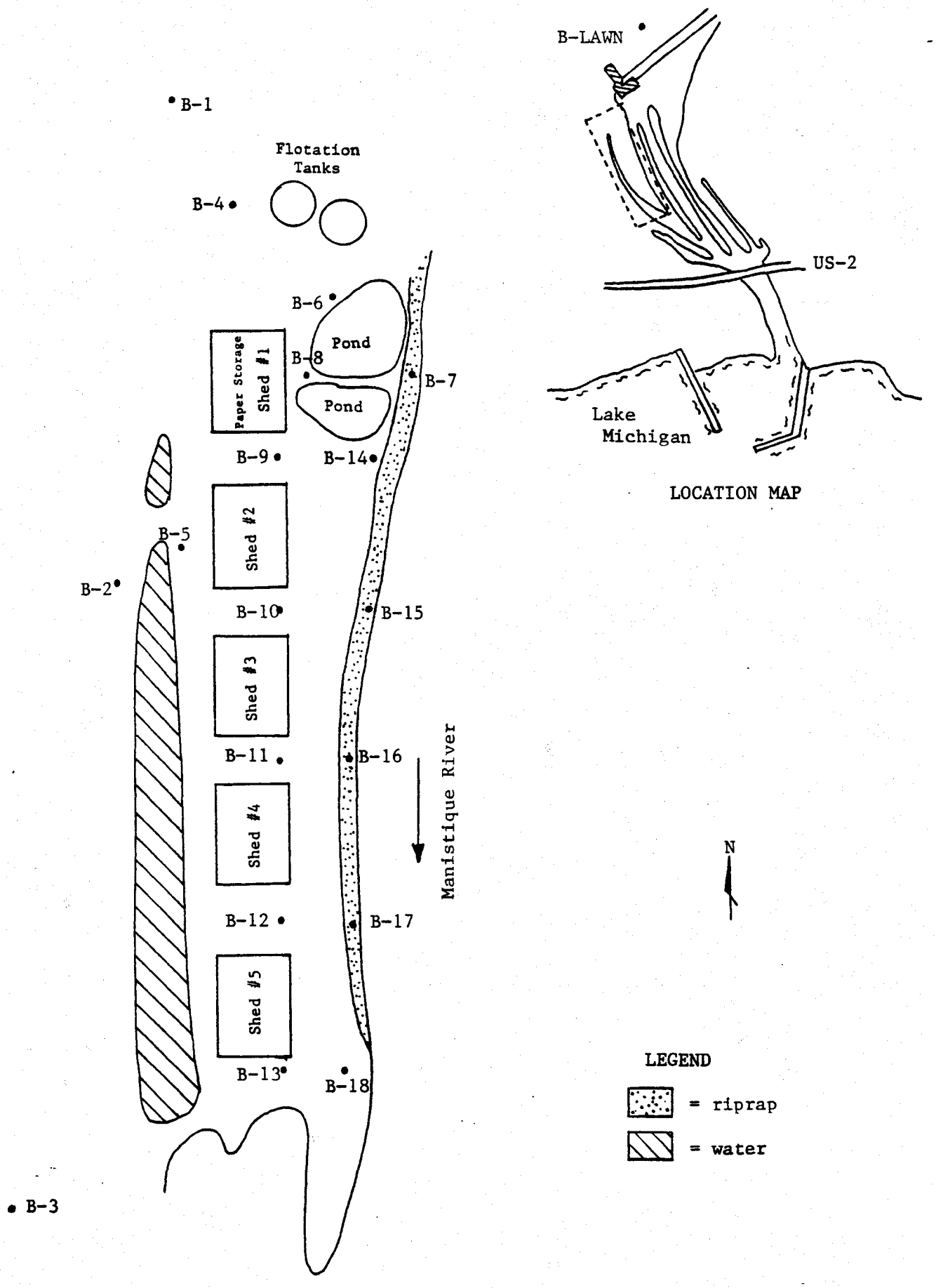


FIGURE 5-3 MANISTIQUE PAPERS SOIL SAMPLING LOCATIONS, 1986

Table 5- 6 Soil Boring Analysis for PCBs at the Site of the Old Deinking Wastewater Settling Lagoon, Manistique Papers, December 1986. Split samples were analyzed by Michigan Department of Natural Resources and Bittner Engineering. All value in mg/kg dry weight.

		Michigan Dept of Natural Resources					Bittner Engineering				
		PCB Isomers					PCB Isomers				
Sample ID	Depth from Surface (ft)	1242	1248	1254	1260	Total PCBs	1242	1248	1254	1260	Total PCBs
B-1	0-1						0.36			0.09	0.45
	4-5.2										< 0.20
	7.5										< 0.20
B-2	0.5-1.5	ND	ND	ND	ND	<0.53(L)					< 0.20
	4.5-5.5										< 0.20
B-3	0.5-1.7										< 0.20
	8-9										< 0.20
B-4	0-1										< 0.20
	3-3.7										< 0.20
	6										< 0.20
B-5	0.5-1.0						0.30			0.11	0.41
	2.9-3.9										< 0.20
B-6	0-1.5						12.20		1.90		14.10
	4-4.5						1.20		0.20		1.40
	7.5						1.50				1.50
	10	ND	ND	ND	ND	<0.83(L)					
B-7	1-1.5	ND	ND	59.00	ND	59.00(D)	20.10		52.00		73.00
	R 1-1.5	ND	ND	31.00	ND	31.00					
	4.5	ND	ND	2.70	ND	2.70	1.20				1.20
	7-8						0.45				0.45
	11	ND	ND	ND	ND	<3.3(L)					
B-8	0-1										< 0.20
	5-5.5	ND	ND	ND	ND	<0.58					< 0.20
	8						0.42				0.42
	10.5-11	ND	ND	ND	ND	<0.55					
B-9	3.5-4										< 0.20
	11										< 0.20
B-10	0-0.5	ND	ND	ND	ND	<0.58					
	3.5-4	ND	ND	ND	ND	<0.91(L)	3.40			0.60	4.00
	7-7.3	ND	ND	ND	ND	<1.40(L)	0.20		0.33		0.53
	10	ND	ND	4.00	ND	4.00					
	12-13	ND	ND	5.00	ND	5.00					
	16-17	ND	34.00	ND	ND	34.00	39.30		4.90		44.20

Table 5-6 Soil Boring Analysis for PCBs at the Site of the Old Deinking Wastewater Settling Lagoon, Manistique Papers, December 1986. Split samples were analyzed by Michigan Department of Natural Resources and Bittner Engineering. All value in mg/kg dry weight.

		Michigan Dept of Natural Resources					Bittner Engineering				
			PCB Isomers					PCB Isomers			
Sample ID	Dept. from Surface (ft)	1242	1248	1254	1260	Total PCBs	1242	1248	1254	1260	Total PCBs
B-11	4-4.5						0.27				0.27
	7	ND	2.30	ND	ND	2.30	1.30				1.30
	10-11	ND	3.20	1.70	ND	4.90					
	14-15	2.50	ND	4.10	2.50	9.10					
	18-18.5	ND	87.00	ND	ND	87.00(D)	17.20		4.40		21.60
	R 18-18.5	ND	17.00	ND	ND	17.00					
B-12	4-5						0.29			0.13	0.42
	11.5-12	ND	3.20	ND	ND	3.20(L)					
	15-16	ND	ND	ND	ND	<1.40	1.10			0.10	1.20
	19-20	4.40	2.90	ND	ND	7.30(L)	4.60			0.10	4.70
B-13	7						0.31				0.31
	13	ND	ND	ND	ND	<0.64					
	15-16	ND	3.70	3.80	ND	7.50	4.80		1.90		6.70
B-14	0-1						0.40			0.04	0.44
	3-4	ND	ND	ND	ND	<0.81	1.30			0.10	1.40
	6.3-6.5									0.10	0.10
B-15	0.4-1.0						0.86		0.05		0.91
	2.5-3.5						0.50		0.08		0.58
	5-6	ND	ND	ND	ND	<0.70					
B-16	2.5-3	ND	1.20	1.00	1.10	3.30	1.40			0.03	1.43
	R 2.5-3	ND	1.00	ND	ND	1.00					
	5.5-6						0.51			0.25	0.76
B-17	0-1						0.21				0.21
	3	ND	ND	ND	ND	<0.66	0.50			0.10	0.60
B-18	0-1						0.60			0.40	1.00
	3.5-4										< 0.20
	7	ND	ND	ND	ND	<0.75					< 0.20
B-LAWN	0-1										< 0.20
	4-5										< 0.20

R = Replicate sample
L = Quality control indicated possible low recovery. The actual level may have been higher than the reported value
D = Sample was not analyzed using optimum dilution

Table 5-7 Soil Boring Analysis for Heavy Metals at the Site of the Old Deinking Lagoon, Manistique Papers, December 1986. Samples Analyzed by MDNR. All values in mg/kg dry weight.

Sample ID	Depth from Surface (ft)	Cd	Cr	Cu	Hg	Ni	Pb	Zn
B-7	1-1.5	< 2.0	390.0	97.5		6.5	2080.0	310.0
	R 1-1.5	< 2.0	450.0	108.0		5.0	2350.0	330.0
B-8	5-5.5	< 2.0	13.0	4.0		5.0	11.0	13.0
	R 5-5.5	< 2.0	9.5	3.5		< 5.0	11.0	9.0
B-10	16-17	< 2.0	195.0	191.0		7.0	935.0	370.0
B-11	18-18.5	< 2.0	192.0	84.9		7.3	990.0	370.0
	R 18-18.5	< 2.0	189.0	254.0		5.0	990.0	360.0
B-15	5-6	< 2.0	7.0	< 2.0	< 0.1	< 5.0	< 5.0	5.5
	R 5-6	< 2.0	7.5	< 2.0		< 5.0	< 5.0	6.5
B-16	2.5-3	< 2.0	25.0	8.0	0.2	5.0	89.5	39.0
	R 2.5-3	< 2.0	28.0	11.0		< 5.0	79.5	37.0
B-17	3	< 2.0	17.0	4.0		< 5.0	48.0	22.0

R = Replicate sample

have been associated with paper recycling operations due to the presence of PCBs in some types of paper inks. Other possible sources of PCBs are the materials used to block off the river slip in creating the lagoon in 1967, or a PCB spill. It is not known at this time to what extent the soils from the old lagoon area have contributed to PCB loadings to Lake Michigan. However, PCB loadings at the mouth of the Manistique river have been estimated to be between 16.5 and 64.7 kg/yr (60).

Heavy metals in the AOC sediments have originated, in part, from the Manistique WWTP and Manistique Papers. Past industry may also have contributed to the heavy metal contamination.

The combined sewers are another possible source of heavy metal and PCB contamination to the Manistique River.

6. HISTORICAL RECORD OF REMEDIAL ACTIONS

6.1 Completed Actions

Completed remedial actions in the Manistique River AOC consist of upgrading the wastewater treatment systems at both the Manistique WWTP and Manistique Papers, Inc., permitting point source dischargers via the NPDES permit program and stabilizing the river banks near the old deinking wastewater settling lagoon.

6.1.1 Manistique Wastewater Treatment Plant

Prior to 1959, storm water and sanitary wastes from the City of Manistique were discharged directly into the Manistique River via combined sewers. In 1959, the WWTP went into operation providing primary treatment. A facilities plan was completed in 1975 and a grant was received from EPA to construct a secondary wastewater treatment plant. The upgraded plant was completed in 1979. The plant is designed to handle 1.5 MGD with a hydraulic capacity of approximately 4.5 MGD.

6.1.2 Manistique Papers, Inc.

Prior to 1960, Manistique Papers did not have a wastewater treatment system and discharged industrial wastes directly into the Manistique River. In 1967, the National Guard blocked off one of the old boat slips in the river creating a lagoon for settling deinking wastewater. In 1973, primary clarifier and air floatation units were installed eliminating necessity for the lagoon by 1975. In 1977, secondary wastewater treatment was added. The unused lagoon was dredged and filled in 1977 to create an area for paper storage sheds. The dredged material was disposed of at the Manistique Papers Inc. landfill. In June, 1986, Manistique Papers, at the request of MDNR, stabilized the east bank of the old lagoon area with crushed stone to reduce erosion of the contaminated bank soils.

In January, 1987, Manistique Paper completed a soil sampling study in the vicinity of the old deinking wastewater settling lagoon to better identify areas of PCB contamination (58). The results of this study are discussed in Section 5.5.

6.1.3 NPDES Permits

The Manistique WWTP and Manistique Papers are the only two point source dischargers within the AOC or within the Manistique River watershed. Both facilities discharge pollutants according to the limits specified in their NPDES permits. Tables 5-1 and 5-2, respectively, display the WWTP's and Manistique Papers current NPDES permit limits.

6.1.4 Sediment Removal

In 1977, Manistique Papers company dredged and filled the deinking wastewater settling lagoon. The sediments were disposed of in the facility-owned landfill.

6.2 Remedial Actions Currently in Progress

There are no remedial actions currently in progress. However, investigations in progress include a hydrogeological study of the Manistique Papers, Inc. landfill and collection of fish above the dam in Manistique for contaminant analysis to compare with contaminant levels in fish below the dam.

6.3 Summary

Historical remedial actions within the AOC include upgrading of treatment systems at both the Manistique WWTP and the Manistique Paper Company. These actions have reduced pollutant loadings to the AOC. In 1986, the eroding banks of the old deinking wastewater settling lagoon were stabilized to reduce erosion of PCB contaminated soils into the Manistique River.

7. DEFINITION OF SPECIFIC GOALS TO RESTORE IMPAIRED USES

7.1 Uses to be Restored and Maintained

The Manistique River has been designated and protected for warm water and cold water fish, industrial water supply, agricultural and navigational uses, total body contact recreation, indigenous aquatic life and wildlife, and public water supply at the point of intake. The impaired designated use within the AOC is the fishery, due to concentrations of PCBs in carp tissue that exceed the FDA and MDPH action level of 2.0 mg/kg. Other aquatic life may also be an impaired use due to sediment contaminants and habitat alteration.

The major goal of improved water quality is to restore and maintain the designated uses. This Remedial Action Plan is aimed at maintaining or enhancing all current uses of water in the AOC that may be limited by low water quality or deteriorated habitat. In order to restore and maintain the uses, pollutant sources will need to be identified and controlled.

8. PROGRAMS AND PARTICIPANTS

This chapter discusses State of Michigan and Federal pollution control and environmental management programs affecting the Manistique River Area of Concern. It also outlines public participation in these programs and governmental efforts to enhance public understanding of pollution problems and the programs designed to solve them.

8.1 Regulatory and Administrative Categories

Regulatory and administrative categories run by either the State of Michigan or the Federal government that could potentially affect remedial actions planned for the Manistique River AOC are:

1. Water quality management and standards 2. Point source control 3. Hazardous waste control 4. Hazardous waste site cleanup 5. Urban stormwater pollution control 6. Nonpoint source control 7. Spill control measures

Each category is described briefly below.

8.1.1 Water Quality Management and Standards

The protection and conservation of State water resources in Michigan falls under the purview of the Water Resources Commission, created under Michigan Act 245 of 1929. The Commission was brought into compliance with the Federal Water Pollution Control Act in 1972 by expanding its powers and responsibilities (based on Michigan Acts 3, 129, and 293). The Commission's responsibilities are to protect and conserve water resources of the State of Michigan, control pollution of any waters of the State and Great Lakes, and control alteration of water courses and flood plains of all rivers and streams in the State. It was also given the power to make rules, require registration of manufacturing products, materials, and waste products where certain wastes are discharged to State waters, and cover investigations, monitoring, and surveillance necessary to prevent and abate water pollution. The administrative functions of the Commission are carried out through the Michigan Department of Natural Resources.

Water quality standards for all surface waters of the State of Michigan have been adopted pursuant to a mandate from the Michigan Water Resources Commission and the Federal Clean Water Act. Michigan's water quality standard is "...to protect the public health and welfare, enhance and maintain the quality of water, protect the State's natural resources, and serve the purposes of P.L. 92-500 (the Federal Water Pollution Control and Clean Water Acts) as amended, Act No. 245 of the Public Acts of 1929 (the Michigan Water Resources Commission Act) as amended, being 27 K323.2 et seq of the Michigan Compiled Laws" (31).

In 1968, under the provisions of Act No. 281 of the Public Acts of 1945, the Central Upper Peninsula Planning and Development Regional Commission (CUPPAD) was organized. CUPPAD serves local units of government in six Upper Peninsula counties: Alger, Delta, Dickinson, Marquette, Menominee, and Schoolcraft, where the Manistique River AOC is located.

In 1978, CUPPAD developed a Water Quality Management Plan, and in 1980, updated it in accordance with Section 208 of the 1972 Federal Water Pollution Control Act. The plan's objective is to define the program and management agencies necessary to achieve established State water quality standards and to achieve the 1983 national water quality goal expressed in the 1972 Act (P.L. 92-500): ...wherever attainable water quality protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983. The plan was subject to comments and review by citizens, local governments, management agencies, MDNR, and final approval by the Governor before it was submitted to EPA.

Under Section 208, the plan identifies Michigan's Upper Peninsula's water quality problems, recommends control measures, and designates State and local agencies responsible for funding and carrying out the programs. The designated agencies must have adequate authority, resources, and capabilities to carry out the program. Once the plan has been approved, EPA cannot award construction grants except to the agency designated in the plan as a management agency. Also, no Federal discharge permits will be issued for any municipal or industrial wastewater discharge which is in conflict with the plan.

The recommendations given in the CUPPAD water quality plan for the Manistique AOC are:

- The City of Manistique should proceed with proposed construction and improvements which include upgrading wastewater treatment, alleviating excessive infiltration/inflow, eliminating combined sewer overflows, and sanitary sewer extension to problem areas within the city. - The City of Manistique should review wastewater rates annually to ensure that an adequate wastewater reserve fund is maintained for the city.

Available information reviewed for this RAP indicates that the only objective completed is improvement of wastewater treatment. Lack of funding has been the limitation in undertaking the other recommendations.

Each county has five representatives on CUPPAD who are also officers of each county's Overall Economic Development Planning Committee (OEDP). The OEDP members include local government officials as well as representatives from the private sector (8).

CUPPAD has performed other activities relevant to the Manistique River AOC:

- Water Quality Monitoring Recommendations: CUPPAD produced water quality monitoring recommendations in order to better assess present and future water quality conditions and to determine where intensive management efforts should be targeted (8). Fifty-three monitoring sites were identified and submitted to the designated agencies which will use the recommendations for future water quality monitoring.

- Inland Lake Studies: In 1978, CUPPAD drafted an inland lake study. The study was conducted as an extension of the Regional Water Quality Management Plan (208) and as a result of a supplemental grant to expand the inland lake studies. Eleven lakes were assessed in the study which provided background information, watershed characteristics, descriptions of shore land areas, land use, soils and topography, zoning, shore line surveys, and local objectives.

- Lake Management Manual: CUPPAD created the Lake Management Manual in 1978. The manual acts as a reference and guide for those concerned with the preservation of the water quality of the Region's inland lakes.

In 1979, the Michigan Department of Natural Resources produced a five-year strategy plan. This strategy outlines the regional priorities, activities, and objectives related to pollutant sources. The two pollutant sources which received high Regional priority and medium Statewide priority are discharges to surface waters from combined sewer overflows and septic systems.

8.1.2 Point Source Control

Section 402 of the Clean Water Act requires all point sources -- such as municipal treatment plants, industries, animal feedlots, aquatic animal production facilities, and mining operations -- to obtain NPDES permits before discharging into waters of the United States. The Act also provides that States with adequate regulations and capabilities will be approved by EPA to administer the NPDES program. Michigan's Water Resources Commission obtained Federal approval to administer the NPDES program for Michigan dischargers in October, 1973. The permit program for municipal and industrial dischargers is operated by the Michigan Department of Natural Resources' Surface Water Quality Division. The Department of Natural Resources organizational structure is shown in Figure 8-1.

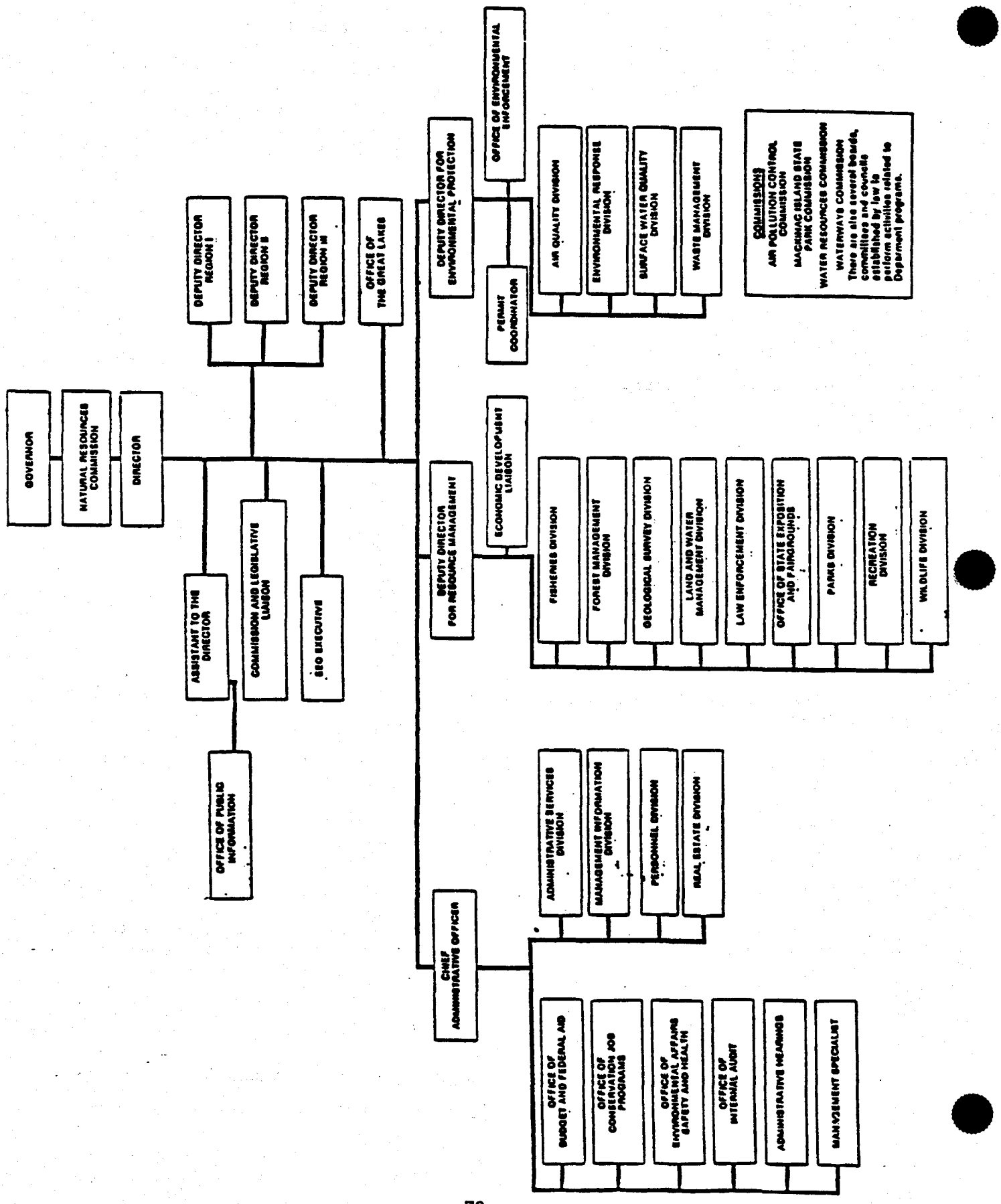
Because NPDES permits in Michigan are issued under the authority of the Water Resources Commission Act in addition to the Federal Clean Water Act, permit violations are considered violations of the State Act and may be subject to civil or criminal penalties. Dischargers are notified of alleged violations by written notices of determination setting forth specific permit provisions that the Commission, through MDNR, asserts have been violated.

NPDES permits must be issued to all point source discharges of wastewater to State waters. Permits are issued for fixed terms not to exceed five years and they:

- Contain and ensure compliance with discharge limitations based on effluent guidelines or water quality standards

- Provide for permit termination or modification for cause

FIGURE 8-1 MICHIGAN DEPARTMENT OF NATURAL RESOURCES ORGANIZATIONAL STRUCTURE



- Require discharger monitoring and reporting to assess compliance with permit conditions or to assist in the development of effluent limitations

- Require other reports as necessary in order for the approved State to ensure compliance with objectives of the Federal Clean Water Act.

Within the AOC, as was previously mentioned, only the Manistique Paper Company and the Manistique WWTP have NPDES permits. Both facilities have compliance schedules in their current NPDES permits. The scheduled items and compliance dates are listed below:

Manistique Papers

Activity	Due Date
Submittal of sludge analysis results	November 20, 1985
Submittal of analytical results of the short term waste characterization study to the Chief of the Surface Water Quality Division	November 20, 1985
Achieve compliance with the elimination of unnatural turbidity	August 22, 1986
Achieve compliance with the Pollution Incident Prevention Plan updating requirements	July of every year
Achieve compliance with the Program for Effective Residuals Management (PERM)	July of every year

Manistique Papers is in compliance with all scheduled activities.

Manistique WWTP

Activity	Due Date
Attain control of combined sewer overflows	November 1, 1983
Submittal of a long-term compliance plan to comply with mercury limit	July 1, 1988
Achieve compliance with the program for effective residuals management (PERM)	December 31, 1988

The Manistique WWTP is currently in noncompliance with the requirement to attain control of combined sewer overflows due to lack of funding.

8.1.3 Hazardous Waste Control Regulations

Hazardous waste control regulations in Michigan are designed to protect surface waters, ground water, and soils from toxic contamination. Hazardous waste control programs are administered by Michigan's Department of Natural Resources, based on State mandates from the Water

Resources Commission Act and the Solid Waste Management Act (Michigan Public Act 641 of 1978) as well as the Federal Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments of 1984.

8.1.4 Hazardous Waste Site Clean-up

Michigan's Environmental Response Act (MERA) Public Act 307) provides a method for identification, risk assessment, and priority evaluation of contaminated sites within Michigan. MERA prioritizes sites by use of a numerical risk assessment model and provides the State with the ability to take action at sites not eligible for remedies under Superfund or at sites which do not rank high enough in the Federal system to receive funding (25). The Michigan Site Assessment system ranks sites according to their present conditions, while the Federal Hazardous Ranking System evaluates the sites at the time when the sites were at their worst. Within the AOC, the Manistique Papers old deinking lagoon area is included on the 307 list as a site needing studies and/or interim pollution control actions.

8.1.5 Urban Storm Water Pollution Control Efforts

In 1978, a facility plan and two addenda were developed to improve the City of Manistique's existing sewer system. The second addendum confirmed that the sewer system was in very poor condition with broken connections, misaligned joints, and many sections close to collapse (22). The system has three combined sewer overflows, two of which discharge to the AOC. At high rates of flow, the combined sewage discharges directly to the Manistique River. The plan also documented that flooding problems existed along new US-2 on the east side of the City where the pumping station is inundated with flow for several days following a rain storm (22). It was recommended that CSOs and infiltration/inflow receive high priority.

Infiltration/inflow, combined sewers, and failing sewer lines were and continue to be problems for the City of Manistique. The City currently does not have a construction grant to help defray the costs to correct these problems. Even with a grant, the City would have a difficult time raising its share of contruction costs.

8.1.6 Nonpoint Source Control Efforts

The Manistique watershed has not been surveyed for nonpoint source problems.

8.1.7 Spill Control Measures

Michigan's Water Resources Commission is authorized to take action in order to reduce damage to water quality resulting from spilled materials. Michigan's regulations on spillage of oil and polluting materials (Part 5 of Water Resources Commission Rules) include regulations on loading, storage, surveillance, and emergency containment structures for oil and salt and other liquid and solid polluting materials. Oil storage facility owners must submit to the Water Resources Commission a spill

prevention plan that outlines emergency cleanup procedures. Provisions of Michigan's spill control rules are enforced by the Commission.

The State of Michigan also has a Pollution Emergency Alert System (PEAS), a State-wide spill response program. It is a 24-hour "hot line" system for pollution emergencies related to liquid and solid waste and air pollution. The response crew is made up of approximately 12 volunteers from MDNR staff. The PEAS program is coordinated with the Army Corps of Engineers and the U.S. Coast Guard. On an international level, the Canadian Department of the Environment and the Ontario government would be notified if the emergency created problems across the border (14).

Manistique Papers, Inc. has an MDNR approved Pollution Incident Prevention Plan, which is part of a State-run spill prevention program for facilities which store or use materials listed on the Critical Materials Register. The plan lists types and quantities of materials stored and existing containment structures, identifies procedures for loading and unloading of chemicals, lists available spill control equipment and organization, and describes possible occurrences resulting in spill or discharge of materials. The plan also summarizes surveillance and security, inventory control procedures, staff training, and maintenance procedures, and analyzes spill occurrences. The Manistique WWTP, however, is not required to develop such a plan.

8.2 Public Involvement

8.2.1 Remedial Action Plan Involvement

Public meetings are conducted by MDNR as part of the public involvement phase of the remedial action planning process. On September 2, 1986 and July 30, 1987, meetings were held in Manistique to inform the public of the status of the pollution problem in the AOC, describe the remedial action planning process, and serve as a question and answer session. In addition, attendees of the meeting were asked to voice their concerns regarding the AOC. MDNR released a notice in the DNR News to notify the public of the date, time and content of the meeting. A summary of the public meetings, including questions asked during the meeting and answers given during the meetings or those requiring further investigation, are included in Appendix D.

8.2.2 Water Quality Program

The Overall Economic Development Planning Committee (OEDP) is the core of the CUPPAD Regional Commission's public participation program (8). The OEDP includes elected local government officials as well as representatives from the private sector as members. The Commission has also used other public participation techniques, such as a monthly newsletter, information depositions, and public meetings with groups, including local planning commissions, lake associations, soil conservations districts, and local governing boards (8).

8.3 Interagency Agreements

8.3.1 Great Lakes Water Quality Agreement of 1978

This agreement establishes water quality planning and regulatory standards for the Great Lakes to be followed by the United States and Canada, the two signatories of the agreement. The International Joint Commission (IJC) and its Water Quality Board are the principal organizations charged with carrying out the provisions of the Agreement through Federal agencies in the U.S. and Canada, and the authority of State and Provincial regulations. Designation of Areas of Concern and drafting of Remedial Action Plans are results of this international treaty.

9. REMEDIAL ACTION PLANNING

The use impairment in the Manistique AOC is the fishery. A fish consumption advisory is currently in effect for carp caught below the dam in Manistique due to elevated levels of PCBs in carp tissue. The advisory recommends that carp caught in the AOC not be eaten. The presence of elevated levels of PCBs in edible fish tissue constitute a threat to public health and therefore an impairment of the Manistique River fishery.

Another possible use impairment is protection of other aquatic life. Impacts to benthic aquatic life were noted during a 1978 study of the Manistique River (20). Impacts may be due to contaminated sediments and/or habitat degradation.

9.1 Specific Remedial Actions

Proposed remedial actions are as follows:

-- Collect additional sediment samples for PCB and heavy metal analysis to better define areas of contamination.

Additional sediment sampling of the Manistique River and Harbor is needed to better define areas of PCB and metal contamination. Some areas have not previously been sampled, sampled only once, or the sampling location is not well documented. A better data base is needed in order to make decisions regarding remedial actions.

It is estimated that the project effort would include collection of 40 sediment samples for PCB and heavy metal analysis. Fifteen of these would be surficial sediment composites from the Manistique River (above and below the AOC), including at least one from the Indian River. Twenty-five samples would be 10-cm sections from 50-cm cores (5 sections/core). All samples would be analyzed for PCBs and heavy metals.

This project is expected to take approximately 8 months to complete with 2 full time aquatic biologists and one student assistant. The time frame for completion of this action follows:

Work Plan	1 month
Collection of sediment samples	4 days
Acquisition of data	4 months
Write report (rough)	2 months
Write report (final)	1 month

An estimated $13,000 will be needed to complete this action. This cost includes personnel, analytical costs, equipment and travel.

Possible funding sources include 106, 307 and 205J.

-- Resample a suspected source of PCBs to the Manistique River

During a 1985 survey of the Manistique River by MDNR staff (42), water samples were collected from all point source discharges

between the harbor and Manistique dam to identify possible inputs of PCBs. PCBs were detected at one location, in a pool-like area immediately below a combined sewer overflow (CSO), at a concentration of 0.024 ug/l. When PCBs are or have been present in the water column, they are usually also found in the sediments due to the affinity of PCBs for organic material. PCBs however, were not detected in the sediments at this location.

Since the concentration of PCBs detected in the water was very close to the level of analytical detection of 0.020 ug/l, and since PCBs were not detected in the sediments, there is some question as to whether PCBs were actually present in the water below the CSO.

To address the possibility of the CSO contributing PCBs to the Manistique River, the water and sediments below the CSO should be resampled. Three sediment samples and one water sample should be collected from different locations within the ponded area below the CSO.

This effort can be combined with the previously described sediments survey of the Manistique River and harbor. The cost of three additional sediment analyses and one water analysis for PCBs is approximately $700.

-- Analyze fish collected from above the dam in Manistique for PCBs

The only background data on fish tissue PCB levels in fish collected from above the Manistique dam is from a 1978 study (20). Analysis was limited to one fish of each species collected.

Current data is needed to aid in determining if PCB sources exist above the dam and to compare with PCB levels in fish previously collected from below the dam. Fish are scheduled to be collected from the Manistique River above the dam during October, 1987. Ideally, a total of 20 fish will be collected, 10 redhorse suckers and 10 predators. Although carp or channel catfish have not previously been found above the dam, either will also be analyzed if collected.

This project is expected to take approximately 14 months to complete with 1 full time aquatic biologist and one student assistant. The time frame for completion of this action follows:

Collection of fish samples	2 days
Acquistion of data	12 months

An estimated $6700 will be needed to complete this action. This cost includes personnel, analytical costs, equipment and travel. The funding source is the Fish Contaminant Monitoring Program.

-- Conduct a benthological survey of the Manistique River and Harbor.

Impacts to benthic aquatic life were noted during a 1978 study of the Manistique River (20). These impacts were attributed to a combination of water quality and habitat degradation, due in part to discharges from the Manistique WWTP and Manistique Papers, Inc.

A benthological study is recommended in order to assess current conditions of the benthic community.

It is estimated that this project would include analyses of the benthic community at 12 locations; 2 above the dam in Manistique, 3 in the Manistique Harbor and 7 in the Manistique River between the dam and the harbor.

This project is estimated to take approximately 8 months to complete with 2 full time aquatic biologist and one student intern. The field work and report can be combined with the harbor and river sediment survey remedial action proposal. The additional cost of laboratory benthological identification is estimated at $200.

-- Determine the bioavailability of PCBs in Manistique River and harbor sediments.

PCBs accumulate in fish tissue through ingestion of contaminated sediments and/or food (ie., fish, invertebrates) and by absorption through the gills. The Manistique River and Harbor sediments are contaminated with PCBs at concentrations ranging from less than detection ($<$0.5 mg/kg) to 28 mg/kg. When approved methods become available, a study to evaluate to what extent PCBs are available to fish in the Manistique River and harbor is recommended.

-- Determine if PCB and heavy metal contaminated sediments are impairing benthic macroinvertebrates

The sediments in portions of the Manistique River and harbor, in addition to being contaminated with PCBs, are also contaminated to varying extents with heavy metals. The sources of these contaminants include Manistique Papers, the Manistique WWTP, and most likely, businesses and industry that discharged to the river in the past. When approved methods become available, a study designed to evaluate the toxicity of these sediments to aquatic life is recommended.

-- Eliminate the old deinking wastewater settling lagoon as a source of PCBs to the Manistique River.

The soils in the vicinity of the old deinking wastewater settling lagoon on the property of Manistique Papers has been a continuing source of PCBs to the Manistique River. A consultant hired by Manistique Papers at the request of MDNR has conducted soil studies of the lagoon area to determine the extent of PCB contamination (results discussed in Chapter 5.5). Additional information to be submitted by the consultant to MDNR includes the extent to which the lagoon area contributes PCBs to the Manistique River, and possible remedial measures to eliminate this source of contamination.

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APPENDIX A

1976 MDNR LIMNOLOGICAL DATA

Sediment Concentrations of Metals, PCBs and General Chemical Parameters in Lake Michigan Near the Mouth of the Manistique River, 1976 (2). Concentrations are expressed as mg/kg dry weight unless otherwise noted.

Station Number	Depth (m)	Total Copper	Total Mercury	Total Cadmium	Total Chromium	Total Zinc	Total Nickel
1	6	4.2	0.01	1.0	7.5	11.0	18.0
2	15	0.1	< 0.01	0.7	0.6	2.0	< 1.0
3	15	0.3	0.01	< 0.1	0.6	2.8	2.0
4	15	0.3	0.01	< 0.1	0.4	2.4	< 1.0
5	30	0.7	0.02	< 0.1	0.7	8.0	3.1
6	30	0.9	< 0.01	< 0.1	1.0	7.8	3.9
7	30	0.6	0.01	< 0.1	1.3	10.0	3.0
8	6	1.6	0.04	< 0.2	3.2	52.0	11.0
9	7	1.8	0.06	< 0.2	4.6	66.0	8.4
10	6	3.5	0.04	< 0.1	2.4	28.0	3.2

Station Number	Total Lead	Total Iron	Total Manganese	Total Solids (%)	Total Volatile Solids (%T.S.)	T.K.N.	T.P.
1	15.0	10000	34.0	86	0.1	85	97
2	< 0.2	870	7.7	88	0.2	43	28
3	< 0.2	880	8.0	86	0.1	49	24
4	0.7	810	7.3	87	0.1	43	21
5	3.8	2400	150.0	82	0.4	80	61
6	2.9	2000	79.0	80	0.5	88	79
7	4.1	2300	91.0	84	0.2	79	66
8	14.0	7000	72.0	32	40.0	1770	240
9	46.0	5700	92.0	32	12.0	2400	320
10	5.7	3600	53.0	62	11.0	670	167

Station Number	C.O.D.	T.O.C. (g/kg)	PCBs: Aroclor 1242	PCBs: Aroclor 1254	PCBs: Aroclor 1260	PCBs: Total PCBs	Oil-Hexane Extrac.
1	17000	2.20	< 0.5	< 0.5	< 0.5	< 0.5	300
2	1200	0.31	< 0.5	< 0.5	< 0.5	< 0.5	200
3	1700	0.38	< 0.5	< 0.5	< 0.5	< 0.5	300
4	1000	0.33	< 0.5	< 0.5	< 0.5	< 0.5	200
5	2100	0.54	< 0.5	< 0.5	< 0.5	< 0.5	300
6	1800	0.41	< 0.5	< 0.5	< 0.5	< 0.5	200
7	1700	0.43	< 0.5	< 0.5	< 0.5	< 0.5	100
8	530000	28.00	5.1	5.1	< 0.5	10.2	2600
9	240000	22.00	2.6	0.7	< 0.5	3.3	1800
10	250000	30.00	17.5	7.8	< 0.5	25.3	700

Water column physical-chemical results at Manistique, Lake Michigan, 197

Station	Depth (m)	Temp C	ph	Conductivity (umho/cm2)	Chlor a (ug/l)	Secchi Disc (m)	Date Sampled	Time
1	0	19.1	8.9	198			8/17	830
	2	18.5	8.9	200				
	4	18.2	8.9	210				
	5	18.1	8.9	210	2.1			
3	0	19.0	8.9	210	1.2(5m)	9.8	8/17	930
	2	19.1	8.9	215				
	4	19.1	8.9	215				
	6	19.0	8.8	215				
	8	17.0	8.8	210				
	10	15.0	8.8	190				
	14	13.0	8.7	185				
6	0	19.2	8.9	218	1.0(5m)	9.8	8/17	830
	2	19.2	8.9	218				
	4	19.2	8.9	218				
	6	19.2	8.9	218				
	8	19.2	8.8	218				
	10	19.1	8.8	218				
	15	19.1	8.8	218				
	20	19.5	8.7	190				
	25	11.8	8.6	170				
	29	7.5	8.5	160				

Concentrations Of Pesticides In Lake Michigan Sediments
Near the Mouth of the Manisitique River, 1976

Station Number	Depth (m)	Dieldrin ug/kg	Chlordane ug/kg	DDD ug/kg	DDE ug/kg	p,p DDT ug/kg	p,p DDT ug/kg
1	6	< 10	< 20	< 10	< 10	< 10	< 10
2	15	< 10	< 20	< 10	< 10	< 10	< 10
3	15	< 10	< 20	< 10	< 10	< 10	< 10
4	15	< 10	< 20	< 10	< 10	< 10	< 10
5	30	< 10	< 20	< 10	< 10	< 10	< 10
6	30	< 10	< 20	< 10	< 10	< 10	< 10
7	30	< 10	< 20	< 10	< 10	< 10	< 10
8	6	< 10	< 20	< 10	< 10	< 10	< 10
9	7	< 10	< 20	< 10	< 10	< 10	< 10
10	6	< 10	< 20	< 10	< 10	< 10	< 10

Water Chemistry of Lake Michigan at Stations 3 and 6 near the Mouth of the Manistique River, 1976

Station Number	Depth (m)	Chemical Oxygen Demand (mg/l)	Total Organic Carbon (mg/l)	Conductivity (umho/cm)	Turbidity (formazin units)	Nitrate & Nitrite Nitrogen (mgN/l)	Ammonia Nitrogen (mg/l)
3	1	5.1	1.8	265	0.7	0.16	0.004
3	14	3.2	1.9	265	0.7	0.18	0.012
6	1	2.1	2.1	265	0.5	0.15	0.002
6	29	6.4	1.8	265	0.4	0.15	0.004
Average - Station 13		4.2	1.9	265	0.6	0.16	0.005
Average - all stations		6.8	2.3	269	1.8	0.17	0.007

Station Number	Depth (m)	Organic Nitrogen (mg/l)	Total Kjeldahl Nitrogen (mgN/l)	Total Phosphorus (mgP/l)	Total Ortho-phosphate-P (mgP/l)	Suspended Solids (mg/l)	Total Dissolved Solids (mg/l)
3	1	0.15	0.15	0.004	0.004	1	152
3	14	0.15	0.16	0.006	0.004	2	151
6	1	0.17	0.17	0.005	0.001	K 1	152
6	29	0.17	0.17	0.007	K 0.001	1	148
Average - Station 13		0.16	0.16	0.006	0.002	1	151
Average - all stations		0.21	0.21	0.01	0.002	4	156

Station Number	Depth (m)	Dissolved Silica (mg/l)	Chloride (mg/l)	Total Iron (mg/l)	Sulfate (mg/l)	Sodium (mg/l)	Magnesium (mg/l)
3	1	0.16	7.6	25	22	4.4	13
3	14	0.34	7.6	17	22	4.8	12
6	1	0.15	7.6	21	23	4.6	12
6	29	0.16	7.6	12	22	4.3	12
Average - Station 13		0.2	7.6	19	22	4.5	12
Average - all stations		0.6	8.3	87	22	4.5	12.5

Station Number	Depth (m)	Calcium (mg/l)	Potassium (mg/l)	Alkalinity (mg/l CaCO3
3	1	33	1	104
3	14	32	1.2	104
6	1	32	1	105
6	29	30	1	104
Average - Station 13		32	1	104
Average - all stations		34	1	107

Sediment Particle Size Percent Composition in Lake Michigan Near the Mouth of the Manistique River, 1976

Station Number	Depth (m)	Solids Total % wet wt.	Total Volatile Solids %T.S.	Gravel >2 mm %dry wt.	Very Coarse Sand 1-2 mm % dry wt.	Coarse Sand 0.5-1mm % dry wt.	Medium Sand 0.25-0.5 mm % dry wt.	Fine Sand 0.1-0.25 mm % dry wt.	Very Fine Sand 0.05-0.1 mm % dry wt.	Silt 0.002-0.05 mm %dry wt.	Clay k 0.002 mm % dry wt.
1	6	86.8		53.5	20.2	20.1	0.0	1.0	0.2	k 0.1	k 0.1
2	15	85.0		0.1	0.8	44.6	51.6	2.8	0.2	k 0.1	k 0.1
3	15	84.8		0.1	0.2	16.1	77.5	6.0	0.1	k 0.1	k 0.1
4	15	84.5		0.0	0.4	31.7	64.8	3.0	0.1	k 0.1	k 0.1
5	30	82.8		0.5	0.6	1.8	49.9	46.7	0.3	k 0.1	k 0.1
6	30	82.8		0.1	0.1	0.8	41.8	56.4	0.8	k 0.1	k 0.1
7	30	83.5		0.2	0.2	3.5	58.5	37.3	0.3	k 0.1	k 0.1
8	6	24.5	41.8	0.0	0.0	1.0	3.7	77.0	16.1	2.7	0.6
9	6	68.8	14.3	0.0	0.1	0.9	2.9	72.5	15.7	5.4	2.5
10	6	58.8	12.0	0.0	0.0	0.0	11.2	79.0	5.8	3.1	1.0

k = less than

APPENDIX B

MANISTIQUE WWTP EFFLUENT DATA

EFFLUENT LOADI
1980 AND 1985
(lbs/day unles
(MDNR, Wasteva

Parameter	Aug (Co
Outfall 001	
Flow (mgd)	
Suspended Solids	
Dissolved Solids	
COD	
BOD_5	
BOD_5 (Carb.)	
Nitrite & Nitrate nitrogen-N	
Ammonia nitrogen-N	
Kjeldahl nitrogen-N	
Orthophosphates-P	
Total phosphorus-P	
TOC	
Chloride	
Total Cadmium (Cd)	
Total Chromium (Cr)	
Total Copper (Cu)	
Total Nickel (Ni)	
Total Lead (Pb)	
Total Zinc (Zn)	
PCB 1242	
PCB 1254	
PCB 1260	

ANALYSES OF GRAB SAMPLES COLLECTED FROM THE MANISTIQUE WWTP
(MDNR, 1985 WASTEWATER SURVEY)

Date	8-13-85	8-13-85	8-13-85	8-13-85	8-14-85	8-13-85 (sludge)
Time	0930	1130	1645	2115	0845	0930
Temp. (°F)	64		64			
pH (S.U.)	6.6		7.6			
CL (mg/l)	1.0		0.8			
Fecal Coliform (cts/100 ml)	1,140	1,260	1,420	1,000	360	
Suspended Solids (mg/l)	<4		7			
Disoolved Solids (mg/l)	280		360			
Dissolved Oxygen (mg/l)	7.0 LP/PS[1]		7.6 LP/PS[1]			
BOD_5 (mg/l)	6.9		14.0			
$CBOD_5$ (mg/l)	4.5		8.8			
COD (mg/l)	30		51			
TOC (mg/l)	9.8		14.0			
NO_2 (mg/l)	0.17		0.40			
NO_3 (mg/l)	2.5		3.90			
NO_2 & NO_3 (mg/l)	2.6		4.3			
NH_3-N (mg/l)	0.87		4.3			
Kjeldahl nitrogen (mg/l)	2.2		6.4			32,000 mg/kg
Total phosphorus (mg/l)	0.77		1.1			24,000 mg/kg
Orthophosphate (mg/l)	0.53		0.67			
Chloride (mg/l)	35		40			
Sulphate (mg/l)	38		50			
Alkalininty ($CaCO_3$)(mg/l)	101		139			
Hardness ($CaCO_3$) (mg/l)	145		175			
Total Aluminum (µg/l)	73		150			20,000 mg/kg
Total Iron (µg/l)	450		740			
Total Mercury (µg/l)	<0.5		<0.5			1.6 mg/kg
Total Molybdenum (µg/l)	<20		<20			
Total Vanadium (µg/l)	<10		<10			
Total Zinc (µg/l)	20		30			960 mg/kg
Total Silver (µg/l)	2.6		3.8			
Total Cadmium (µg/l)	0.9		0.3			4.5 mg/kg
Total Chromium (µg/l)	<3		<3			37 mg/kg
Total Copper (µg/l)	13		21			680 mg/kg
Total Nickel (µg/l)	4.8		<4			15 mg/kg
Total Lead (µg/l)	2.5		3.1			240 mg/kg
Oil & Grease Grave (mg/l)	44		22			
Total Arsenic (mg/kg)						<10
Total Beryllium (mg/kg)						<2
Total Lithium						6
PCBs (mg/kg)						<3100

[1]LP - Quality control indicated that the precision of the result may have been less than normal
PS - Possible interference may have affected the accuracy of the lab result

ANALYSES OF GRAB SAMPLES COLLECTED FROM THE MANISTIQUE WWTP (MDNR, 1980 WASTEWATER SURVEY)

Date	8-11-80	8-11-80	8-11-80	8-12-80	8-12-80	8-12-80 (sludge sample)
Time	1435	1715	2220	0730	1400	1515
Temp (°C)[1]	19	20	17.5	17	18.5	
pH (S.U.)[1]	7.4	7.2	7.2	7.4	7.5	
Residual Chlorine (mg/l)[1]	0.7	0.7	1.3	2.6	1.0	
Fecal Coliform (cts/100 ml)	30,000	22,000	8,000[2]	2,900		
Oil and Grease (I.R. (mg/l)			1			
Oil and Grease Grav. (mg/l)			<2			
Suspended Solids (mg/l)			16			
Dissolved Solids (mg/l)			330			
COD (mg/l)			29			
BOD_5 (mg/l)			7.9			
BOD_5 Carb. (mg/l)			7.8			
Nitrite & Nitrate-N (mg/l)			6.5			
Ammonia Nitrogen			0.14			
Kjeldahl Nitrogen			1.2			
Orthophosphates-P			0.12			
Total Phosphorus-P			0.34			
Total Cadmium (mg/kg)			<0.02			4
Total Chromium (mg/kg)			<0.05			22[3]
Total Copper (mg/kg)			<0.02			440
Total Nickel (mg/kg)			<0.05			13
Total Lead (mg/kg)			<0.05			340
Total Zinc (mg/kg)			<0.05			840
Aromatic Amines µg/l			<100			
Aromatic Hydrocarbon Scan µg/l			U[4]			
Trichloromethane µg/l			4			

[1] Values determined in the field at time of sampling
[2] Results based on colony counts outside the acceptable range -- number of colonies counted greater than the upper limit
[3] Estimated value; value may not be accurate
[4] Material analyzed for but not detected

MANISTIQUE WASTEWATER TREATMENT PLANT - WASTEWATER HEAVY METAL ANALYSIS RESULTS. AUGUST 1981 TO JANUARY 1982. ALL UNITS IN UG/L.

Parameter	8/10/81	8/17/81	8/25/81	8/31/81	9/8/81	9/14/81
Zinc	< 30	100	40	50	< 30	32
Copper	< 30	< 30	< 30	< 30	< 30	< 30
Nickel	< 50	< 50	< 50	67	< 50	< 50
Chromium	< 25	< 25	< 25	< 25	< 25	< 25
Cyanide	30	22	17	21	19	47
Lead	< 20				< 20	
Cadmium	< 30				< 20	
Mercury	2.2				2.3	
Arsenic	< 10				< 10	
Selenium	< 25				< 20	
Silver	< 20				80	

Parameter	9/21/81	9/28/81	12/17/81	12/22/81	12/30/81	1/6/82
Zinc	32	< 30	< 30	< 30	34	< 30
Copper	< 30	< 30	< 30	< 30	< 30	< 30
Nickel	< 50	100	< 50	< 50	60	50
Chromium	< 25	< 25	< 25	< 25	< 25	< 25
Cyanide	30	33	110	17	23	12
Lead					21	
Cadmium					< 20	
Mercury					< 0.5	
Arsenic					< 5	
Selenium					< 20	
Silver					< 30	

Parameter	1/13/82	1/20/82	1/27/82	2/3/82
Zinc	39	65	63	62
Copper	< 30	< 30	< 30	< 30
Nickel	< 50	< 50	< 50	< 50
Chromium	< 25	< 25	< 25	< 25
Cyanide	23	13	17	8
Lead			< 20	
Cadmium			< 20	
Mercury			< 0.5	
Arsenic			< 5	
Selenium			< 20	
Silver			< 30	

MANISTIQUE WASTEWATER TREATMENT PLANT, SLUDGE HEAVY METAL ANALYSIS RESULTS, AUGUST 1981 TO JANUARY 1982. ALL UNITS IN MG/KG.

Parameter	8/10/81	9/8/81	12/16/81	1/13/82
Zinc	1130.0	660.0	580.0	900.0
Copper	380.0	410.0	500.0	810.0
Nickel	19.0	23.0	20.0	20.0
Chromium	32.0	20.0	44.0	68.0
Cyanide	3.6	2.6	5.3	6.3
Lead	310.0	200.0	160.0	180.0
Cadmium	4.3	2.5	4.4	9.7
Mercury	2.3	14.0	4.2	12.0
Arsenic	2.3	3.5	6.5	6.2
Selenium	< 1.5	< 1.5	< 2.0	2.6
Silver	11.0	32.0	43.0	82.0

MANISTIQUE W.W.T.P. WASTEWATER HEAVY METAL ANALYSIS - AUGUST TO SEPTEMBER 1986. ALL UNITS IN MG/L.

	DATE SAMPLED					
Parameter	8/4/86	8/13/86	8/21/86	8/27/86	9/3/86	9/18/86
Cyanide	0.039	0.018	0.028	0.053	0.022	0.058
Silver	< 0.01	< 0.01	< 0.01	< 0.01	< 0.00025	< 0.00025
Mercury	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Zinc	0.033	0.017	0.017	< 0.02	0.023	0.058
Lead	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

APPENDIX C

MANISTIQUE PAPERS, INC. EFFLUENT DATA

EFFLUENT LOADINGS FOR MANISTIQUE PAPERS PROCESS WATER DISCHARGE (OUTFALL 006).
A SUMMARY OF MICHIGAN DEPARTMENT OF NATURAL RESOURCES WASTEWATER SURVEY DATA
All values in kg/day.

Survey Date:	AUG 1973	JUL 1974	AUG 1975	OCT 1977	JUN 1979	AUG 1980	OCT 1981	MAY 1984	AUG 1985
Reference:	55	40	39	3	4	56	5	57	6
Parameter									
Suspended Solids	2842	7416	2948	3290	1700	1100	320	1200	2300
Dissolved Solids	2042	-	4763	5870	5700	5500	5000	2800	13000
BOD5	930	1157	952	1690	4200	2000	160	380	1800
COD	2237	7552	5761	3420	4500	3900	1700	1700	5400
TOC	-	-	-	-	-		700	470	1600
Aluminum	-	-	-	-	86	78	38	38	94
Cadmium	-	-	-	-	-	<0.4	<0.2	0.002	<0.2
Chromium	-	0.7	-	-	-	<0.2	<0.6	<0.3	<0.5
Copper	>.14	0.5	-	0.2	<0.08	0.2	<0.2	<0.1	0.6
Nickel	-	<0.3	-	-	-	<0.4	<0.6	<0.3	<0.5
Lead	<0.5	3	<0.4	0.6	8	<0.4	<0.6	<0.3	<0.5
Zinc	4.8	5	5.1	1.7	0.3	1.8	3.2	0.5	3.1

EFFLUENT CONCENTRATIONS FOR PCBS, HEAVY METALS, AND CONVENTIONAL POLLUTANTS FOR MANISTIQUE PAPERS PROCESS WATER DISCHARGE (OUTFALL 006). A SUMMARY OF MICHIGAN DEPARTMENT OF NATURAL RESOURCES WASTEWATER SURVEY DATA. All values in mg/l.

Survey Date:	AUG 1973	JUL 1974	AUG 1975	OCT 1977	JUN 1979	AUG 1980	OCT 1981	MAY 1984	AUG 1985
Reference:	55	40	39	3	4	56	5	57	6
Parameter									
Suspended Solids	321	599	344	370	220	140	28	230	110
Dissolved Solids	289		552	660	720	670	440	520	640
BOD5	105	210	110	190	530	240	14	71	85
COD	280	1380	670	384	570	480	150	320	260
TOC							60	88	79
Aluminum					11	9.5	3.4	7.2	4.5
Cadmium						<0.02	<0.02	0.0004	<0.02
Chromium		0.13				<0.05	<0.05	<0.05	<0.05
Copper	0.025	0.09		0.02	<0.01	0.03	<0.02	<0.02	0.03
Nickel		<0.05				<0.05	<0.05	<0.05	<0.05
Lead	<0.05	0.56	<0.05	0.07	1	<0.05	<0.05	<0.05	<0.05
Zinc	0.56	0.9	0.27	0.19	0.04	0.22	0.28	0.09	0.15
PCBs	<0.0002	<0.00001	<0.00001			<0.0001	<0.0003	<0.0001	<0.0001

APPENDIX D

PUBLIC MEETING SUMMARY

Office of the Great Lakes
Public Meeting Summary
Manistique River Area of Concern

Date and Time: Tuesday, September 2, 1986, at 7:00 p.m.

Place: Ramada Inn
Manistique, Michigan

Chair: Thomas D. Martin, Office of the Great Lakes

Chief Technical Presenter: Brenda Sayles, Surface Water Quality Division

Other Presenters: John Schrouder, Fisheries Division

Other Department of Natural Resources Officials: Karen Gottlieb, Office of the Great Lakes
David Kenaga, Surface Water Quality Division
Steven Casey, Surface Water Quality Division

Attendance: 38 Members of the Public

Problem Statement

The Manistique River drains 1,500 square miles of land in the Upper Peninsula into Lake Michigan. A large concrete trough starts immediately below the dam and diverts almost one-half of the total river flow to provide hydroelectric power for the paper company. The Manistique wastewater treatment plant was constructed in 1958. Before that time, raw sewage emptied directly from homes and businesses into the River below the dam. Until 1960, the paper company also had virtually no treatment for their paper process wastes. The environmental problem of concern in PCBs in the fish and in the sediments of the Manistique River below the dam and in the harbor in Lake Michigan. Above the dam, PCBs were not detected above the detection level of 0.2 parts per million (ppm). Below the dam, PCBs were found in the river sediments at concentrations as high as 172 ppm. In carp and suckers, PCB concentration levels exceeded the FDA 2 ppm concern level. In the past, a fish consumption health advisory was issued for carp and suckers. The current advisory is for carp only because recent data indicate the PCB level in suckers is below the 2 ppm action level. The fish from the lower Manistique River are monitored on a yearly basis and to date there is insufficient data to determine whether the PCB levels are rising, falling, or remaining the same. PCBs were detected in the water from only one source - a combined sewer overflow in the upper portion of the channel. Extensive analyses of soils and river sediments are needed to better identify all area of PCB contamination. Some of the most highly contaminated soils along the banks have been stabilized with crushed stone. The Fox River contributes to the high water quality coming from the headwaters area which is a coldwater fishery. Fishery concerns include degraded habitat in the lower river, the preponderance of suckers

and bullheads, and a lack of public access facilities. Future remedial efforts will include eliminating or reducing the input of PCBs from sources in the Manistique River, and fish management work including planting walleye fingerlings.

The comments that were raised during the public meeting are summarized here and include responses given during the meeting and/or those that required further investigation.

C = Comment
R = Response

C. We would like to see better public access below U.S. 2 to include parking areas and fish cleaning stations and boardwalks.

R. Although not directly addressed by this RAP, this comment has been forwarded to appropriate state and local agencies.

C. Chuck Varnum (City Manager) - The City of Manistique would be happy to act as the agency to apply for grants or other types of funding to assist private industry or other concerns in the cleanup of PCBs.

R. The interest of local government is essential to the success of future remedial actions. The willingness to cooperate in this effort is appreciated.

C. Fifty to sixty boats can often be seen in the Harbor and Lake Michigan with many local people enjoying the fishing.

C. Has there been any recent testing of fish in the Manistique River for PCBs?

R. Yes. Carp and walleye were collected in July, 1986. These fish will be analyzed by the Michigan Department of Natural Resources (MDNR) laboratory for heavy metals, pesticides and PCBs. These results are expected by August, 1987.

C. What were the results of the laboratory analysis on fish collected in 1985?

R. In June of 1985, carp, walleye, and largemouth bass were collected for PCB analysis. The concentration of PCBs in the walleye and largemouth bass were below the Food and Drug Administration and Michigan Department of Public Health 2.0 mg/kg concern level. The concentration of PCBs in 7 out of 10 carp, however, exceeded the 2.0 mg/kg level, up to a maximum of 8.98 mg/kg.

C. Is the concentration of PCBs in fish tissue on the decline?

R. We are unable to determine if the concentration of PCBs in fish tissue is on the decline due to the limited data base we currently have. Fish were collected for PCB analysis in 1984 (white and red suckers and walleye) and 1985 (carp, walleye and largemouth bass). We will need to continue monitoring PCB levels in Manistique River

fish before we can determine if there are trends in PCB tissue concentrations. This continued monitoring is a recommended remedial action.

C. Have you identified any continuing sources of PCBs?

R. The primary continuing source of PCBs has been contaminated soils in the vicinity of an old deinking waste settling lagoon on the property of Manistique Papers, Inc. The soils have eroded into the Manistique River due to rainfall and erosion by the Manistique River. Manistique Papers, Inc. has stabilized these eroding soils with crushed rock. PCBs have not been detected in the wastewater from either the Manistique WWTP or Manistique Papers, Inc. However, PCBs were detected in the water below a combined sewer overflow in 1985. This potential PCB source will be investigated as part of the Remedial Action Plan.

C. What are some possible solutions to this problem?

R. As outlined in the Remedial Action Plan, the solutions will depend, in part, upon the results of additional biological and chemical studies of the Manistique River and Harbor. An option for a long-term solution includes removal of contaminated soils and river sediments. The Manistique Paper Company has temporarily stabilized the eroding contaminated soils with crushed rock.

C. Have you identified the site of the old Berry Chemical Company as being a potential contributor to the PCB problem? They produced phenols and solvents from the destructive distillation of wood.

R. The Berry Chemical Company was located on the east side of the Manistique River directly across from Manistique Papers. The plant closed down sometime in the 1930s. Since we have not found elevated levels of PCBs in the river sediments on the east side of the river, we do not suspect Berry Chemical as a potential contributor of PCBs to the Manistique River. In addition, PCBs were not manufactured until about 1930, so there is little chance that Berry Chemical used PCBs.

C. You mentioned that walleye fry will soon be planted in Mead Creek, but also remarked that the habitat is unsuitable to support these fish. How will planting them improve the fishery?

R. The missing link in the walleye fishery is suitable habitat for natural reproduction. Walleye required washed rock and rubble. There is very little natural reproduction in Mead Creek due to siltation. By bypassing the early life stages and stocking fall fingerlings of 2 to 2.5 inches, the young fish will have a better chance of survival. The fall fingerlings will be planted in Mead Creek in July of 1987. Viable catches can then be expected in 3 to 4 years.

C. How long will it take for action when the plan comes out?

R. Action has already begun on some remedial measures. Manistique Papers began extensive sampling of the soils in the proximity of the old deinking lagoon in December 1986 to better characterize the extent of PCB contamination. In addition, the paper company stabilized portions of the crumbling bank in the vicinity of the deinking lagoon where contaminated soils have been found. Fish will again be collected from the Manistique River for PCB analysis in 1987.

C. How is the public notified that they should not eat carp caught from the Manistique River?

R. The public is notified of fish consumption advisories through the Michigan Fishing Guide. This pamphlet is provided to the purchasers of Michigan fishing licenses. The Michigan Department of Public Health also periodically makes news releases on fish advisories which are usually carried by local news media.

C. Has testing of the sediments in other river slips (besides the slips immediately to the east and west of the old deinking lagoon) been done to determine if PCBs are present?

R. Yes. PCBs have not been detected or have been detected only slightly above a level of detection in other slips.

C. There is dumping of septic tanks in the Manistique Lake area, especially near Curtis, Michigan. Has any PCB contamination been found in that area?

R. The sediments or water in that area have not been tested for PCB contamination. We do not suspect this area as a source of PCB contamination since PCBs have not been detected in the sediments above the Manistique Dam. In addition, PCBs are not normally found in household waste which goes to septic tanks.

C. What is the effect of the very high Lake Michigan water level on washout of contaminated soils?

R. The high Lake Michigan water level has probably not affected washout of PCB contaminated soils in the old deinking lagoon area.

C. Where is the water purification plant located?

R. The City of Manistique draws its public water supply from the Indian River. The intake and water filtration plant are located on Intake Park Road across from Riverside Park in Manistique.

C. Where, relative to the water purification plant, does the Manistique Paper Company dump their sludge?

R. The Manistique Papers landfill site is located on Frankovitch Road near Manistique, and is approximately 3/4 mile Northwest of the public water supply intake.

C. What effect is the landfill having on the groundwater?

R. A hydrogeological study which has been prepared by a consultant for Manistique Papers has recently been approved by the MDNR Groundwater Division. This study will consist of groundwater sampling in the vicinity of the landfill to determine if contaminants are leaching to the groundwater.

C. When was the paper mill sludge last tested?

R. The MDNR analyzed the sludge in August, 1985. PCBs were not detected in this sludge.

C. In 1978, court action was brought against Manistique Papers and a landowner on the Indian River for disposal of paper sludge on the banks of the Indian River in 1974. The court action was brought by an adjacent property owner, who had the sludge analyzed for contaminants at their own expense. The results of this assay are available through File No. 77-348-CE of the Circuit Court of Schoolcraft County. The paper company had not done their own analysis of the sludge at the time of the trial.

C. Have you looked at the concentrations of mercury and lead in the Manistique River sediments?

R. The levels of lead in the sediments are elevated at some locations below the dam in Manistique. This will be investigated further and is addressed in the Remedial Action Plan. The levels of mercury found in the sediments are only slightly above background concentrations.

C. Some paper mill sludge was dumped along Lake Michigan behind the senior citizen towers. This was stopped after the trial in 1978.

R. This is being looked into by MDNR Marquette district staff.

C. What can the public do to get more plantings of brown trout and steelhead? We have a nice port, but up until the last five years, there was not a consistent supply of catchable fish to support a charter in our ports. We can now catch fish from the middle of June through November. Is the fishing going to be consistent?

R. One of our most difficult jobs is getting the fish and the fisherman together. We have planted a total of approximately 60,000 steelhead trout and chinook salmon each year for the past 7 years. We plan on continuing these plantings in order to provide a reliable sports fishery.

C. Have you studied any other pollutants in the area waters besides PCBs? There used to be midnight taps from septic systems to the Indian and Manistique Rivers. We are concerned that contaminants from these septic systems are getting into our public water supply.

R. There are no industrial type discharges to the Indian River or Manistique River above the Manistique Dam. Therefore, we would not expect toxic pollutants to be present in these waters.

There have been problems, however, with septic waste leaching to the lakes and rivers. For instance, the elevation of the southeastern shore of Indian Lake is only slightly above lake level. Consequently, the vast majority of residences discharge sewage directly to the groundwater, which then ends up in Indian Lake and the Indian River.

The option of constructing municipal waste treatment plants in the Indian Lake and Manistique Lake areas has been considered. However, costs were prohibitive.

No studies have been done to evaluate the impact of the leaky septic systems on the Indian River public water supply. This concern has been referred to the Schoolcraft County Health Department.

C. Cancer rates in Manistique area seem to be high. Could this be related to the PCBs, mercury, lead, etc., in the Manistique River?

R. There have been no studies done to examine the incidence of cancer in Manistique as compared to surrounding areas or through Michigan. This concern has been referred to the Schoolcraft County Health Department.

PUBLIC MEETING SUMMARY

Date and Time:	Thursday, July 30, 1987, 7:00 p.m.
Place:	Ramada Inn, Manistique, Michigan
Chair:	Thomas D. Martin, Office of the Great Lakes
Chief Technical:	Brenda Sayles, Surface Water Quality Division
Other Presenters:	Steve Scott, Fisheries Division
Other Department of Natural Resources Officials:	Jack Rydquist, Surface Water Quality Division
Attendants:	24 members of the public

Tom Martin opened the meeting with an explanation of the Areas of Concern and the Remedial Action Planning process. Brenda Sayles gave a brief summary of the Manistique Area of Concern. Steve Scott described a fisheries survey of the Manistique River above the dam in Manistique.

The comments that were raised during the public meeting are summarized here and include responses given during the meeting and/or those that required further investigation.

C=comment
R=response

C. Is the Michigan Legislature going to appropriate funds to implement remedial actions in the Areas of Concern.

R. The legislature has not yet appropriated funds for implementation of remedial actions.

C. Since suckers have been dropped from the public health advisory, it appears that the levels of PCB's in fish is declining.

R. We do not yet have enough data to define any definite trends in the levels of PCB's in fish tissue of fish collected from the Manistique River. Carp have been collected from the Manistique River on three occasions since 1978 and the levels of PCB's have been fairly similar all three times. One sucker was collected in 1978 and the level of PCB's in the tissue at 2.6 mg/kg exceeded the 2.0 mg/kg FDA and MDPH action levels. Out of eight suckers collected in 1984, none exceeded the 2.0 mg/kg PCB action level.

C. The public health advisory for fish was just lifted for Torch Lake. The fish in Torch Lake have tumors. How does this situation compare with the Manistique River.

R. The public health advisory is still in effect for sauger and walleye in Torch Lake. We do not know what is the cause for the fish tumors. A public health advisory exists for carp in the Manistique River due to levels of PCBs in some carp that exceed the FDA and MDPH 2.0 mg/kg action level.

C. At the public meeting in September, 1986, for the Area of Concern, the result of the July 1986 fish contaminant monitoring for the Manistique River was not yet available. Are these data now available?

R. Yes, five walleye and five carp were collected in July 1986. The levels of PCBs in three of five carp exceeded the 2.0 mg/kg action level at concentrations up to 9.3 mg/kg. PCBs were not found in walleye above the action level.

C. What were the levels of PCBs in white suckers collected in 1986?

R. White suckers were not collected in 1986.

C. When Manistique Papers dredged the drinking wastewater lagoon in 1977, why did the MDNR allow them to dispose of the material in the Manistique Papers landfill, which is located in a high water table area?

R. At the time the lagoon was dredged there probably was no knowledge that PCBs were or may have been present in the dredged material.

C. Why wasn't the material tested?

R. The wastewater effluent for Manistique Papers had been analyzed for PCBs in 1973, 1974 and 1975 and PCBs were never detected. Therefore, PCBs were not expected to be present in the lagoon sludge. This is the most likely reason the sludge was not analyzed for PCBs.

C. We are concerned that the sludge has been placed in a high water table area where contaminants may enter the groundwater.

R. Manistique Papers is currently studying the landfill area and will be analyzing the groundwater to see if contaminants are leaching to the groundwater.

C. Shouldn't the MDNR be doing that instead of Manistique Papers?

R. The MDNR budget doesn't always allow for us to do these studies ourselves and, therefore, we have to rely on industry and municipalities to do the work. We review the study design and results.

PCBs are strongly attracted to organic material such as soil. The likelihood of PCBs leaching to the groundwater are slim.

We don't believe that there are sources of PCBs to the Manistique River above the dam since we have not detected PCBs in the sediments above the dam.

C. What danger does the Manistique Papers landfill present to residents in the vicinity of the landfill and what additional danger might occur if a proposed quarry begins operation in the vicinity of the landfill?

R. These questions will better be answered when the landfill study being conducted by a consultant for Manistique Papers is completed.

C. How close is the quarry to the landfill.

R. Less than one quarter mile.

C. Although PCBs tend to bind to the soil in Hiawatha Township, there is little soil overlying the bedrock.

R. PCBs also bind to the landfilled material. Therefore, if PCBs are bound to the sludge in the landfill, they are likely to remain in the sludge.

C. Have heavy metals been found in the sludge and can they be a problem to people in the vicinity of the quarry?

R. Yes, heavy metals have been found in the sludge in the landfill. However, it is not known at this point to what extent heavy metals are, if at all, reaching the groundwater. This can better be answered when the results of the Manistique Paper landfill study are complete.

C. Can anything be done to clean up the sawdust from the beaches.

R. (Charles Varnum-City Manager) Motorized vehicles, i.e., dump trucks, cannot be taken on the beaches to remove the sawdust. Perhaps some organization, such as a university or college, may be able to undertake the study to determine what to do with the sawdust. The sawdust comes and goes depending on weather conditions.

C. Do you have any records of untreated sewage going to the Manistique River or Lake Michigan?

R. Manistique still has a combined sewer system. combined sewers are drains that convey both stormwater and domestic sewage to the waste treatment plant. During periods of heavy rainfall or heavy snow melt, the sewers overflow into the river. There are two such combined sewer overflows to the Area of Concern. The City of Manistique will need to address this problem.

C. Is it possible for the Corps of Engineers to remove the contaminated sediments in the harbor or would it be best to leave them in place?

R. The remedial action plan recommends additional sampling and contaminant analysis of the harbor sediments to help us in making this decision.

C. The last couple of years there has been a good fishery for channel catfish. Have you thought of adding channel catfish to your list of species for PCB testing?

R. Yes. We are recommending that channel catfish be added to the list of species to be collected in 1988 for contaminant analysis as part of the Fish Contaminant Monitoring Program.

C. The remeidal action plan identified three active landfills in the Manistique River watershed, including the Schoolcraft County landfill. This landfill has been closed for seven years.

R. Noted.

APPENDIX E

A SUMMARY OF BUSINESSES HISTORICALLY AND PRESENTLY LOCATED NEAR OR WITHIN THE AOC

The following historical summary of businesses that were located on or near the Manistique River to the mouth at Lake Michigan was supplied by Mrs. Florence T. Meron, a certified Genealogical Record Searcher in Manistique (23).

The first patents were issued on lands bordering the mouth of the Manistique River between 1846 and 1860.

Spinnery and Boyd was a small sawmill near the location where Charles T. Harvey built a dam to create power to interest lumber companies.

Other companies were:

Chicago Lumber Co.
C.L. Lumber Co. - in business for 41 years, 1863-1912
Ball and Buell Lumber Mill 1880-1890
Delta Lumber Co.
J.W. Weston Co.
J.D. Weston Co.
Consolidated Lumber Co.
Goodwillie Plant - located on property where present Manistique Paper is located
Manistique Light and Power Co.- located on the east side of the river
Berry Chemical Co.
Charcoal Iron Co.
Coffey Fishing Industries
Sellman Fishing Industries
Bronson Mill
Burrell Chemical Co.
Cookson Lumber Co.
Willebrand - Manistique Brewing Co.
Ann Arbor Car Ferry
Ekstrom Lumber Co, now called Manistique Lumber Co.
Girvin Coal Co. (formerly owned by Coffey Industries)
Stack Lumber Co. Michigan Deminision So.
Wyman Nursery - owned and operated by Forestry Division of MDNR
Brown Lumber Co.

The present companies are -

Manistique Papers, Inc.
Manistique Rentals
Warshawsky Junk Dealer - since sold?
Manistique Marina
Manistique Coal and Lumber Co.