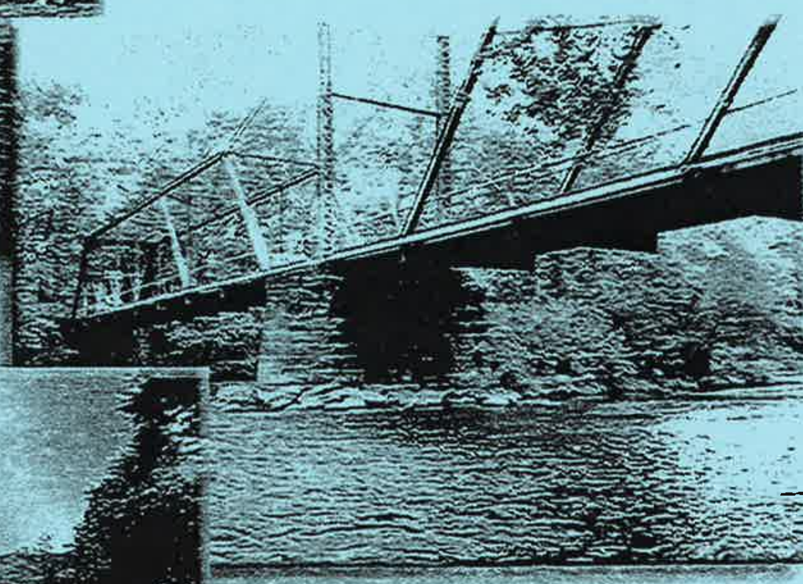
US Army Corps of Engineers
Pittsburgh District

Final Report

Lower Mahoning River, Pennsylvania Environmental Dredging Reconnaissance Study

U.S. Army Corps of Engineers
Pittsburgh District
1000 Liberty Avenue
Pittsburgh, Pennsyvania



August 2001

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

REPLY TO
ATTENTION OF

CELRP-PM-MM

29 MARCH 2002

MEMORANDUM FOR Commander, U.S. Army Corps of Engineers, Great Lakes and Ohio River Division, PO Box 1159, Cincinnati, OH 45201

SUBJECT: Lower Mahoning River, Pennsylvania, Environmental Dredging Reconnaissance Study, Lawrence County, Pennsylvania, August 2001, Final Report and Policy Review Documentation

1. Enclosed for your review and approval is a copy of the subject reconnaissance report. The study area is located within the 4th - Congressional District of Pennsylvania (US Representative - Hart). Funds for the report were provided in the 1999 Energy and Water Appropriations Act (E&WAA).

2. The report concluded that "...the reconnaissance report be used as a technical reference document to facilitate further [study efforts]."

3. The District is working with non-Federal agencies, the Commonwealth of Pennsylvania, and local officials to initiate preparation of a draft Project Study Plan and Feasibility Cost Sharing Agreement.

4. If you have any question or need additional information contact Carmen Rozzi (412) 395-7227.

Raymond K. Scrocco
RAYMOND K. SCROCCO
Colonel, Corps of Engineers
Commanding

Enclosures
1. Reconnaissance Report (3-ring binder)
2. Policy Review Documentation (3-ring binder)

Lower Mahoning River, Pennsylvania
Environmental Dredging Reconnaissance Study

FINAL REPORT

U.S. Army Corps of Engineers
Pittsburgh District
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

August 2001

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EXECUTIVE SUMMARY

This Lower Mahoning River Environmental Dredging Reconnaissance Study was conducted by the United States Army Corps of Engineers (USACE) pursuant to Section 312 of the Water Resources Development Act of 1990, as amended by Section 205 of the Water Resources Development Act of 1996. The amended Section 312 provides for the removal of contaminated sediments within "navigable waters" for the purpose of ecosystem restoration and identifies the Mahoning River, Ohio and Pennsylvania, due to the severity of contamination, as one of five rivers in the nation given top priority for removal and remediation of contaminated sediments.

Planning for projects to remove and remediate contaminated sediments is conducted in two phases: a reconnaissance phase and a feasibility phase. This report was prepared as part of the reconnaissance phase study, which is 100% federally funded. The feasibility phase requires identification of a local sponsor to cost share on a 50% Federal to 50% non-Federal basis.

The Mahoning River is 108 miles long, rising in Columbiana County, Ohio and flowing northward to Warren, Ohio and then southeasterly to New Castle, Pennsylvania, where it joins the Shenango River to form the Beaver River. In 1999, the Corps completed a reconnaissance study of a 31-mile stretch of the Lower Mahoning River located in northeastern Ohio, from Warren, Ohio (River Mile 42.9), to the Ohio-Pennsylvania border (River Mile 11.85). The reconnaissance study included a biological assessment, a sediment investigation, and an analysis of potential restoration alternatives. Based on the study findings, removal of contaminated material was recommended.

The purpose of this reconnaissance study was to complement the Ohio study and determine problems and opportunities for ecosystem restoration related to contaminated sediments in the Lower Mahoning River in Pennsylvania. The area of study included the 12-mile reach of the Lower Mahoning River that lies between the Ohio-Pennsylvania state line and the river's confluence with the Shenango River at New Castle.

The Lower Mahoning River in Pennsylvania has been identified as being moderately to severely impaired due to contaminated sediments originating from upstream industrial activity in the Ohio reaches of the river. The Lower Mahoning River project goal was to identify the activities and level of funding necessary to remediate the Lower Mahoning River within the study reach. The remediation, as conceived for this study, is intended to restore the aquatic ecosystem to the biotic integrity existing on a model reach of the Lower Mahoning River located just upstream of the study area. The success of the Lower Mahoning River, Pennsylvania, Environmental Dredging Project is linked to the restoration of the upstream Ohio portion of the Lower Mahoning River and the elimination of the Ohio Department of Health Public Health Advisory. The objective is to reestablish a fishable and swimable stream in compliance with the mandates of the Clean Water Act.

Restoration of the riverine habitat will benefit the aquatic ecosystem and serve as a focus for the revitalization of recreation along the Lower Mahoning River. The riparian corridor is mostly intact and aesthetically appealing. The principal opportunity is to return the river and its ecosystem to a healthy condition, thus allowing the river to become a scenic recreational resource that will serve as a focus for the revitalization of the Lower Mahoning River. This, in turn, would lead to economic benefits for the area.

1.0 INTRODUCTION

1.1 Study Authority

This Lower Mahoning River, PA Environmental Dredging Reconnaissance Study was conducted by the United States Army Corps of Engineers (USACE) pursuant to Section 312 of the Water Resources Development Act of 1990, as amended by Section 205 of the Water Resources Development Act of 1996. The amended Section 312 provides for the removal of contaminated sediments within "navigable waters" for the purpose of ecosystem restoration, if such removal is requested by a non-federal sponsor, and if that sponsor has agreed to pay 50 percent of the cost of removal and 100 percent of the cost of disposal. Planning for projects to remove and remediate contaminated sediments is conducted in two phases: a reconnaissance phase and a cost-shared feasibility phase. This report was prepared as part of the reconnaissance phase study.

1.2 Purpose and Scope

The Mahoning River lies mostly in northeastern Ohio. The portion of the Mahoning River below Warren, Ohio at River Mile (RM) 46 is referred to as the "lower Mahoning River." This reconnaissance study addresses problems and opportunities for ecosystem restoration throughout the reach of the lower Mahoning River that lies between the Ohio-Pennsylvania state line (RM-11.85) and the River's confluence with the Shenango river at New Castle, PA (RM 0), which is degraded because of contaminated sediments (Plate 1). Although there has been limited industry and few significant sources of pollution in this 12-mile reach of the Mahoning River, sediments are likely to be contaminated because of intense historical industrial pollution upstream in the Warren/Youngstown, Ohio corridor. River Miles referred to in this report are USACE River Miles, and differ from Ohio Environmental Protection Agency (OEPA) River Miles used in OEPA's reports.

Previous studies have indicated that sediments and riverbanks of the Mahoning River are contaminated, but a comprehensive multi-disciplinary investigation directed specifically towards the restoration of the river has not been undertaken. These previous studies included assessments of sediments, bank materials, fish, water quality, and river biota in the Mahoning River. In addition to the review of existing information, this reconnaissance study also included both a biological assessment and a sediment quality survey. One investigation focused on determining the chemical and physical characteristics of contaminated river sediments and bank materials, and provided an estimate of the volume of contaminated materials. The other investigation was a quantitative assessment of the instream biological condition of the river.

Based on historical information as well as the data collected for this study, various restoration alternatives were formulated and evaluated. Recommendations for implementation were presented based on their benefits to the aquatic ecosystem, costs, and feasibility, as well as their impacts on natural, cultural, and socioeconomic resources.

sampling locations between Warren, Ohio (RM 42.9) and the Beaver River (RM 0) exhibited non-attainment of water quality standards. In addition, the report concluded that there was little or no indication that Mahoning River sediments were less contaminated in 1994 compared to prior years. During the period between 1980 and 1994, there was only a slight improvement in the use attainment status for the lower half of the Mahoning River. The presence of contaminated sediments was identified as the main reason that the river ecosystem failed to respond to decreased pollutant loads (OEPA, 1996).

2.0 DESCRIPTION OF STUDY AREA

The Mahoning River is 108 miles long, rising in Columbiana County, Ohio and flowing northward to Warren, Ohio and then southeasterly to New Castle, Pennsylvania where it joins the Shenango River to form the Beaver River. The project area for this reconnaissance study included the 12-mile reach of the lower Mahoning River that lies between the Ohio-Pennsylvania state line (RM 11.85) and the river's confluence with the Shenango River at New Castle, PA (RM 0). The lower Mahoning River in Pennsylvania has been identified as being moderately to severely impaired due to contaminated sediments originating from historical industrial activity in upstream reaches of the river.

2.1 Sources of Contamination

The Mahoning River basin is underlain with abundant mineral resources, giving rise to extensive coal mining, manufacturing of iron and steel, and supporting industries. From around 1900 until the mid-1970s, the lower Mahoning River supported one of the most intensely industrialized steel-producing regions in the world. By 1970, there were approximately 15 plants in steel production and 35 plants in steel related industries. Steel mills, railroads, and support industries used the river for cooling and process water. Other industrial effluents discharged to the river included pickling liquors, electroplating discharges, coke quench water, and cutting and lubricating oils. The river water contained high concentrations of metals (copper, zinc, lead, chromium, iron, nickel, cadmium), cyanide, ammonium nitrogen, and phenols. In the 1970s, the steel mills began to close. Currently, most of the steel mills have been razed, leaving only a few working mills in existence.

Historically, the lower Mahoning River has been severely impacted by untreated or poorly treated industrial and municipal discharges. Municipal wastewater treatment was nonexistent until the mid-1950s. Since the 1950s, significant reductions in the volumes of wastewater, total suspended solids, oil and grease, total iron and total phenols have occurred, primarily because of partial or complete shutdowns of steelmaking facilities and advances in water treatment. During the 1980s, most of the municipal wastewater treatment plants (WWTPs) attained secondary or better levels of wastewater treatment. The upgrades resulted in significant improvements in dissolved oxygen (DO) and ammonia nitrogen.

The Village of Lowellville (Ohio) was the last major WWTP to upgrade to secondary treatment, which became final in 1992. Located at RM 12.2, this facility is the nearest point-source discharge upstream of the Pennsylvania state line. The New Castle Sanitation Authority's WWTP discharges to the Mahoning River at RM 0.2.

2.2 Socioeconomic Setting

The estimated 1999 population of Lawrence County, Pennsylvania was 94,508, a decrease from the 1997 estimated population (95,281) and the 1990 enumerated population (96,246). New Castle, Pennsylvania, the largest city in the county, had a 1997 estimated population of 26,500, a decline from the 1990 enumerated population of 28,334. Towns and communities along the lower Mahoning River in Pennsylvania include Edinburg (1990 population 3,240), Hillsville (est. 2000 population 600), North Edinburg, Peanut, and Robinson.

2.3.2 Geology and Soils

The Mahoning River drains a glaciated portion of the Allegheny Plateau physiographic province. South of Warren, Ohio, the Mahoning watershed is underlain by the Pottsville and Allegheny Formations, which are of Pennsylvanian age and include interbedded sandstones, claystones and thin limestone, and coal beds. The Mahoning River Valley is underlain by the Cuyahoga Formation while the uplands along the river are underlain by the Pennsylvanian units. The Allegheny Formation underlies most of Lawrence County. The entire Mahoning watershed is mantled by glacial materials. The river valley is occupied primarily by outwash gravels south of Warren. Well logs indicate that up to 70 feet of clay and other surficial materials lie above the bedrock in the river valley, although in some areas, the bedrock intrudes directly into the river channel (USACE, 1999a; USDA, 1982).

Soils along the Mahoning River are predominately of the Conotton-Chili-Holly association. These deep soils were formed in glacial outwash and alluvium; they inherited many of their physical and chemical properties from this glacial material. Conotton soils are found on outwash plains, kames, eskers, and terraces. They are sandy and gravelly and are droughty during dry periods; they are dominantly gently sloping to very steep. Chili soils are found on outwash plains, kames and terraces. They are deep and well drained and underlain by sand and gravel. Holly soils are found on flood plains. They are poorly drained and frequently flooded, and have a high water table (USDA, 1982).

Upland soils along the Mahoning River Valley are in the Ravenna-Canfield-Frenchtown, Canfield-Ravenna-Loudonville, and Udothents-Canfield-Ravenna associations. The first two associations are level to steep, poorly drained to well drained, and formed in glacial till. The last association is level to steep, poorly drained to excessively drained, and formed in materials from strip mines and glacial till (USDA, 1982).

Other soils along the river are in the Braceville, Chagrin, Lobdell, Ravenna, Holly, and Sloan series. The Braceville, Chagrin, Lobdell and Ravenna soils are silt loams that occur in floodplains and qualify as prime farmland (USDA, 1982, 1983). The Holly and Sloan soils are silt loams that occur in outwash plains, terraces, floodplains, and moraines. The Holly, Sloan and some Braceville soils qualify as lands of state importance (USDA 1982, 1983). Holly and Sloan soils are hydric and may support wetlands. The Braceville, Chagrin, and Lobdell soils may have inclusions of hydric components (USDA, undated).

2.3.3 Wetlands

Riverine wooded and emergent wetlands that are influenced by river hydrology, occur adjacent to the river channel and below the ordinary high water line throughout the study reach. Major emergent wetlands are located closest to the river channel, primarily in gently sloped, depositional areas, and on islands.

According to the US Fish and Wildlife Service National Wetlands Inventory maps (USFWS National Wetlands Inventory Internet site, Wetlands Interactive Mapper Tool, 1977 base photos), palustrine groundwater-fed wetlands also occur throughout the riparian corridor, primarily between RMs 2 and 3 and in the vicinity of RMs 6, 8, 10, and 12. Palustrine wetlands near RMs 2 and 3 are primarily emergent wetlands. Palustrine wetlands near RMs 8-12 are deciduous forests while those near RM 6 are mostly forested with some shrub-scrub wetland. Human activities have eliminated wetlands along several stretches of the river.

Figure 2-1 provides a snapshot of total iron concentrations for Mahoning River, PA water samples collected between May and October 1999, compared to the control reach. The control reach is a free-flowing reach of the Mahoning River located upstream of the Warren-Youngstown industrialized corridor and downstream Levittsburg, Lovers Lane Dam, between RMs 43.0 and 46.2. Of the observations that year, only one value (collected from the Mahoning River at RM 20) slightly exceeded he PaDEP maximum iron water quality criterion of 1.0 of 1.0 mg/L. These data indicate that, although iron periodically exceeds the criterion, water quality, with respect to iron, continues to improve.

Table 2-3

Lower Mahoning River May through October Water Quality Statistical Analyses for Period of Record, Mean (Standard Deviation) Total Iron (µg/L)[1]

Sampling Period	Pennsylvania (RM 0-12)	Ohio (RM 12-43)	Control (RM 43-47)
1970-1979	1.65 (0.98)	2.80 (1.71)	0.93 (0.32)
1980-1989	0.93 (0.67)	1.29 (0.67)	0.98 (0.57)
1990-1999	1.26 (0.72)	1.05 (0.41)	0.87 (0.19)

[1] 349 observations

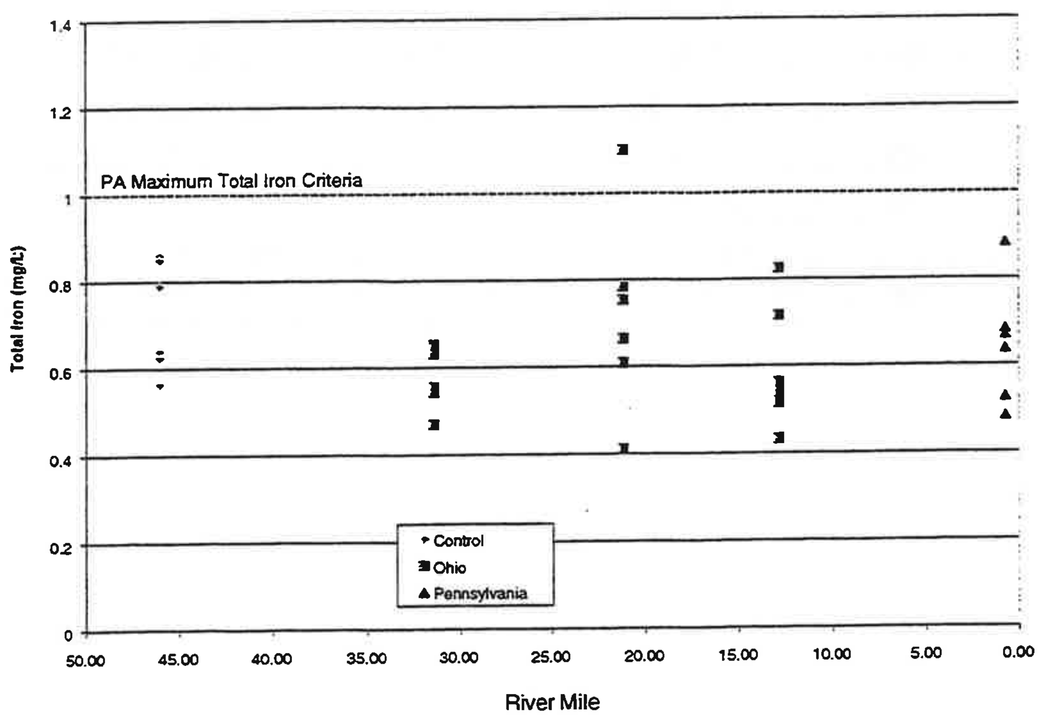


Figure 2-1

May through October 1999 Lower Mahoning River Water Quality Analyses, Total Iron (µg/L)

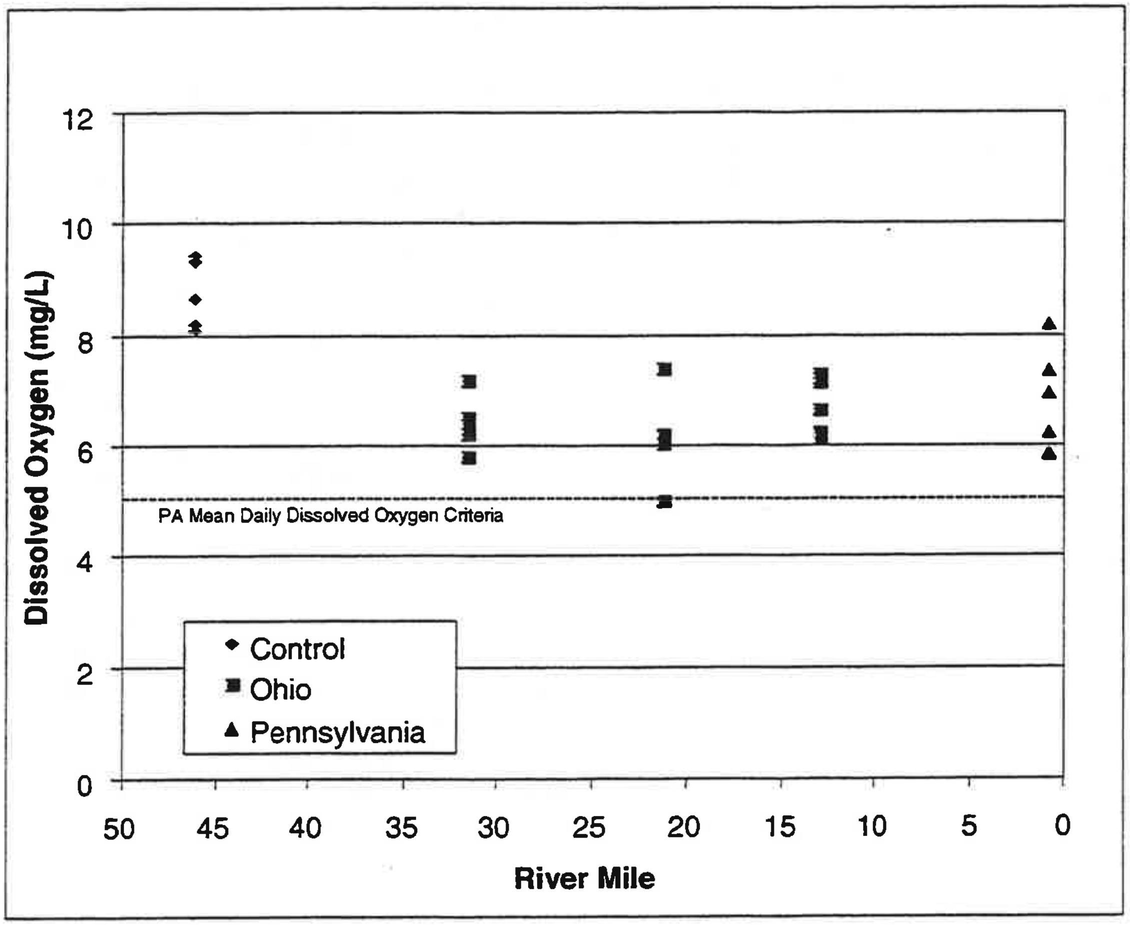


Figure 2-2

1999 May through October Lower Mahoning River Water Quality, Total Dissolved Oxygen (mg/L)

2.3.5 Hydrology and Hydraulics

The Mahoning River drains 1,132 square miles of northeastern Ohio and west-central Pennsylvania. Approximately 1,085 square miles, or 96% of the watershed, lies in Ohio and the remaining 4% lies in Lawrence County, Pennsylvania. The Mahoning River is 108 miles long with 11.85 miles of that length stretching from the Ohio-Pennsylvania border to the Mahoning River's confluence with the Shenango River to form the Beaver River.

Five reservoirs constructed in the watershed have a capacity of 29,000 acre-feet (ac-ft) or more. Information on these reservoirs, all in Ohio, is summarized in Table 2-5. In addition to these reservoirs, there are several other storage impoundments for water supply and/or recreation, including 11 that have a surface area of 90 acres or more.

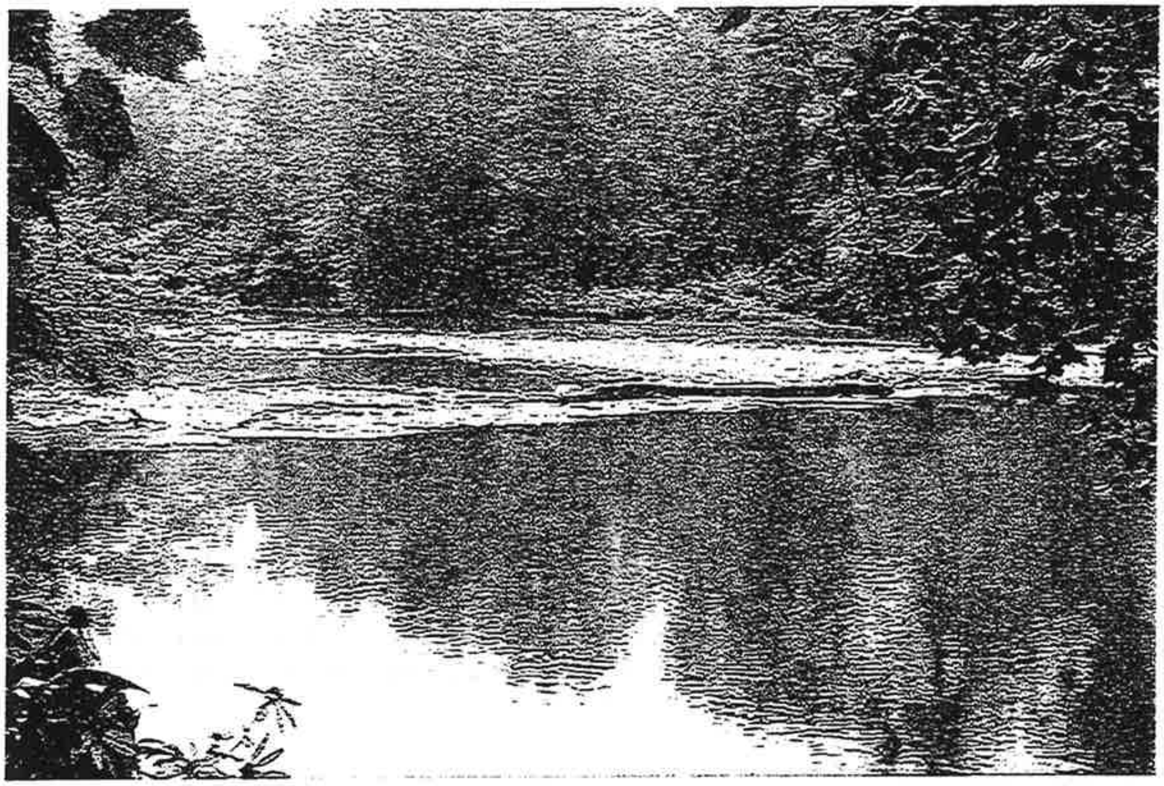


Figure 2-3. Remnants of Edinburg Dam at Mahoning River Mile 6.85

2.3.6 Ordinary High Water

The OHW mark is a distinct line along the shore, which has been established by fluctuations in the water level, with enough frequency and duration to change the character of both the vegetation and soil from upland to riverbed. Sections 9 & 10 of the River and Harbor Act (1899 and 1966) established Federal jurisdiction over navigable waters, and the OHW level defines the lateral extent of Federal jurisdiction. This law states that "...the bed of navigable streams includes lands below the ordinary high water line and the exercise of the power to regulate commerce within the bed of a navigable stream is not an invasion of any private property right for which the US must make compensation". Periodic high water events therefore have an observable and permanent effect on the shoreline. Since the vegetation and soils of lands located below the OHW line are aquatic (hydric), or transitional between wetland and upland, this area is also jurisdictional wetland.

Between August 24 and August 31, 1999, an OHW study (Appendix A) was conducted along the Mahoning River in order to define the lateral boundaries for the Mahoning River, Pennsylvania Environmental Dredging Reconnaissance Study and to facilitate right-of-entry for the proposed restoration project. The OHW study area included the entire Mahoning River, Pennsylvania Environmental Dredging Reconnaissance Study area: an 11.85 mile reach of the of the Mahoning River located in Lawrence County, PA, between RM 0 (the confluence of the Mahoning River with the Shenango River) and 11.85 (Hillsville, PA). Eleven sites were selected along the study reach, approximately one site per mile. In addition, sites were also selected upstream and downstream of the dam located at RM 6.85 in Edinburg, PA.

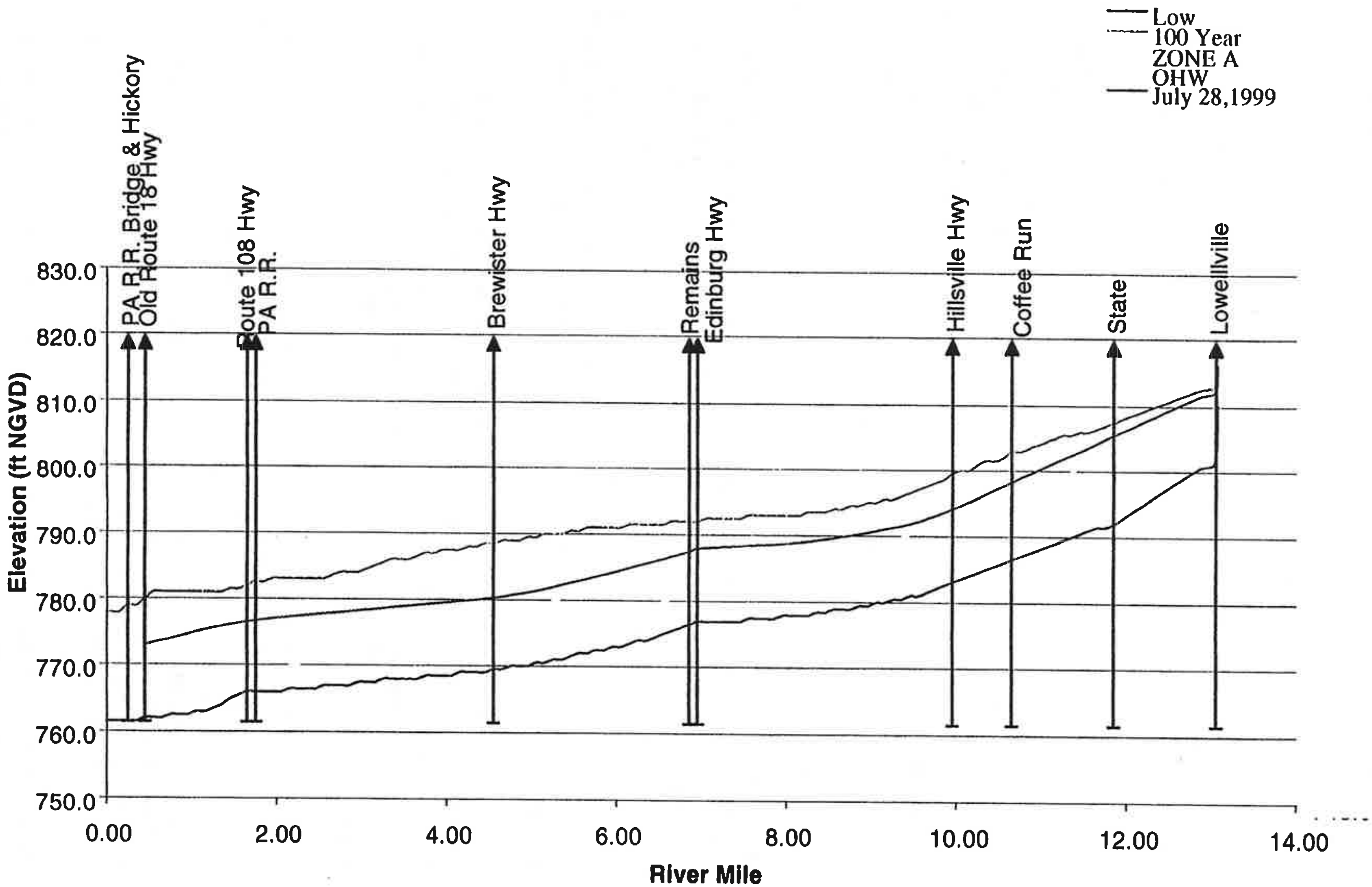


Figure 2-4
Mahoning River, PA Ordinary High Water Profile
August 1999

fishery, and recreational opportunities that pose no environmental or health concerns. This, in turn, would lead to economic benefits for the area.

2.5 Landfill Regulatory Issues

To determine the potential regulatory status of dredged Mahoning River sediments and bank materials, representative samples were collected and submitted for laboratory analysis. Landfill profiling samples were collected from the top 6 inches of sediment within the stream channel at RM 6.9. Landfill profiling samples were also collected from river banks at several transect locations and at various depths, as follows: RM 4.6 (1-1.5 foot depth), RM 6.9 (0.5-5.5 foot depth), RM 7 (1-4.3 foot depth) and RM 10.6 (1-2 foot depth). The samples were analyzed using the Toxicity Characteristic Leaching Procedures (TCLP) to determine whether the materials would require disposal as hazardous wastes. The results indicated that the dredged materials would not have to be treated as hazardous or toxic wastes.

Under current Pennsylvania regulations, however, dredged materials are regulated as "residual wastes." Residual wastes are defined as non-hazardous industrial waste. They include waste materials produced by industrial, mining, and agricultural operations. Residual waste does not include material defined by law as hazardous; however, it does include "near hazardous" wastes that are not covered by hazardous waste regulations. Nearly 400 facilities in Pennsylvania have PaDEP permits to process or dispose of residual wastes.

Residual wastes are regulated by the PaDEP Bureau of Land Recycling and Waste Management. In a recent Final Rulemaking, the PaDEP Environmental Quality Board recently revised 25 PA Code Chapters 250 and 287–299 dealing with Residual Wastes. In commentary associated with the new regulations, it was stated that dredged materials were included with residual wastes because, in many instances, they have physical and chemical qualities similar to those of residual waste. In addition, the residual waste regulations may provide more opportunities for reuse than the municipal wastes regulations. For example, the use of dredged material may qualify as a coproduct in some instances.

As discussed in Section 4.2.1, beneficial reuse may be preferable to landfill disposal in that it represents significant cost savings and preserves diminishing landfill space. If the dredged materials are to be landfilled, however, one of the nearest potential disposal locations may be the Carbon Limestone facility, just over the Ohio state line. Other facilities include the Seneca Landfill in Allegheny County, PA or the NW Sanitary Landfill in Butler County, PA. Analytical testing requirements vary for each landfill. Costs for disposal will also vary.

During the feasibility study, any additional sample analyses performed for disposal characterization should include parameters established by the waste receiving facilities. Also, additional analytical protocols may be required to investigate potential reuse scenarios for the material.

3.0 PROBLEMS AND OPPORTUNITIES

3.1 Sediment Contamination

3.1.1 Previous Studies

Feasibility Study on the Removal of Bank and River Bottom Sediments in the Mahoning River, Pittsburgh District (USACE, 1976).

For the 1976 USACE feasibility study, sediment and water quality data from 24 sampling stations were evaluated. The sampling data, compiled from three different sources, covered the reach of the Mahoning River from RM 1.8 to RM 46.2. The sediment samples were analyzed for oil and grease, fecal coliform, volatile solids, chemical oxygen demand, and metals; the analytical results were compared to the USEPA Pollutant Index. The "Pollutant Index" (PI) was developed by determining the percent of each constituent on a dry weight basis and dividing this percentage by the USEPA-determined percentage for polluted sediment. A number equal to or greater than one for any one of the constituents would characterize the sediment as polluted. The following findings were reported:

- Sediment samples from all in-stream locations, except in the control reach (RM 46.2) were characterized as polluted, since their respective PI values were greater than 1.
- Elevated zinc levels in the bottom sediment contributed most heavily to each sample's overall pollution rating.
- The oil and grease in river bottom sediment, identified in the reach located between RM 24 and RM 1.8, was the second most significant contaminant, with concentrations ten or more times greater than the USEPA PI value.

Chemical Analysis of Sediments and Fish from the Mahoning River, Lawrence County, Pennsylvania (USFWS, 1992).

For the USFWS's 1992 study of the sediments and fish of the Pennsylvania reach of the Mahoning River (RMs 0–12), ten surface sediment samples were collected. Seven of these were collected from the river channel of the study reach and one was collected from riverbank materials. In addition, two background samples were collected from Hickory Run, a right-descending bank tributary which confluences with the Mahoning River at RM 2. The samples were collected from the top 4 inches of sediments found in depositional areas at the edge of the river. The sediment samples were analyzed for metals, organochloride compounds, and polycyclic aromatic hydrocarbons (PAHs); the analytical results were compared to the USEPA (1977) guidelines for classification of Great Lakes sediments. The study was deliberately biased to seek out fined-grained sediments that would represent the worst-case degree of chemical contamination. The following findings were reported:

- The inorganic analysis showed that concentrations of many elements were an order of magnitude higher in the Mahoning River samples when compared to the Hickory Run background samples: including chromium, copper, iron, mercury, molybdenum, nickel, lead, and zinc.

sediment samples were analyzed for TRPH or oil and grease, metals, PCBs, and PAHs. Select samples were also analyzed for VOCs, SVOCs, pesticides, herbicides, dioxins and total cyanide. The following findings were reported:

- The contaminated bank materials were found to have similar chemical compositions to and occur at similar locations and elevations as the contaminated near-shore channel deposits. The bank areas, however, were typically capped by a relatively clean, vegetated layer that resembled natural banks.
- It was suggested that the "oil-soaked banks" described in previous studies were actually "contaminated deposits that formed in the old river channel."
- The bank sample analyses confirmed visual findings that (1) the sediment cap samples were relatively clean, (2) the deeper bank sediments were contaminated, and (3) there was a distinct horizontal and vertical limit to the extent and distribution of the contaminated soils/sediments in the river banks, with the deeper, most contaminated materials lying closest to the soil/water interface.
- TRPH /oil and grease concentrations were found to correlate well with the concentrations reported for other contaminants of concern, such as PCBs and heavy metals.

3.1.2 Current Study

For the current study, sediment quality sampling and analyses were conducted on in-stream and bank sediments/soils along the Pennsylvania reach of the lower Mahoning River. Sections from the "Sampling and Analysis Report, Lower Mahoning River," which outlines the complete sampling plan for this reconnaissance study, are provided in Appendix B; the complete sampling and analysis report is available in the Pittsburgh District files separately. Sampling of surface (0 to 6 inches) in-river and bank sediments was performed at seven transects located at RMs 1.7, 4.2, 6.8, 6.9, 8.8, 10.6, and RM 46.2 (the control reach).

Additional sampling was conducted to characterize the quality and vertical/horizontal distribution of contaminated material in the riverbanks. Six bank sampling transects were selected at RMs 0.4, 4.6/4.7, 6.8, 9.9, 11.2 and 11.25, where transect locations were biased to represent a "worse case" scenario and sample cores were driven to resistance. All samples collected were analyzed for TRPH. Select samples were also analyzed for the USEPA's priority pollutant VOCs, SVOCs, target analyte list metals, pesticides, herbicides, PCBs and cyanide.

Where appropriate, the sediment quality and quantity data collected during the current reconnaissance study were compared to the data from previous studies. Pennsylvania data was compared primarily to data collected during the 1999 Mahoning River Ohio Environmental Dredge Reconnaissance Study, to demonstrate differences between conditions in the Pennsylvania reach and those further upstream and closer to the sources of historical pollution. Although there were some differences between sample analyses and sample collection methodologies in the two studies, the intent of both studies was to characterize the quality and vertical/horizontal distribution of contaminated sediments and bank materials. All studies demonstrated a general trend towards decreasing concentrations of contamination with distance from historical sources.

concentrations were reported at around RM 16 and RM 37 in the Ohio reach. The highest TRPH concentration documented in the Pennsylvania reach was at RM 6.8, upstream of the only low-head dam in this reach.

- Total SVOC concentrations (mostly PAHs) did not appear to decrease as a function of distance from the former industrial sources. However, with the exception of one outlier (2,089 ppm reported in a sample collected upstream of the Youngstown-Hasselton Center Street Dam in the Ohio reach at RM 18.2), the concentrations reported in the Ohio and Pennsylvania samples were within the same order of magnitude.

- As with the Pennsylvania samples, Ohio sediments did not exhibit contamination by pesticides/herbicides or VOCs; however, low concentrations of PCBs were reported in a five of the sediment samples collected from the Ohio reach of the Mahoning River.

- The highest concentrations of chromium, copper, zinc, and lead occurred in Ohio samples. The mean lead concentration reported in Ohio was over one order of magnitude above the mean lead concentration reported in Pennsylvania (Figures 3-1and 3-2).

River Bank Sampling Results

Bank sampling conducted during the Pennsylvania Mahoning River Reconnaissance study included the collection of both surface (0 to 6 inches) and subsurface soil samples. At some locations, only surface samples were collected; at other locations, both surface and deeper samples were collected. Where deeper samples were collected and distinct soil horizons were analyzed, trends could be inferred from the data. Visual observations (Figure 3-3) reported during sampling indicated that a relatively clean layer of surface sediments was found above a more contaminated subsurface layer. The analytical data appeared to support this observation.

In addition to comparing surface and deeper bank samples, an attempt was made to determine how contamination appeared to vary as a function of distance from the former industrial sources.

The following trends were observed in the bank sampling results.

- Riverbank TRPH concentrations were within the same order of magnitude as the in-stream TRPH concentrations.

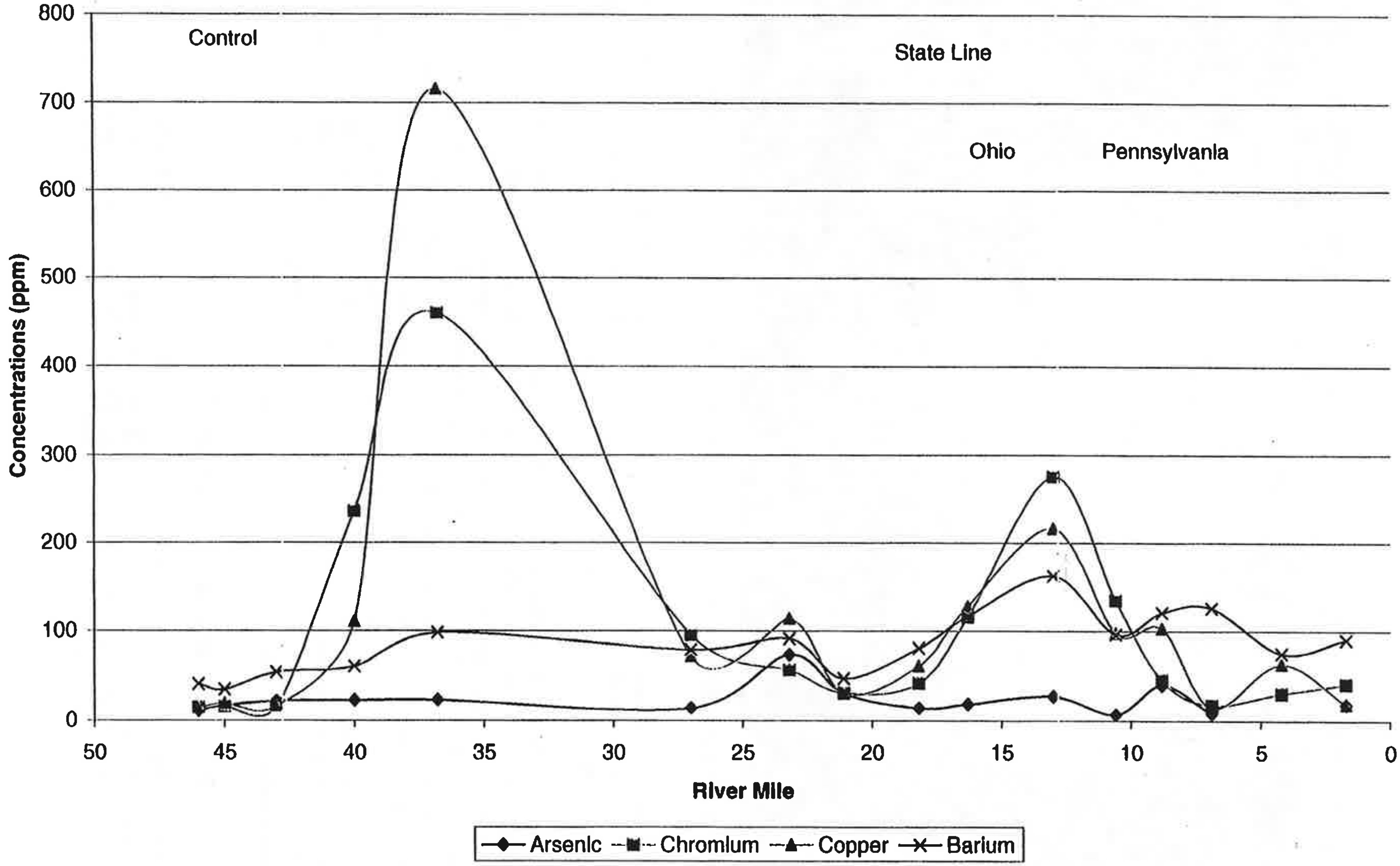
- Where vertical profiling was performed, deeper bank materials generally exhibited higher levels of TRPH contamination than surface bank materials (Figure 3-4).

- TRPH concentrations were generally higher at the bank/water interface than at overbank sample locations.

- No evidence was observed to suggest contamination by pesticides/herbicides, PCBs, or VOCs.

- Total SVOCs (mostly PAHs) were highest (~170 ppm) at RM 6.9, upstream of the only lowhead dam located within the Pennsylvania reach of the Mahoning River. PAH concentrations were elevated above those reported in the control reach (RM 46.2) even at the furthest downstream sample locations (RM 4.2 and 1.7).

Figure 3- 2. Lower Mahoning River Ohio and PA, Stream Channel Sediment Quality Metal Analyses, 1998 and 2000



Ohio samples were composited 0 to 4 feet deep;
Pennsylvania samples were 0 to 6 inches or surface

All sampling sites in the Mahoning River downstream from Warren Consolidated Industries and the Warren Wastewater Treatment Plant at RM 35.4 to the Beaver River (RM 0) exhibited non-attainment of water quality standards (OEPA, 1996). River quality begins to deteriorate significantly at about RM 39 (OEPA, 1996).

The greatest declines in the biological community metrics coincided with high to very high stressor and exposure indicator levels. The poor rating of the response indicators and exposure indicators extended downstream of the Pennsylvania state line (RM 12) despite generally low stressor levels from the state line to the mouth (OEPA, 1996).

A biological assessment (Damariscotta, 2000; Appendix C) was conducted of the Mahoning River in Lawrence County, Pennsylvania, to complement a biological assessment conducted earlier in the lower Mahoning River upstream of the Pennsylvania-Ohio state line (USACE, 1999a and Schroeder, 1998). The study area included the 12-mile section of the Mahoning River in Lawrence County, Pennsylvania that extends from the state line to its confluence with the Shenango River (RM 0) at New Castle, Pennsylvania.

Eight sampling sites were selected between the state line (RM 12) and the mouth of the Mahoning River (RM 0) (Damariscotta, 2000). The assessment procedures focused on three primary and two secondary OEPA-developed biotic indices to be consistent with the procedures used in the biological assessment conducted upstream of the study area (OEPA, 1996, Schroeder, 1998, Yoder and Rankin, 1999). The primary indices were:

- Invertebrate Community Index (ICI), used to measure overall macroinvertebrate community condition
- Qualitative Habitat Evaluation Index (QHEI), used to assess riverine habitat quality as an empirical quantified evaluation
- Index of Biotic Integrity (IBI), used to measure ecological impairment of a given river compared to relatively non-impacted rivers in the same ecoregion

The secondary indices were:

- Modified Index of Well Being (MIwb), used to measure the health of the fish community
- Deformities, Eroded Fins, Lesions, or Tumors (DELT) index, used to assess the physical health of the fish population.

Measured values for the above biotic indices are presented in Table 3-1 and are plotted against RM and shown in Figure 3-5. The reference value and mean Ohio study area value are also given for each index. The OEPA established that the reference zone for the Mahoning River quality was RMs 39–46. The reference values for the indices are reported in OEPA, 1996.

3.2.1 Invertebrate Community Index

The ICI compares the invertebrate populations in a stretch of the river to a reference area.

- The mean ICI score for the eight Pennsylvania sampling locations was 20.
- The mean ICI value reported for the Mahoning River in Ohio between RM 39 and RM 12 was 9.1 (Schroeder, 1998).
- The mean ICI value for the reference zone of river was 30 (Schroeder, 1998).
- None of the sampling locations generated the score of 34 necessary for a WWH designation.

These values indicated poor river quality and severe degradation as compared to the reference zone. The Pennsylvania reach of the Mahoning River shows overall higher ICI values than the Ohio study area, indicating improved invertebrate community quality as the river progresses downstream. This finding potentially exists because the Pennsylvania reach is relatively free flowing and is not influenced by low head dams. Additionally, it is assumed that greater concentrations of contaminated sediments and commensurably less suitable physical habitat for benthic organisms exist in the Ohio study area than in the Pennsylvania section of river. Generally, the total number of taxa tends to decrease in larger rivers or in the same river as it becomes larger flowing downstream because of a decrease in habitat types as the river becomes larger.

Table 3-1
Biological Indices Values for the Mahoning River in Pennsylvania and Ohio

INDEX	INDEX VALUES			
	Mahoning River Pennsylvania RMs 0–12 (Mean SD)[a]	Mahoning River Ohio RMs 12–35 (Mean SD)[b]	Reference Zone Ohio RMs 39–46 (Mean SD)[b]	Warm Water Habitat Criteria[c]
Invertebrate Community Index	20 4.3	9.1 4	30 8	34
Qualitative Habitat Evaluation Index	74.9 4.3	64 13	58 14	60
Index of Biotic Integrity	29.8 6.1	22 5	28 4	40
Modified Index of Well Being	5.9 2.6	5.5 1.3	7.6 0.7	8.7
Deformities, Eroded fins, Lesions, or Tumors	<0.1 0	14 7	5.6 3	<3

[a] Source: Damariscotta, 1999
[b] Source: Schroeder, 1998
[c] Source: OEPA. 1996

All sampling stations in Pennsylvania exceeded the WWH minimum. The greatest declines in the biological community metrics coincided with high stressor and exposure indicator levels. The QHEI data indicate that environmental stresses along the lower 12 miles of the Mahoning River are depressing the potential diversity of the aquatic macroinvertebrate populations, but the populations are generally improved over the upstream Ohio section. The data suggests that there is adequate substrate and cover, the depths of the pools and riffles offer suitable habitat, and the river is fairly stable. In the absence of any known significant source of water quality pollution, it is assumed that limiting toxic conditions exist within the substrate. The lack of overall pollution-sensitive taxa supports this assumption.

3.2.3 Index of Biotic Integrity

The Index of Biological Integrity examines 12 different quantifiable fish community metrics. The value of each metric is compared to the value expected at a reference site where human influence has been minimal. A rating of 5, 3, or 1 is assigned to each metric according to whether its value approximates (5), deviates some (3), or strongly deviates (1) from the value expected at a reference site. The maximum IBI score possible is 60 and the minimum is 12.

The individual IBI metrics measure attributes that are presumed to correlate with biotic integrity. Although no one metric alone can indicate this consistently, all of the IBI metrics combined include the redundancy that is needed to accomplish a consistent and sensitive measure of biotic integrity and a requirement when the system being evaluated is complex. The metrics examined three broad categories: species richness and composition, trophic composition, and fish abundance and condition.

- The study section of the Mahoning River in Pennsylvania had a mean IBI of 29.8.
- The Ohio portion of the Mahoning River between RM 12 and RM 39 had a mean value of 22 (Schroeder, 1998).
- The reference zone value was 28 (Schroeder, 1998).
- The WWH score criterion is 40.

Overall, the lack of pollution intolerant species, percent abundance of tolerant species, and lack of intolerant darter and sucker species in the study area contributed heavily to the calculated IBI for this stretch of river.

The Pennsylvania study area supports a viable fishery. This is validated by the number of DELT anomalies, number of insectivores, and total number of individuals, all of which contribute positively to increasing the IBI value.

Whenever structures (e.g., logs) were encountered during sampling, there was an increase in species numbers and diversity. This was reflected at stations where structures existed that apparently supplied habitat to fish species not encountered at the sampling stations where similar structures were absent.

Summary

The results of the biological assessment reflect a potentially recovering ecosystem (Table 2.2). The fishery remains degraded, but has improved from a historically severely polluted condition and shows a healthy condition for the level of present recovery. The Pennsylvania Fish and Boat Commission (PFBC) fish sampling data from 1999 also indicates a possible rebound of the fishery in the Mahoning River (PFBC, 1999). Overall, it appears that the lower 12 miles of the Mahoning River, though degraded in comparison to the reference area, supports a viable biotic community that could be enhanced through restoration activities.

4.0 PLAN FORMULATION

The preferred alternative plan recommended for the Ohio reach of the Mahoning River is dredging (hydraulic and mechanical) of contaminated bed material, removal of contaminated bank materials, and selected dam removals (USACE, 1999a). Since the fate of the Pennsylvania reach of the Mahoning is linked to the Ohio reach, it is essential to evaluate restoration of the Pennsylvania Mahoning considering restoration efforts upstream. However, it is unclear when, or if, the recommendations for the Ohio Mahoning will be implemented. Therefore, the following plan formulation will consider both implementation of the preferred alternative in Ohio and no action as a basis.

Furthermore, a comparison of biological, sediment, and soil conditions in the Pennsylvania Mahoning and the Ohio Mahoning shows that the Pennsylvania Mahoning exhibits impaired, but improved conditions compared with the Ohio Mahoning. The current plan formulation process acknowledges these differences.

In this section, several alternatives are considered and evaluated for ecosystem restoration in the Pennsylvania reach of the Mahoning River. They are:

- No action
- Bed material removal (dredging)
- Bank material removal
- In-situ bioremediation of bed and bank material
- Bed and bank material stabilization/capping
- Habitat enhancement
- Dam removal

4.1 No Action Alternative

The No Action Alternative will continue the gradual improvement observed in the biological assessment. However, it is not clear when, or if, a satisfactory equilibrium point will be reached under the no action alternative. The potential for improvement is also influenced by actions taken upstream in the Ohio Mahoning. If dredging and dam removal are conducted as recommended (USACE, 1999a), the potential for enhancing recovery exists unless the dredging and dam removal release contaminated sediments that subsequently settle in the Pennsylvania Mahoning. If such releases are successfully mitigated, the restoration activities proposed for Ohio would remove potential sources of contaminants to Pennsylvania, increase the stretch of free-flowing waters and, therefore, increase potential fish habitat, and aid in the natural transport of sediments through the Ohio and Pennsylvania reaches of the river. However, since reservoirs capture sediment from 784 mi^2 of the 1,132-mi^2 watershed (69%), a natural balance of sediment flow through the river is unlikely to occur.

4.2 Other Alternatives

This study, and others, have documented the existence of contaminated sediments in the riverbed, contaminated soil in the riverbanks, and impaired biological conditions. The alternatives considered here focus on removal or containment of all or part of the contaminated materials and improvements to the habitat structure of the river.

The depth of contamination was estimated based on the Photo Ionization Detector (PID) screening measurements and laboratory data. In each of the river transects the highest PID readings were recorded in the top 0.5 feet and diminished with depth. For this reason, all riverbed laboratory samples were taken from this depth. Depth of contamination was estimated at one-half of the mean boring depth at each transect. In the river, boring depths ranged from one to four feet with an average of 2.4 feet.

Volume estimates assume depths and widths at each transect are representative of conditions between transects. Table 4-1 shows that the volume of contaminated sediments is much greater from the Ohio-Pennsylvania border (RM 11.85) to RM 6.8. In this 5.05-mile stretch, 159,700 yd^3 (86%) of the total estimated volume is found. Potential dredging limits for RM 0.0 to 6.8 are adjacent to the banks and approximately symmetrical. Limits for RM 6.8 to 11.85 cover the entire channel width. These limits should be refined in the feasibility analysis.

Table 4-1
Estimated Volume of Contaminated Sediments

River Mile	Transect	Mean depth (ft)	Mean width (ft)	Volume (yd^3)	Volume per mi (yd^3)
0		1.1	10		
				3,700	2,176
1.7	1	1.1	10		
				9,900	3,960
4.2	2	1.6	20		
				11,400	4,385
6.8	3	1.4	10		
				2,200	22,000
6.9	4	1.2	160		
				69,100	36,368
8.8	5	1.2	150		
				55,400	30,778
10.6	6	0.9	150		
				33,000	26,400
11.85		0.9	150		
Total				184,700	15,586

It is recommended that dredging activity focus on RM 6.8 to the Ohio-Pennsylvania border (RM 11.85). In this reach, an estimated width of dredging varies, but approximates 150 to 160 feet. Using the long-stick excavator requires access to be developed along the river, either with roads along both banks, or with a temporary road constructed in the existing riverbed as dredging progresses. If dredging is a part of the preferred alternative, this choice is influenced by the strategy adopted for addressing contaminated soils in the banks and enhancing habitat (both of these alternatives are evaluated separately). However, given the nature of the banks along the Mahoning (heavily vegetated), constructing a temporary road within the existing riverbed is the preferred option. In fact, it is likely that two parallel roads will be required to cover the 160-foot dredging width with a 50-foot dredging apparatus.

separation rate combined with the anticipated dredging rate will influence the size of the dewatering basins. This dewatering approach is recommended.

- Natural drying – Sediments are spread out and allowed to dry in the sun. This approach is inexpensive, but requires a large drying area and equipment to turn it to complete drying. Confirmation that water infiltrating into the ground and evaporating into the atmosphere would pose no contamination danger to groundwater or air would need to be obtained. Some preliminary dewatering in a holding basin would likely be required to permit transportation of hydraulically dredged materials. This approach is not recommended.

- Other – Other options including filter presses, industrial centrifuges, evaporators, and stabilization by addition of amendments were also considered. Each of these options requires the construction of structures to hold the dewatering equipment. Continuing maintenance is also required. These options are not recommended because they are not well suited for the significant water content anticipated for the dredged materials.

For the purpose of sizing the recommended dewatering basins, it is assumed that hydraulically dredged material will require a basin volume equal to 125 percent of the estimated sediment volume and that mechanically dredged material will require a volume equal to 110 percent of the estimated sediment volume. Based on a sediment volume of 159,700 yd^3, the basin volumes are then 199,600 yd^3 and 175,700 yd^3, respectively. These volumes may need to be adjusted based on the actual water content, dewatering rate, and dredging rate.

Dewatering basins are designed to maximize capture of solids and meet suspended solids criteria in the discharge of water. Their shape and size may be highly variable, however, for this analysis, it will be assumed that they will be between 5 and 10 feet in depth.

For hydraulically dredged material, this will require a total surface area of between 12.4 and 24.7 acres, not including the area required for the berms and access. Since sediments may be pumped without a booster station up to two miles, the required area would be divided between two basins.

For mechanically dredged material, dewatering will require a total surface area of between 10.9 and 21.8 acres, not including the area required for berms and access. Mechanically dredged material may be trucked or pumped so it may require two basins or one larger, centrally located basin.

The berms of the holding basins are designed according to dam construction regulations with 6H:1V sidewalls. The material to construct the berms would be obtained from an off-site borrow source and transported to the work site(s) for grading and compaction. A 1-foot layer of gravel would be placed at the base of the holding basins to collect water, which would then be directed, to a corrugated metal piping system for discharge or treatment.

4.2.2 Bank Material Removal

Removal of contaminated soils from the river banks by excavation has been recommended as part of the Ohio study and was recommended for the Ohio reach of the Mahoning in an earlier study by the Corps (USACE, 1976). However, in the 1976 USACE study, it was concluded that bank materials in the Pennsylvania reach were not sufficiently contaminated to warrant excavation and the destruction of the riparian habitat. The excavation process consists of removal of contaminated soils, and either treatment or disposal. Mitigation to prevent releases of sediment downstream during excavation is also an important component of the process.

Selection of an effective excavation strategy depends, in part, on the volume of sediments to be removed and their location. Table 4-2 summarizes the volume estimates obtained during three field surveys. The table provides estimates of the mean depth and width of contamination at each transect where samples were taken. The mean widths given are divided equally between the two banks. For example, the mean width of 16.8 feet at transect 1 represents 8.4 feet on each bank. Volume estimates assume depths and widths at each transect are representative of conditions between transects. The table also shows that the volume of contaminated sediments is greater at the Ohio-Pennsylvania border (RM 11.85) and modestly diminishes to the confluence with the Shenango River (RM 0.0), primarily due to the decreasing estimated depth of contamination. However, the volume of contaminated bank soils is much more consistent throughout the study area than was observed earlier for contaminated river sediments.

Table 4-2

Estimated Volume of Contaminated Bank Soils

River Mile	Transect	Mean depth[1] (ft)	Mean width[1] (ft)	Volume (yd^3)	Volume per mi (yd^3)
0		1.2	16.8		
				6,700	3,941
1.7	1	1.2	16.8		
				11,500	4,600
4.2	2	1.6	16.8		
				16,800	6,462
6.8	3	3	12		
				600	6,000
6.9	4	2.4	12		
				13,400	7,053
8.8	5	3.6	12		
				15,200	8,444
10.6	6	3.6	12		
				10,600	8,480
11.85		3.6	12		
Total				**74,800**	**6,312**

[1] Width and depth increased by 20% to reflect sampling uncertainty.

Engineered treatments include solidification/stabilization, biological treatment, chemical treatment methods, and ground freezing. Solidification/stabilization immobilizes the sediment and contaminants by treating them with reagents that fix or solidify them. These reagents neutralize or bind the pollutants to reduce their mobility, usually through leaching. Problems associated with this type of treatment include inaccuracies in reagent placement, erosion, long-term monitoring requirements, the inability of the procedure to remove/detoxify contaminants, and the difficulty in adjusting solidification mixtures/agents for subaqueous settings. This technique also has not been accepted as treatment for contaminated sediment and would not be practicable in an area where there is the potential for disruption to the solidified mass.

Biological treatment of the soils can treat a wide range of organic contaminants, but not inorganics. Aerobic biological treatment effectively treats soils with organic materials and requires a continual supply of oxygen; therefore, it is not feasible for bottom sediments where organic concentrations and oxygen demands are high. Anaerobic biological treatment uses organisms that survive in an oxygen deficient environment to help combat the pollutants; however, the degradation is slower and applies to fewer compounds.

Chemical treatment of contaminated soils includes neutralization, precipitation, oxidation, and chemical dechlorination. Numerous problems exist with each of these treatments, but all *in situ* chemical treatments have a potential for secondary impacts. Therefore, it is limited to situations where the contaminated area can be contained during treatment or where the stream can be diverted. Another disadvantage with this method is the necessity of ensuring all treatment reagents are thoroughly mixed with the contaminated soil.

The use of ground freezing has been successfully employed for the construction of dams and tunnels in order to cut off water and support loads. Recently, the use of ground freezing for the treatment of contaminants in soils has been considered. It involves placing refrigeration probes into the contaminated area and allowing them to cool, thereby, allowing ice crystals to grow and form a wall of frozen sediment. The disadvantage to this method is that the process is slow and expensive because each probe can only freeze an area of about 1.5 feet in diameter, therefore, precluding it from use in areas with large volumes of contamination.

Solidification/Stabilization mixes reactive materials with solids, semi-solids, and sludges to immobilize contaminants. Disadvantages to this method entail many critical parameters including the selected stabilizing agents, other additives, waste-to-additive ratio, mixing variables, and curing conditions. Most of these depend upon the physical and the chemical make-up of the waste. Some tests show success in treating oily sludges and solvent-contaminated sludges and soils, but the most success with solidification/stabilization technologies has been the treatment of inorganic waste streams.

Numerous variations are available for this alternative. The most successful have been the cement-based and the silicate-based solidification. The cement-based method mixes the waste directly with the cement, whereas, the silicate-based waste uses a siliceous material and suitable setting agents to mix with the waste.

The use of a geosynthetic liner over the bank to minimize sloughing of material or other transfer of contaminants from the banks to the river could also be utilized. The liner would need to extend six feet onto the shore of the bank, which provides sixteen linear feet along the bank. The use of riprap placed over the liner would stabilize the bank. Natural vegetation may also be employed to stabilize the bank and to control erosion.

stabilization, it is recommended that if dredging, bank excavation, or any other construction-related restoration activities are implemented in the Ohio or Pennsylvania reaches of the Mahoning River, a period of at least two years should be allowed to pass before adding additional structures. This will allow the river to adjust to the other restoration activities and allow better planning for appropriate habitat structures in the adjusted river.

4.2.5 Dam Removal

A single partial dam exists in the Pennsylvania reach of the Mahoning River at RM 6.85. Originally breached at some time before 1976, its remains have been subjected to the river flows for over twenty years, further reducing the effects of the former dam. Except for the abutments secured in the riverbanks, the residue of the dam has created a small pool upstream and a riffle/rapids section downstream. Unless it is determined that the dam residue is an impediment to fish populations (it is most likely an asset), no further removal is recommended.

4.3 Plan Formulation

Six alternative plans have been formulated based on the strategies described in the previous sections. These plans are intended to describe the range of feasible options available for restoration of the Pennsylvania reach of the Mahoning River. The alternative plans are:

1. Plan 1. No action. No further action is taken. Further improvements to the ecosystem rely on natural processes.

2. Plan 2. Selective habitat restoration. Place improved substrate and structure at key locations in the river for fisheries habitat enhancement.

3. Plan 3. Hydraulic dredging and bank excavation of upper sub-reach. Removal of contaminated sediments and bank materials from the reach of river located between RM 6.8 and 11.85. All contaminated in-stream sediments and accessible contaminated bank materials will be removed, using mechanical dredging equipment. Improve habitat substrate. Dispose of dredged materials in a landfill if beneficial uses are not identified.

4. Plan 4. Mechanical dredging and bank excavation of upper sub-reach. Removal of contaminated sediments and bank materials from the reach of the river located between RM 6.8 and 11.85. All contaminated in-stream sediments and accessible contaminated bank materials will be removed, using mechanical dredging equipment. Improve habitat substrate. Dispose of dredged materials in a landfill if beneficial uses are not identified.

5. Plan 5. Hydraulic dredging and bank excavation of entire reach. Removal of contaminated sediments and bank materials from the entire study area, located between RM 0 and 11.85. All contaminated in-stream sediments and accessible contaminated bank materials will be removed using hydraulic dredging equipment. Improve habitat substrate. Dispose of dredged materials in a landfill if beneficial uses are not identified.

Plan 6 may be compared directly with Plan 4 because they both employ mechanical dredging. However, Plan 5 includes dredging and bank excavation throughout the entire 11.85-mile study reach rather than just the upper reach included in Plan 4. The total cost for Plan 6 is estimated at $40.5 million. Compared with Plan 4, Plan 6 would result in the removal of 24 percent more contaminated river sediments and bank material at a 45 percent increase in cost. The costs for Plan 6 are developed from Tables 4-7 and 4-9.

4.4.2 Natural and Cultural Resource Cost

Natural and cultural resource costs represent negative effects the proposed plans may have on the natural and cultural resources in the vicinity including consideration of mitigation activities. More information on these resources is found in a subsequent chapter.

The No Action Alternative, by definition, would not create additional negative impacts on the natural resources in the Pennsylvania reach of the Mahoning River. Selective habitat enhancement (Plan 2) would be expected to generate some impact because of the activity of construction vehicles, but with appropriate planning, these impacts should be negligible. Construction activities associated with the dredging and excavation alternatives (Plans 3, 4, 5, and 6) could be substantial and must be mitigated to make the project successful. Impacts to instream habitat, riparian vegetation, and downstream reaches could be significant, but can be mitigated by careful planning and attentive implementation. However, the potential negative natural resource effects of Plans 5 and 6 are approximately double those of Plans 3 and 4 because the construction area is approximately doubled.

Similarly, the No Action Alternative would not create additional negative impacts on the cultural resources adjacent to the study area. These resources are described more fully in a subsequent section. Selective habitat enhancement (Plan 2) should have negligible effects on cultural resources. Construction access roads are the only potential effect and can be located to avoid potentially significant resources. Cultural resources should also be avoidable in the dredging/excavation plans (Plans 3, 4, 5, and 6). Construction access roads, mobilization and laydown areas, and dewatering basins should be located to avoid known resources. Plans 5 and 6 would approximately double potential resource impacts compared to Plans 3 and 4 because the construction areas are double.

Table 4-4

Cost Estimate for Upper Sub-Reach Hydraulic Dredging

Item	Quantity	Unit	Unit Price[5]	Amount
CONSTRUCTION ITEMS				
Mobilization and Demobilization	1	JOB	$220,000	$220,000
Clearing and Grubbing from Land	None Required	Acre	$6,700	
Clearing and Grubbing from Water	None Required	Acre	$13,000	
Site Development: laydown area	1	JOB	$61,000	$61,000
Construction Access Roads (36' width)	2,400	LF	$90	$216,000
Temporary Instream Roads (20' width)	53,328	LF	$40	$2,133,120
Removal of Instream Roads (30% of construction)	53,328	LF	$12	$639,936
Dredging of Sediments (Hydraulic)	159,700	CY	$18	$2,874,600
Construction of Dewatering Basins	199,600	CY	$12	$2,395,200
Water Treatment (if needed)	439,810,000	Gallon	$0.0022	$967,582
Sediment Treatment	None Required	Ton		
Sediment Transportation	237,200	Ton	$9	$2,134,800
Sediment Disposal (landfill)	237,200	Ton	$20	$4,744,000
Utility/Facility Relocation	10	Facility	$4,000	$40,000
Total Construction Costs				$16,426,238
LANDS AND DAMAGES				
Easement Administrative Costs (tracts)	3	Easement	$15,000	$45,000
Easement Administrative Costs (road)	1	Easement	$100,000	$100,000
Easement (laydown and storage)	10	Acre	$750	$7,500
Easement (temporary road)	30	Acre	$1,000	$30,000
Easement (dewatering basins)	24.7	Acre	$750	$18,525
Total Lands and Damages				$201,025
RELOCATIONS	None Required			
ENVIRONMENTAL COMPLIANCE AND REQ'D MITIGATION[3]	1	JOB	$1,642,624	$1,642,624
ENGINEERING AND DESIGN[1]	1	JOB	$1,642,624	$1,642,624
CONSTRUCTION MANAGEMENT[2]	1	JOB	$1,396,230	$1,396,230
			Subtotal	$21,308,741
			Contingencies[4]	$5,327,185
			Total Costs	$26,636,000

1.Engineering and Design is estimated as 10% of construction costs.
2.Construction Management is estimated as 8.5% of construction costs.
3.Environmental compliance is estimated as 10% of construction costs.
4.Contingencies are estimated as 25% of total costs.
5. 2001 costs.

Table 4-6

Cost Estimate for Entire Reach Hydraulic Dredging

Item	**Quantity**	**Unit**	**Unit Price[5]**	**Amount**
CONSTRUCTION ITEMS				
Mobilization and Demobilization	1	JOB	$220,000	$220,000
Clearing and Grubbing from Land	None Required	Acre	$6,700	
Clearing and Grubbing from Water	None Required	Acre	$13,000	
Site Development: laydown area	1	JOB	$61,000	$61,000
Construction Access Roads (36' width)[6]	5,520	LF	$90	$496,800
Temporary Instream Roads (20' width)[6]	122,654	LF	$40	$4,906,176
Removal of Instream Roads (30% of construction)[6]	122,654	LF	$12	$1,471,853
Dredging of Sediments (Hydraulic)	184,700	CY	$18	$3,324,600
Construction of Dewatering Basins	230,900	CY	$12	$2,770,800
Water Treatment (if needed)	508,660,000	Gallon	$0.0022	$1,119,052
Sediment Treatment	None Required	Ton		
Sediment Transportation	274,300	Ton	$9	$2,468,700
Sediment Disposal (landfill)	274,300	Ton	$20	$5,486,000
Utility/Facility Relocation[6]	23	Facility	$4,000	$92,000
Total Construction Costs				$22,416,981
LANDS AND DAMAGES				
Easement Administrative Costs (tracts)	3	Easement	$15,000	$45,000
Easement Administrative Costs (road)[6]	1	Easement	$230,000	$230,000
Easement (laydown and storage)	10	Acre	$750	$7,500
Easement (temporary road)	69	Acre	$1,000	$69,000
Easement (dewatering basins)	28.6	Acre	$750	$21,450
Total Lands and Damages				$372,950
RELOCATIONS	None Required			
ENVIRONMENTAL COMPLIANCE AND REQ'D MITIGATION[3]	1	JOB	$2,241,698	$2,241,698
ENGINEERING AND DESIGN[1]	1	JOB	$2,241,698	$2,241,698
CONSTRUCTION MANAGEMENT[2]	1	JOB	$1,905,443	$1,905,443
			Subtotal	$29,178,770
			Contingencies[4]	$7,294,693
			Total Costs	$36,473,000

1.Engineering and Design is estimated as 10% of construction costs.
2.Construction Management is estimated as 8.5% of construction costs.
3.Environmental compliance is estimated as 10% of construction costs.
4.Contingencies are estimated as 25% of total costs.
5. 2001 costs.
6. Quantities estimated by multiplying the selective estimates by 2.3 (proportional to river length).

Table 4-8

Cost Estimate for Upper Sub-Reach Bank Excavation

Item	Quantity	Unit	Unit Price[5]	Amount
CONSTRUCTION ITEMS				
Mobilization and Demobilization	1	JOB	$220,000	$220,000
Clearing and Grubbing from Land	None Required	Acre	$6,700	
Clearing and Grubbing from Water	8.1	Acre	$13,000	$105,300
Site Development: laydown area[6]	None Required	JOB	$61,000	
Construction Access Roads[6]	None Required	LF	$90	
Temporary Instream Roads[6]	None Required	LF	$40	
Removal of Instream Roads[6]	None Required	LF	$12	
Excavation	19,200	CY	$28	$537,600
Sediment Treatment	None Required			
Sediment Transportation	28,500	Ton	$9	$256,500
Sediment Disposal (landfill)	28,500	Ton	$20	$570,000
Utility/Facility Relocation[6]	None Required	LF	$4,000	
Total Construction Costs				$1,689,400
LANDS AND DAMAGES				
Easement Administrative Costs (tracts)	20	Easement	$15,000	$300,000
Easement (bank excavation)	12	Acre	$1,000	$12,000
Total Lands and Damages				$312,000
RELOCATIONS	None Required			
ENVIRONMENTAL COMPLIANCE AND REQ'D MITIGATION[3]	1	JOB	$168,940	$168,940
ENGINEERING AND DESIGN[1]	1	JOB	$168,940	$168,940
CONSTRUCTION MANAGEMENT[2]	1	JOB	$143,599	$143,599
			Subtotal	$2,482,879
			Contingencies[4]	$620,720
			Total Costs	$3,104,000

1.Engineering and Design is estimated as 10% of construction costs.
2.Construction Management is estimated as 8.5% of construction costs.
3.Environmental compliance is estimated as 10% of construction costs.
4.Contingencies are estimated as 25% of total costs.
5. 2001 costs.
6. No additional costs if completed with dredging.

4.4.3 Aquatic Ecosystem Benefit

The Pennsylvania reach of the Mahoning River has experienced a partial recovery as is demonstrated by the biological assessment performed as part of this study. Additional improvements may be achieved as measured by various biotic indices including the Invertebrate Community Index (ICI), the Index of Biotic Integrity (IBI), the Modified Index of Well Being (MIwb), Deformities, Eroded Fins, Lesions and Tumors (DELT), and the Qualitative Habitat Evaluation Index (QHEI). The degree to which these measures will improve with any particular action is speculative so a monitoring program is important to determine if anticipated benefits are being realized.

The aquatic ecosystem benefit of no action (Plan 1) is considered low. The river has made improvements as discharges upstream have been reduced or eliminated. However, the ability to make further improvements may be limited by the existence of contaminated banks and sediments as well as the dams located upstream in Ohio.

According to the biological assessment, two factors limiting habitat are a lack of structure and poor substrate. Selective improvements (Plan 2) to these two factors are expected to produce moderate benefits to the aquatic habitat beyond what the river can accomplish on its own.

The dredging/excavation alternatives (Plans 3, 4, 5, and 6) have a high potential for improving the aquatic ecosystem by removing contaminated bank and sediment material. A component of all of these plans is to improve substrate conditions throughout the work areas as contaminated river sediments are removed. Because Plans 5 and 6 address the entire 11.85-mile study area, the potential benefits of Plans 5 and 6 would be somewhat greater than Plans 3 and 4. However, as noted before, construction for all three of these plans must be conducted so that damage to the habitats is not permitted.

Conditions in the Ohio reach of the river contribute to the ability of the river in Pennsylvania to improve. If no action is taken in Ohio, these conditions may limit the benefits of any of the plans applied to the Pennsylvania reach.

4.4.4 Economic/Social Benefit

Economic and social benefits derived from a restoration project in the Pennsylvania Mahoning River include increases in recreation activities, extractive use benefits for municipal and industrial water users, and non-user benefits. Quantification of these benefits is beyond the scope of this study so comments are qualitative. A useful reference for further assessment is a study by Dr. Richard Thorn of the University of Pittsburgh (1981).

Potential benefits in recreational uses include fishing, swimming, and boating. The increase in fishing would result from a general increase in aquatic wildlife diversity, but particularly from restoration of the smallmouth bass and other warmwater fish populations to the Mahoning River. Diversification of aquatic wildlife and continued improvements in water quality could also result in increases in boating, and perhaps swimming uses.

Extractive use benefits relate to improvements in water quality that permit increases in withdrawals for municipal water supply and industrial process or cooling water. Two factors limiting this benefit for this project are: 1) water quality is already supportive of many municipal or industrial uses and 2) little evidence exists that water supply needs in the region are unmet.

Beyond this general issue, further investigation is warranted on issues specific to each alternative plan, as follows:

- Plan 1: No action
  - What is the expected rate of natural attenuation of contaminants, and what are the limits to continued self-cleansing?
- Plan 2: Selective habitat enhancement
  - What types of habitat structures are most appropriate for the Mahoning River?
  - How many structures are appropriate and where should they be located?
  - What is the optimum type of substrate enhancement and how extensively should it be placed?
  - Will modifications in the operations of upstream Corps reservoirs improve habitat conditions?
  - Should habitat enhancement be pursued under the Authority of Section 206?
- Plans 3, 4, 5, and 6: Dredging, bank excavation, and substrate placement
  - Confirm extent of sediment and bank contamination through additional sampling.
  - Assess feasibility of instream roads and the use of construction equipment capable of operating in shallow riverine environments as well as in the deeper pools.
  - Research effects of bank excavation on riparian vegetation.
  - Investigate use of the rails-to-trails easement in lieu of temporary rail crossings for construction access.
  - Select hydraulic or mechanical dredging equipment.

4.5 Preferred Alternative

Based on the preceding analysis, the preferred alternative can not be determined without considering anticipated actions in the Ohio reach of the river. The Corps has completed a reconnaissance study of the Ohio reach and is seeking cost share partners for the feasibility study. The preferred alternative for Pennsylvania is dependent on the course of action pursued in Ohio.

If no action is taken in Ohio the potential benefits of extensive work in the downstream Pennsylvania reach of the river are considered limited by the upstream conditions. Therefore, the preferred alternative under this scenario is either no action (Plan 1) or selective habitat enhancement (Plan 2). If, however, action is taken in Ohio to implement the recommended dredging, bank excavation, and dam removal, the potential benefits of compatible actions in Pennsylvania may be maximized. Therefore, the preferred alternative is Plan 5. Hydraulic Dredging and Bank Excavation of Entire Reach. This plan consists of the following components:

5.0 REAL ESTATE

The purpose of this section is to outline the real estate issues for the preferred alternative, to discuss the real estate interests needed to implement the plan and to provide a cost estimate to acquire those interests.

The real estate considerations for this environmental dredging project are complex for several reasons. The first is the application of the Government's rights under navigation servitude. The navigation servitude is defined as the Government's dominant right to use, control and regulate the navigable waters of the United States and the submerged lands there-under for various commerce-related activities, such as navigation and flood control. This power derives from the Commerce Clause of the U.S Constitution (U.S. CONST. Art. I, §8, cl.3). The limit of the navigational servitude rights, for this project, is the OHW mark on each bank. All lands lying at or below the existing OHW elevation are considered part of the servitude rights and can be used by the Government without paying just compensation to the adjacent landowner. Application of these rights is determined by evaluating whether the waterway is navigable. The Mahoning River is considered a navigable waterway of the United States of America; therefore, the navigational servitude rights apply. Therefore, only the lands that lie outside the limits of the servitude are included in this section.

The preferred alternative calls for the removal of the material in the river by hydraulic dredging methods within the servitude between River Miles 0 and 11.85, and selective bank remediation consisting of removal of 50% of the bank material, also located between River Miles 0 and 11.85 and extending outside of the servitude limits.

The hydraulic dredging method requires dewatering basins of between 14.3 and 28.6 acres. This section includes costs for the entire 28.6 acres. Most of the bank work will be below the existing OHW elevation and will consist of placing a geotextile fabric and stone on the banks. However, portions of the banks will be remediated by excavating them to a point 20 feet back from the ordinary high water line. A real estate interest will be required for these areas. The real estate interest, or estate, that will be acquired for the bank remediation is a modified standard temporary work-area easement. Normally, excavating and replacing material is considered a project feature that requires a permanent real estate interest for operation and maintenance. The excavation work for this project, however, is intended solely to remove contaminated material from the banks and re-build the banks where necessary. The banks will then be allowed to return to their natural condition. No permanent real estate rights are needed for operation and maintenance purposes; therefore, only a temporary work-area easement is recommended for removal of the bank deposits. The bank excavation work consists of approximately 28 acres of land. (The term of the easement should be sufficient to re-stabilize the banks.)

Temporary road easements are also needed for access roads to the river. Access to the river is excellent from the right bank. The Norfolk-Southern railroad parallels the right bank from a point near the mouth of the Mahoning River all the way to the State line. The riverward track of a formerly two track system has been removed thus permitting easy access by construction equipment. Only in a few scattered areas does the river diverge significantly from the railroad. One of these areas can be used as a site for the dewatering basins. The left bank is occupied by the CSX railroad tracks; access from this side is not recommended. The total amount of temporary road easement is estimated to be 69 acres.

6.0 Environmental Assessment

6.1 Cultural Resources

A survey of historic and archaeological sites along and within 0.5 mile on either side of the river was conducted using resources at the Pennsylvania Bureau for Historic Preservation and Bureau of Environmental Quality (Appendix D and Plate 1). Eleven historic sites were identified within this corridor; six of these were located within the Mahoning River floodplain. One site, the bridge over the Mahoning River at Covert's Crossing (RM 4.64), has been determined by the Pennsylvania State Historic Preservation Office to be eligible for the National Register of Historic Places. A total of 22 archaeological sites and surveys were identified in the corridor. Twenty of these sites were located in close proximity to the river channel, and eight of these, including one survey site, were located within the floodplain. The archaeological survey site, Site "A", RM 3, was at a proposed wetland mitigation site for the Beaver Valley Expressway. If Plan 2, 3, 4, or 5 is implemented, action should be taken in consultation with the State Historic Preservation Office to avoid or mitigate any potential impact to the bridge at Covert's Crossing.

6.2 Natural Resources

The USFWS, Pennsylvania Game Commission, PFBC, and Pennsylvania Department of Conservation and Natural Resources (PaDCNR) were contacted (Appendix E) requesting information on Federal and State-listed threatened or endangered species in the vicinity of the Mahoning River from the Pennsylvania state line to the Mahoning River's confluence with the Shenango River. The PaDCNR identified one state-endangered species, the Crepis rattlesnake root (*Prenanthes crepidinea*) as being documented in a small wooded floodplain along the River near Robinson (approximately RM 10.5). The other agencies identified no listed species as occurring in the project area. If Plan 2, 3, 4, or 5 is implemented, actions should be taken in consultation with the PaDCNR to avoid or mitigate any potential impact to the Crepis rattlesnake root.

6.3 Hazardous, Toxic, and Radiological Waste

A database search for hazardous material sites was performed for the Mahoning River, along the 12-mile stretch from the Ohio border to the confluence with the Shenango River. The search areas included a half-mile distance from the river along the study area. Seven sites were identified in the database and mapped on Plate 1.

1. IB Diesel Service, Inc. located on Route 422, is a RCRIS Small Quantity Generator of hazardous wastes.

2. United States Cement Company, located at 6969 Center Road in Lowellville, Ohio, is a RCRIS Small Quantity Generator of hazardous wastes.

3. Browning-Ferris Industries of Ohio, located at 8100 State Line Road in Lowellville, Ohio, is a licensed municipal solid waste landfill.

7.0 SUMMARY AND CONCLUSIONS

This Lower Mahoning River Environmental Dredging Reconnaissance Study was conducted by the United States Army Corps of Engineers (USACE) pursuant to Section 312 of the Water Resources Development Act of 1990, as amended by Section 205 of the Water Resources Development Act of 1996. The amended Section 312 provides for the removal of contaminated sediments within "navigable waters" for the purpose of ecosystem restoration. Planning for projects to remove and remediate contaminated sediments is conducted in two phases: a reconnaissance phase and a feasibility phase. This report was prepared as part of the reconnaissance phase study.

The Mahoning River is 108 miles long, rising in Columbiana County, Ohio and flowing northward to Warren, Ohio and then southeasterly to New Castle, Pennsylvania, where it joins the Shenango River to form the Beaver River. In 1999, the Corps completed a reconnaissance study of a 31-mile stretch of the Lower Mahoning River located in northeastern Ohio, from Warren, Ohio (River Mile 42.9) to the Ohio-Pennsylvania border (River Mile 11.85). The reconnaissance study included a biological assessment, a sediment investigation, and an analysis of potential restoration alternatives. Based on the study findings, removal of contaminated material was recommended.

The purpose of this reconnaissance study was to complement the Ohio study and determine problems and opportunities for ecosystem restoration related to contaminated sediments in the Lower Mahoning River in Pennsylvania. The area of study included the 12-mile reach of the Lower Mahoning River that lies between the Ohio-Pennsylvania state line and the river's confluence with the Shenango River at New Castle. The Lower Mahoning River in Pennsylvania has been identified as being moderately to severely impaired due to contaminated sediments originating from upstream industrial activity in the Ohio reaches of the river.

The Lower Mahoning River project goal was to identify the activities and level of funding necessary to remediate the Lower Mahoning River within the study reach. The remediation, as conceived for this study, is intended to restore the aquatic ecosystem to the biotic integrity existing on a model reach of the Lower Mahoning River located just upstream of the study area. The success of the Lower Mahoning River Environmental Dredging Project is linked to the restoration of the upstream Ohio portion of the Lower Mahoning River and the elimination of the Ohio Department of Health Public Health Advisory. The objective is to reestablish a fishable and swimable stream in compliance with the mandates of the Clean Water Act.

Restoration of the riverine habitat will benefit the aquatic ecosystem and serve as a focus for the revitalization of recreation along the Lower Mahoning River. The riparian corridor is mostly intact and aesthetically appealing. The principal opportunity is to return the river and its ecosystem to a healthy condition, thus allowing the river to become a scenic recreational resource that will serve as a focus for the revitalization of the Lower Mahoning River. This, in turn, would lead to economic benefits for the area.

Work for this reconnaissance study of the Pennsylvania reach of the Lower Mahoning River included an evaluation of historical data and the collection of new data. The historical data was obtained from previous studies, published reports, and other sources of information. The existing data was reviewed to characterize the natural, cultural, and socioeconomic resources within the study area; to ascertain water resource and ecosystem problems and opportunities; to identify on-and the mouth of the Mahoning River. The assessment procedures focused on three primary and two secondary Ohio EPA-developed biotic indices, consistent with the procedures used in the Ohio study.

The results of the biological assessment reflect a potentially recovering ecosystem. Although degraded, the fishery showed a trend towards improvement when compared to historical conditions. The Pennsylvania Fish and Boat Commission fish sampling data from 1999 also indicates a possible rebound of the fishery in the Mahoning River. Overall, it appears that the lower 12 miles of the Mahoning River, though degraded in comparison to the reference area, supports a viable biotic community that could be enhanced through restoration activities.

Based on previously collected information as well as the data collected for this study, various restoration alternatives were formulated and evaluated. Recommendations for implementation were presented based on their costs and technical feasibility, as well as their potential impacts on natural, cultural, and socioeconomic resources.

The preferred alternative plan recommended for ecological restoration of the Ohio reach of the Mahoning River is dredging (hydraulic and mechanical) of contaminated bed material, removal of contaminated bank materials, and selected dam removals. Since the fate of the Pennsylvania reach of the Mahoning is linked to the Ohio reach, it is essential to evaluate restoration of the Pennsylvania Mahoning considering restoration efforts upstream. Therefore, the plan formulation of alternatives and selection of a preferred alternative considered two possible actions for the Ohio portion, which include: (1) no action is taken in Ohio or (2) action is taken in Ohio, as the basis.

Six alternative plans have been formulated. These plans are intended to describe the range of feasible options available for restoration of the Pennsylvania reach of the Mahoning River. The alternative plans are:

1. Plan 1. No action. No further action is taken. Further improvements to the ecosystem rely on natural bioremediation and attenuation processes.

2. Plan 2. Selective habitat restoration. Place improved substrate and structure at key locations in the river for fisheries habitat enhancement.

3. Plan 3. Hydraulic dredging and bank excavation of upper sub-reach. Removal of contaminated sediments and bank materials from the reach of the river located between RM 6.8 and 11.85. All contaminated in-stream sediments and accessible contaminated bank materials will be removed using hydraulic dredging equipment. Improve habitat substrate. Dispose of dredged materials in a landfill if beneficial uses are not identified.

4. Plan 4. Mechanical dredging and bank excavation of upper sub-reach. Removal of contaminated sediments and bank materials from the reach of the river located between RM 6.8 and 11.85. All contaminated in-stream sediments and accessible contaminated bank materials will be removed, using mechanical dredging equipment. Improve habitat substrate. Dispose of dredged materials in a landfill if beneficial uses are not identified.

removal of the bank deposits. The bank excavation work consists of approximately 28 acres of land. (The term of the easement should be sufficient to re-stabilize the banks.)

Temporary road easements are also needed for access roads to the river. Access to the river is excellent from the right bank. The Norfolk-Southern railroad parallels the right bank from a point near the mouth of the Mahoning River all the way to the State line. The riverward track of a formerly two track system has been removed thus permitting easy access by construction equipment. The total amount of temporary road easement is estimated to be 69 acres.

A 10-acre site needed for contractor laydown and storage areas will be acquired using the standard temporary work-area easement. A disposal site for the dredge and excavated material has not been included because the preferred alternative calls for the beneficial re-use of the material. A beneficial re-use considers the material to be an asset instead of a liability. As such, the material may be used as fill material on commercial or industrial land, for the restoration of brownfield sites or as cover in a licensed landfill.

No residences, farms or businesses have to be relocated as part of the preferred alternative, although some utility/facility relocations are included for submarine crossings. Attorney's Opinions of Compensability for these facilities will be prepared during the feasibility phase of the study to determine the Government's responsibilities to provide a replacement utility/facility.

The value of the land, including administrative costs, is estimated to be $1.18 million. A breakdown of unit costs, as well as the costs for the alternative plans, is provided in Section 4.4.1.

Environmental considerations associated with the preferred alternative include: socio-economic; cultural and natural resources; hazardous, toxic, and radiological waste (HTRW); fish and wildlife; endangered species; public involvement; and environmental benefits. Environmental documentation would involve preparation of an environmental assessment (EA) and finding of no significant impact (FONSI) or an environmental impact statement (EIS and record of decision (ROD). The estimated cost for environmental compliance is approximately $2.44 million.

Total project cost, including engineering and design, for the preferred alternative is detailed in Table 4-6 and Table 4-9 and equals $42.4 million. Construction cost is cost-shared on a 65% Federal to 35% non-Federal basis.

Identification of a non-Federal sponsor will allow the study process to continue. The sponsor must agree to pay one-half of the cost of the Feasibility Study, the next step in the restoration effort. The Feasibility Study is estimated to cost in the range of $1.5 to $2 million. Once a non-Federal sponsor is identified a project study plan will better define the Feasibility Study cost.

7.0 SUMMARY AND CONCLUSIONS

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secondary Ohio EPA-developed biotic indices, consistent with the procedures used in the Ohio study.

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4. Plan 4. Mechanical dredging and bank excavation of upper sub-reach. Removal of contaminated sediments and bank materials from the reach of the river located between RM 6.8 and 11.85. All contaminated in-stream sediments and accessible contaminated bank materials will be removed, using mechanical dredging equipment. Improve habitat substrate. Dispose of dredged materials in a landfill if beneficial uses are not identified.

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A 10-acre site needed for contractor laydown and storage areas will be acquired using the standard temporary work-area easement. A disposal site for the dredge and excavated material has not been included because the preferred alternative calls for the beneficial re-use of the material. A beneficial re-use considers the material to be an asset instead of a liability. As such, the material may be used as fill material on commercial or industrial land, the restoration of brownfield sites or as cover in a licensed landfill.

No residences, farms or businesses have to be relocated as part of the preferred alternative, although some utility/facility relocations are included for submarine crossings. Attorney's Opinions of Compensability for these facilities will be prepared during the feasibility phase of the study to determine the Government's responsibilities to provide a replacement utility/facility.

The value of the land, including administrative costs, is estimated to be $1.18 million. A breakdown of unit costs, as well as the costs for the alternative plans, is provided in Section 4.4.1.

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Total project costs, including engineering and design, for the preferred alternative is detailed in Table 4-6 and Table 4-9 and equal $42.4 million. Construction cost are cost-shared at a 65% Federal to 35% non-Federal basis.

Identification of a non-Federal sponsor will allow the study process to continue. The sponsor must agree to pay one-half of the cost of the Feasibility Study, the next step in the restoration effort. The Feasibility Study is estimated to cost in the range of $1.5 million to $2 million.

8.0 RECOMMENDATIONS

It is recommended that this reconnaissance report be used as a technical reference document to facilitate further dialog between the USACE and non-Federal agencies including the Commonwealth of Pennsylvania and local Lawrence County officials, for further study efforts. It is further recommended that, after receipt of a letter of intent to be the cost-sharing partner for the feasibility phase, this report be used as a basis for the preparation of a draft Feasibility Study Cost-Sharing Agreement (FCSA) that contains a Project Study Plan (PSP). Completion of the draft FCSA/PSP would allow the conduct of a Reconnaissance Review Conference, if required, between the representatives of the local sponsor and the USACE, and certification of the reconnaissance phase of study. Reconnaissance certification could then be followed by final negotiations and execution of the FCSA/PSP by the local sponsor and the USACE.

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10.0 ACRONYMS AND ABBREVIATIONS

Ac-ft	Acre-foot
Cfs	Cubic Feet/Second
DELT	Deformities, Eroded Fins, or Tumors
DO	Dissolved Oxygen
FCSA	Feasibility Study Cost-Sharing Agreement
Ft	Foot
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
Mi	Mile
MIwb	Modified Index of Well Being
NPDES	National Pollutant Discharge Elimination System
ODH	Ohio Department of Health
OEPA	Ohio Environmental Protection Agency
OHW	Ordinary High Water
PaDCNR	Pennsylvania Department of Conservation and Natural Resources
PaDEP	Pennsylvania Department of Environmental Protection
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PEM1	Palustrine Emergent Persistent
PEM2	Nonpersistent Emergent Persistent
PFBC	Pennsylvania Fish and Boat Commission
PFO1	Palustrine Forested Broad-leaved Deciduous
POTW	Publicly-owned Treatment Works
Ppm	Parts per Million
PSP	Project Study Plan
PSS1	Palustrine Shrub-Scrub Broad-leaved Deciduous
PUB	Palustrine Unconsolidated Bottom
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SR	State Route
SVOCs	Semivolatile Organic Compounds
TRPH	Total Recoverable Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOCs	Volatile Organic Compounds
WWH	Warm Water Habitat
WWTP	Wastewater Treatment Plant
Yd	Yard