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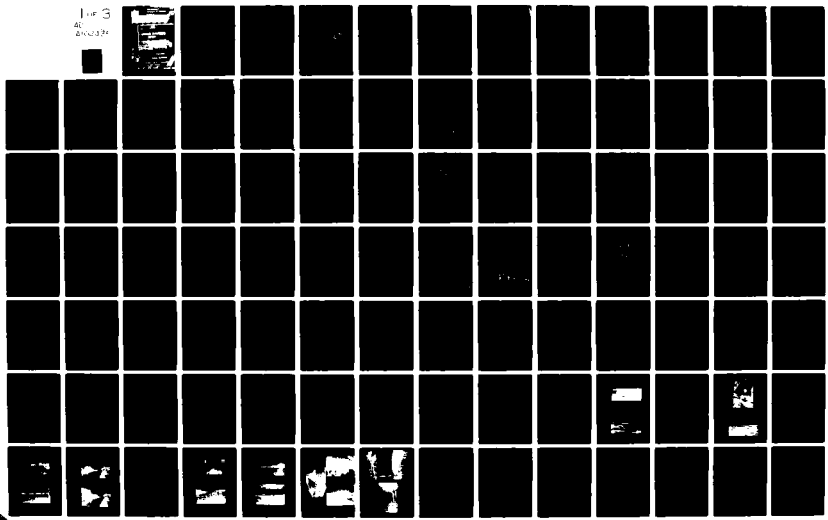

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This technical appendix documents work preformed in the preparation of preliminary engineering designs, cost estimates and other related work for modifications to the Federal commercial navigation project at Lorain Harbor, Ohio. The document work is part of a "Preliminary Feasibility Report" for commercial navigation improvements to Lorain Harbor being prepared by the Buffalo District, U.S. Army Corps of Engineers. The purpose of this report is to clearly document the engineering analysis, quanity estimates and cost estimates developed for proposed alternative navigation improvements.

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Prime emphasis has been on alternative engineering solutions that would enable passage and safe navigation of new and larger vessels operating on the Great Lakes. It has been determined that the solutions should meet the navigation needs of vessels in the Class 10 (1000 ft. x 105 ft. x 28 ft.) and larger categories (1200ft. x 130 ft. x 28 ft.) that are now, or are projected to operate on the Great Lakes.

LORAIN HARBOR, OHIO
PRELIMINARY FEASIBILITY STUDY
(STAGE 2)
REVIEW OF REPORTS

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A Preliminary Engineering Designs and Cost Estimates

B Economic Evaluation

C Cultural Resources

D Fish and Wildlife Coordination

E 1,000-Foot Vessel Information

F Study Management

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This Preliminary Feasibility Report on Lorain Harbor is the result of input, research, and study by many individuals from the Corps of Engineers, other Federal agencies, State of Ohio agencies, local agencies, industry, and the consulting engineering firm of Michael Baker Associates. Personnel who contributed significantly to the content of this report are as follows:

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- Robert James Webster, Jr., Project Manager
- Michael Pelone, Regional Economist
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Other agencies participating in this phase of the Lorain Harbor Study include:

North Central Division, Corps of Engineers

U. S. Fish and Wildlife Service

Ohio Department of Natural Resources

Lorain Planning Agency

Industrial Users of the Lorain Harbor

The report itself was produced through the efforts of many other Corps personnel, including the following who contributed significantly to its preparation:

Roman Bartz - Chief, Drafting Section
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Lillian Stryczek - Word Processing Center
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The Buffalo District Engineer during the preparation of this Preliminary Feasibility Report was Colonel George P. Johnson. The Chief of Engineering Division was Donald M. Liddell. The Chief of the Planning Branch was Charles E. Gilbert. The study was performed under the direct supervision of John Zorich, Chief of the Western Basin.

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SECTION A
INTRODUCTION

Lorain Harbor, located on the south shore of Lake Erie approximately 25 miles west of Cleveland, OH and 90 miles east of Toledo, OH, accommodates the waterborne movement of bulk cargo to and from the city of Lorain and points inland. It serves developments within Lorain and throughout industrial and commercial portions of the State of Ohio and adjacent States. Iron ore and limestone are the major cargoes handled. The present configuration of the breakwaters and river channel limit the size of vessel which can move these commodities. Significant transportation savings can be realized if the harbor were modified to permit the use of larger, more efficient vessels. (See Plate 1).

GEOGRAPHIC SETTING

Lorain Harbor, in the northcentral part of Ohio, consists of a lake approach channel, an outer harbor, and a navigation channel in the Black River which serves as the inner harbor, as shown on Plate 1. The outer harbor consists of a triangular shaped area of about 60 acres protected by four breakwater structures. The inner harbor consists of an improved channel extending approximately 3 miles up the Black River.

STUDY AUTHORITY

Recognizing the importance of commercial navigation to the economy of the nation, the Committee on Public Works and Transportation of the House of Representatives on 23 September 1976 passed the following resolution:

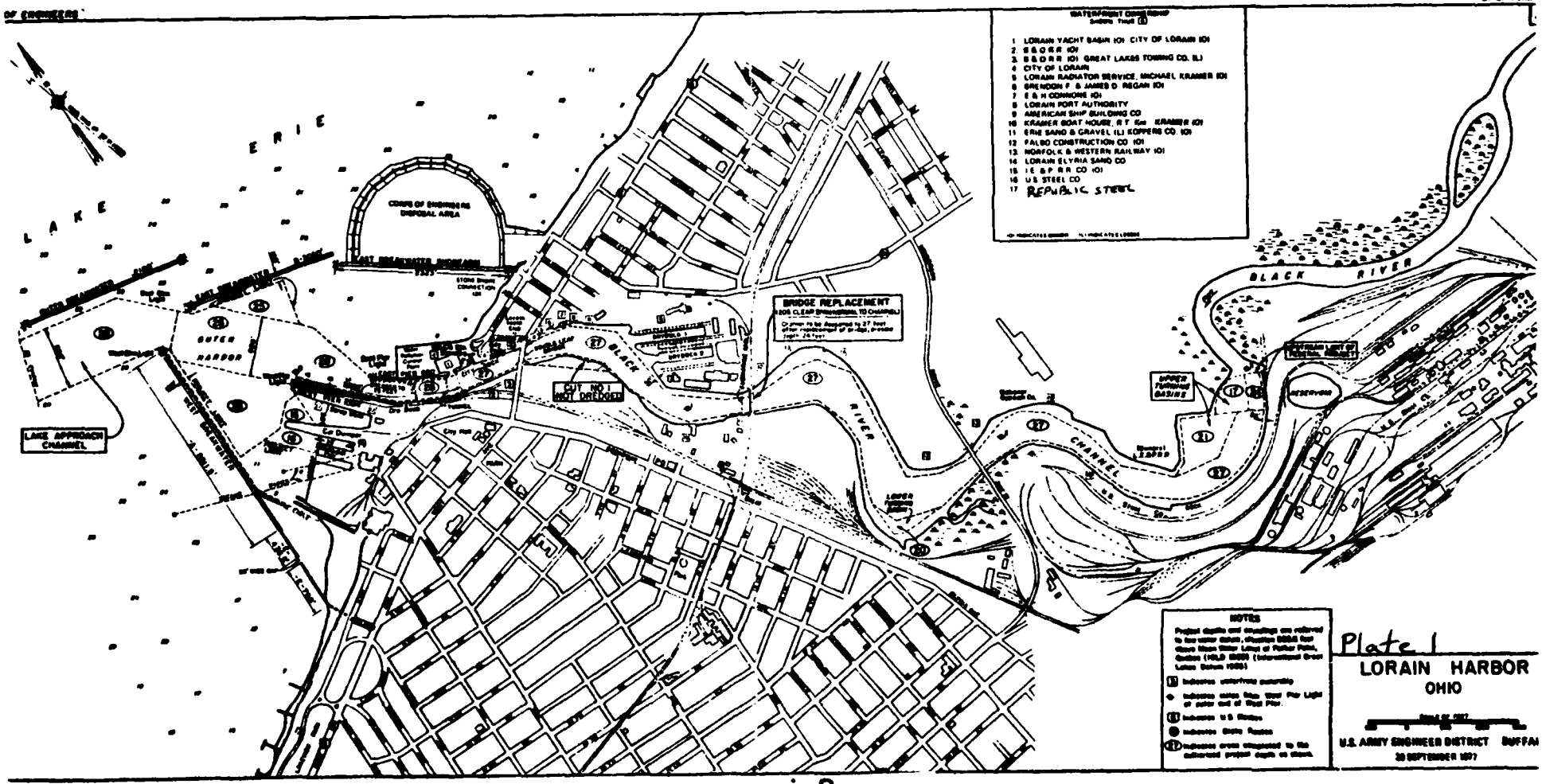
> "Resolved by the Committee on Public Works and Transportation of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Lorain Harbor, Ohio, published in House Document No. 166, 86th Congress, 1st Session, and other pertinent reports, with view of determining whether any modification to the recommendations contained therein is advisable at the present time, including consideration of the passage and safe navigation of new and larger ships operating on the Great Lakes."

This quoted resolution is the authority under which this Preliminary Feasibility Report is prepared.

SCOPE OF STUDY

As a result of public involvement and coordination activities undertaken during Stage 1 (Preparation of the Reconnaissance Report), the following principal water resources problems and needs at Lorain Harbor were identified for further study:

a. Harbor modifications for commercial navigation;


WATERFRONT OWNERSHIP
1 LORAIN YACHT BASIN (O) CITY OF LORAIN (O)
2 B & O R R (O)
3 B & O R R (O) GREAT LAKES TOWING CO. (L)
4 CITY OF LORAIN
5 LORAIN RADIATOR SERVICE, MICHAEL KRAMER (O)
6 BRENDON F. & JAMES D. REGAN (O)
7 E & H CORNORE (O)
8 LORAIN PORT AUTHORITY
9 AMERICAN SHIP BUILDING CO
10 KRAMER BOAT HOUSE, R.T. Kas KRAMER (O)
11 ERIE SAND & GRAVEL (L) KOPPERS CO. (O)
12 FALBO CONSTRUCTION CO (O)
13 NORFOLK & WESTERN RAILWAY (O)
14 LORAIN ELYRIA SAND CO
15 I.E.&P.R.R. CO (O)
16 U.S. STEEL CO
17 REPUBLIC STEEL
LAKE ERIE
CORPS OF ENGINEERS DISPOSAL AREA
EAST BREAKWATER
OUTER HARBOR
LAKE APPROACH CHANNEL
CUT NO 1 NOT DREDGED
BRIDGE REPLACEMENT
BLACK RIVER
UPPER TURNING BASIN
CHANNEL
NOTES
Plate 1
LORAIN HARBOR
OHIO
U.S. ARMY ENGINEER DISTRICT BUFFALO
30 SEPTEMBER 1971

b. Additional marina facilities to serve recreational navigation demand, and;

c. Reduction of sedimentation on the Black River, and thus reduction in harbor maintenance dredging and improved water quality.

The thrust of this Preliminary Feasibility Study (Stage 2) is directed towards the investigation of commercial navigation needs at Lorain Harbor, which is consistent with the study direction outlined in the Reconnaissance Report dated September 1978 and revised January 1979. Commercial navigation was selected because: 1) finding and timing constraints would extend the completion date of the Final Feasibility Study (Stage 3) significantly if Stage 2 studies of all three water resources needs were completed concurrently; 2) the authorizing resolution specifically identifies commercial navigation as the study purpose; and 3) local interests have identified commercial navigation as the priority water resources need at Lorain Harbor. However, this course of action will not preclude possible improvements for recreational navigation and/or sediment reduction which will be investigated, for the most part, in Stage 3.

On this basis, the objectives of this Stage 2 study are: 1) to evaluate a full range of alternatives for commercial navigation modifications at Lorain Harbor considering related benefits, costs, social and environmental implications, and constraints that might be imposed on improvements in the interest of recreational navigation and sedimentation; and 2) to recommend those commercial navigation alternatives which warrant additional study during the detailed study phase (Stage 3).

STUDY PARTICIPANTS AND COORDINATION

This Preliminary Feasibility Report was prepared by the Buffalo District of the Corps of Engineers with the assistance of the North Central Division, Corps of Engineers and the consulting firm Michael Baker, Jr., Inc., Beaver, PA. The consultant studied and reported on the technical aspects of cargo handling, transportation, and marine structures. The consultant also prepared the alternative preliminary design plans and related cost estimates. The consultants material is contained in Appendix A.

An Orientation Workshop for the Lorain Reconnaissance Report took place on 27 April 1978. (See Appendix B of Reconnaissance Report dated September 1978 for summary minutes.) The Initial Public Meeting for the Stage 1 study was held on 31 May 1978. An Information Workshop on the design alternatives for the harbor took place on 10 July 1979. The purpose of this Stage 2 workshop was to present the preliminary designs and cost estimates to the principal study participants. These meetings afforded interested parties and the general public an opportunity to express their views concerning the improvements desired and the need and advisability of execution. These meetings were attended by four basic interest groups. These groups were: (1) commercial and industrial interests; (2) social, environmental, and recreational interests; (3) local government and planning interests; (4) general public interests.

Continual coordination has and will be maintained with Federal, State, regional, county, town, city agencies and departments, and with private interests affected by water resource actions at Lorain Harbor and the Black River, which empties into Lorain Harbor. The coordination has been facilitated by making written material available in advance of meetings. Suggested items for discussion and questions concerning the study were furnished so that meeting participants could be prepared with specific information. Flexibility has been maintained throughout the study to insure that the desires of the majority are made manifest and that the selected plan of action will be acceptable to their interests even if the no-action plan is selected, and least destructive to the natural environment.

PRIOR STUDIES AND REPORTS

Corps Studies For Lorain Harbor

A number of Congressionally authorized reports have been prepared by the Chief of Engineers concerning the need for navigation improvements in Lorain Harbor. A summary of the reports that have resulted in the existing projects is given in Table 1.

Table 1 - Prior Reports

Year of Rpt.	Work Considered	Congressional Document	Recommendation	Action By Congress, R&H Act
1897	Breakwaters and extension of piers to present dimension and dredging	H. Doc. 131, 55 Cong., 2nd Sess. and Ann. Rpt., 1898, p. 2718	Favorable	3 Mar 1899
1907	Widening Black River	H. Doc. 560, 60th Cong., 1st Sess.	Favorable	2 Mar 1907
1910	Extending breakwaters and dredging	H. Doc. 644, 61st Cong., 2nd Sess.	Favorable	25 Jun 1910
1913	Widening and straightening Black River	H. Doc. 160, 63rd Cong., 1st Sess.	Unfavorable	-
1916	Extending west breakwater	H. Doc. 980, 64th Cong., 1st Sess.	Favorable	8 Aug 1917
1916	Dredging certain parts of harbor to project depth	H. Doc. 985, 64th Cong., 1st Sess.	Favorable	8 Aug 1917
1918	Improvement of river above existing project	H. Doc. 1200, 65th Cong., 2nd Sess.	Unfavorable	-
1919	Improvement of river above existing project	House Committee 1, 66th Cong., 1st Sess.	Unfavorable	-
1919	Extending east breakwater and dredging	H. Doc. 254, 66th Cong., 1st Sess.	Unfavorable	-
1926	Extending project upriver	H. Doc. 587, 69th Cong., 2nd Sess.	Favorable	3 Jul 1930

Table 1 - Prior Reports (Cont'd)

Year of Rpt.	Work Considered	Congressional Document	Recommendation	Action By Congress, R&H Act
1932	Widening of two bends in river and enlargement of turning basin opposite Nat. Tube Co. dock	H. Doc. 469, 72nd Cong., 2nd Sess.	Favorable	30 Aug 1935
1932	Approach channel to municipal pier	Senate Comm. print, 73rd Cong., 2nd Sess.	Favorable	30 Aug 1935
1935	Deepening outer harbor, river channel, and turning basin	Rivers and Harbors Comm. Doc. 51, 74th Cong., 1st Sess.	Favorable	30 Aug 1935
1941	Turning basin in the bend of Black River immediately upstream from the Baltimore and Ohio RR Coal Dock	H. Doc. 161, 77th Cong., 1st Sess.	Favorable	2 Mar 1945
1954	Renovation of Lake View Park beach and construct three offshore break-water structures to prevent beach erosion	H. Doc. 229, 83rd Cong., 1st Sess.	Favorable	3 Sep 1954
1958	Construction of detached break-water lakeward of present entrance; breakwater removal; extension of east breakwater to shore; removal of outer 1,100 feet of the east pier; dredging entire harbor to greater	H. Doc. 166, 86th Cong., 1st Sess.	Favorable	14 Jul 1960

Table 1 - Prior Reports (Cont'd)

Year of Rpt.	Work Considered	Congressional Document	Recommendation	Action By Congress, R&H Act
	depths; and replacement of existing railroad bridge			
1960	Construct bank stabilization works at Cut No. 1 along left bank of Black River above Erie Avenue Bridge	PL 89-298	Favorable	27 Oct 1965
1970	Construction of 58-acre confined dredged material disposal area off the east break-water shore arm	PL 91-611	Favorable	31 Dec 1970

Other Corps of Engineers Studies

Other ongoing studies by the U. S. Army Corps of Engineers are pertinent to and may have an influence upon future considerations at Lorain Harbor. These are:

a. The Navigation Season Extension Study - This study covers the entire Great Lakes-St. Lawrence River System. The purpose of this study is to investigate the feasibility of winter navigation on the Great Lakes. The finding of this study may have a significant impact upon the physical, logistic, and economic considerations at Lorain Harbor and must be considered in the future feasibility studies for Lorain Harbor. The Final Feasibility Report has been completed and submitted to the Board of Engineers for Rivers and Harbors for action.

b. The Great Lakes Connecting Channels and Harbors Study - This study covers the upper Great Lakes Region (Lakes Superior, Michigan, Huron, and Erie). The purpose of this study is to determine the feasibility of modifications to the existing commercial navigation system. Inasmuch as waterborne commerce at Lorain involves interlake commodity transport, recommendations for size and draft requirements at the conclusion of the Connecting Channels and Harbors Study must be considered in the formulation of alternative futures and their economic impact on navigation demands to be made upon Lorain Harbor and the existing harbor channels. This study is presently in Stage 2 preparation of the PFR and is scheduled for completion at the end of Fiscal Year 1984.

c. St. Lawrence Seaway, Additional Locks Study - The purpose of this study was to determine the adequacy of the existing locks and channels in the U.S. section of the Seaway with respect to present and future commercial navigation needs, and the advisability of their rehabilitation, enlargement or augmentation. Buffalo District is, in conjunction with the Connecting Channels POS in Detroit, preparing the PFR, the completion of which is expected in 1981.

d. The Maximum Ship Size Study - This study was completed by North Central Division, Corps of Engineers, to screen vessels and improvement alternatives for use as input in the Great Lakes Connecting Channels and Harbors Study and the St. Lawrence Seaway Additional Locks Study. This study is presently being reviewed based on current conditions in 1981. Forecasts of the number of vessels, freight rates, and commodity data may provide useful information in feasibility studies for Lorain Harbor.

e. The Great Lakes-St. Lawrence Seaway Traffic Forecast Study - This study is a system-wide transportation planning tool to be used in establishing the economic feasibility of navigation improvements. The purpose of this study is to evaluate the effects navigation improvements, such as season extension, channel modifications, and harbor improvements, may have upon future commodity shipments and traffic. The model is an effort to lower the cost of simulating navigation improvements at the field level and to simulate the impact of increased traffic service. The model measures the effect on tonnage levels of potential system-wide improvements, thus influencing the traffic and benefits derived from the proposed improvement. Distribution of traffic forecasts between individual harbors within port ranges (port split traffic forecasts) are also produced to evaluate the economic impact of future traffic flows and will represent a check upon other sources of traffic forecasts for Lorain Harbor.

f. Energy Impact Study for Great Lakes-St. Lawrence Seaway Navigation Season Extension Program - This study was prepared by the Detroit District Corps of Engineers to investigate the effects of waterborne transportation on national energy consumption. This study was initiated during the preparation of the Season Extension Study and its conclusions will be reviewed for application to potential improvements to Lorian Harbor.

g. Lock Capacity Studies - These studies deal with the St. Lawrence, Welland, and Sault Ste. Marie Locks and were completed under the supervision of the North Central Division Economics Branch. Analytical studies were prepared under contract with Artec, Inc., and resulted in a generalized computer model capable of simulating the interaction of ships and lock facilities in the future. This investigation is relevant to the Lorain Harbor study in that traffic forecasts at the harbor should address physical constraints that may develop within the Great Lakes-St. Lawrence Seaway and ultimately provide realistic predictions for harbor commerce.

Studies By Others

a. The Great Lakes Cooperative Port Planning Study - This study was prepared by the Great Lakes Regional Office of the Maritime Administration U.S.

Department of Commerce in Cleveland, OH. It is a comprehensive study of Great Lakes bulk-handling facilities, waterborne traffic, competition between Great Lakes ports and other coastal ports, general cargo shipments, port financing, and marketing programs. Lorain Harbor has been included as one of the major bulk cargo ports. The results may provide meaningful input for further development of this study.

b. Small-Boating Study by City of Lorain - This study was prepared under the supervision of the Lorain Community Development Department. This report summarizes the recreation potential of the Lorain Harbor area, including the Corps 58-acre dredge disposal area, immediately east of the harbor.

THIS REPORT

In the interest of clarity of presentation and reference, this Preliminary Feasibility Report has been arranged into a Main Report and six appendices. The Main Report is written to give both the technical reviewer and the general reader a clear understanding of the study, the study results, and the key conclusions and decisions reached in possible harbor modifications in the interest of commercial navigation. The Main Report describes the resources and economy of the study area; identifies problems and needs; formulates a full range of possible harbor modification alternatives; describes economic, social, and environmental implications of the alternatives; and identifies feasible and economically justified improvements. It also includes, in summary form, the costs and benefits of the various alternatives, and the division of project responsibility between Federal and non-Federal interests for the feasible and economically justified improvements. Also, the report provides the District's recommendations regarding further detailed study under the Congressional Resolution.

The six appendices to the report present supporting data and details covering the features of the Preliminary Feasibility Report. Appendices A through D will be of primary interest to the technical reviewer.

Appendix A is a technical report of the preliminary designs and cost estimates for Lorain Harbor and was prepared by Michael Baker, Jr., Inc., under contract with the Buffalo District. The information presented is divided into design work components (project features) and then combines the appropriate work components to obtain the 16 alternative plans of improvmenet considered in Stage 2.

Appendix B is a technical report on the economic evaluation of the Alternatives. This appendix was prepared by the Economics Section of the Buffalo District and includes, but is not limited to, traffic forecasts, fleet mix projections, benefits, and sensitivity analyses.

Appendix C is the cultural resources report. This appendix was prepared by the Environmental Section of the Buffalo District.

Appendix D is a summary of the field studies completed by the U. S. Fish and Wildlife Service for the Lorain Harbor study area. The appendix identifies

the species and distribution of flora and fauna in the project area, identifies and evaluates the habitat for the identified species, discusses the major areas of concern, and discusses possible environmentally acceptable alternatives.

Appendix E contains all pertinent correspondence in connection with the Preliminary Feasibility Study, including comments from interested agencies.

Appendix F shows the Study Management requirements for the remainder of the Feasibility Study.

STUDY PROCESS

The Lorain Harbor Feasibility Study will be completed in three stages (See Plate 2). These three stages are:

Stage 1	Reconnaissance Report
Stage 2	Preliminary Feasibility Report (PFR)
Stage 3	Final Feasibility Report (FFR)

Stage 1, the initial planning stage, defines the scope and character of the feasibility study and provides a guide to subsequent planning by carrying out four planning tasks, discussed below, at a preliminary level. The emphasis in Stage 1 is on Task 1, problem identification. The Reconnaissance Report defines broad planning objectives, formulates possible alternative measures for achieving the objectives, and produces a tentative impact assessment and evaluation. The level of detail is general and the planning tasks draw upon a broad data base which may be more qualitative than quantitative. The product of Stage 1 is a Reconnaissance Report document setting forth in general terms, the study scope and management actions necessary to implement the study purposes. The Reconnaissance Report for the Lorain Harbor Feasibility Study was completed in January 1979.

Stage 2, the intermediate planning stage, is characterized by developing a range of alternatives to achieve the planning objectives without concentrating on highly detailed engineering designs. Potential impacts of these alternative plans are assessed and evaluated, concentrating on their significant consequences. Data should be sufficient to set forth and analyse alternative concepts and should narrow the choices to the most viable options available in the study area. The product of Stage 2 is a Preliminary Feasibility Report (PFR). This document is the Preliminary Feasibility Report for Lorain Harbor, with primary emphasis on commercial navigation.

During the final stage, Stage 3, the recommended alternatives from the PFR are studied. Detailed design, assessment, and evaluation necessitate specific data and well-defined study assumptions. The plans must be sufficiently detailed to facilitate effective choices for recommended plan implementation. A recommended plan will state the planning objectives forming the basis for the technical and institutional measures selected to accomplish resource

management. Both nonstructural and structural measures are described and the means of implementing and managing specified. The product of Stage 3 is a Final Feasibility Report (FFR).

If the recommended plan is favorable for Federal involvement, then the Federal and non-Federal cost-sharing will be described. Then the FFR, after review at Division and Washington levels, will be submitted to Congress for their action.

The FFR would include a recommendation for construction.

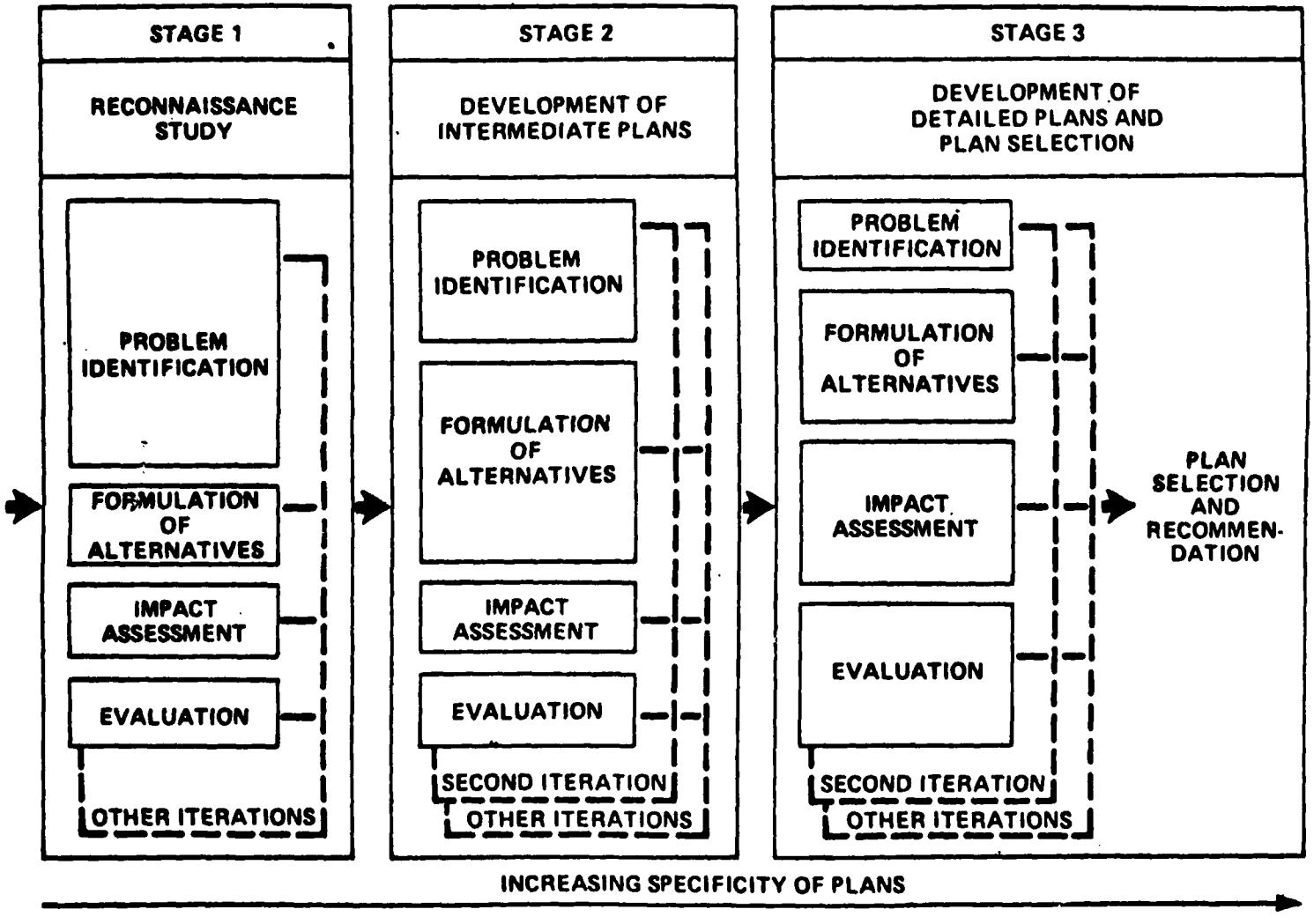
In each of these three stages, plans are developed through an iterative process of four taks (See Plate 2). These tasks are: Task 1 - Problem Identification; Task 2 - Formulation of Alternatives; Task 3 - Impact Assessment; and Task 4 - Evaluation.

Task 1, Problem Identification, consists of defining the problems and needs of the study area with the goal of delineating the planning objectives for the feasibility study. This is accomplished by identifying concerns, analyzing the problems and needs, describing the base conditions, projecting future with and without implementation of a plan of action, and refining the planning objectives to insure that the ientified problems adhere to these objectives.

Task 2, Formulation of Alternatives, consists of developing resource management systems (alternative plans of improvement) that will achieve the planning objectives. Initially, a broad range of technical and institutional measures, both structural and nonstructural, are identified. These measures are then combined to develop alternative plans that satisfy the planning objectives. Where individual planning objectives are not addressed by plans previously developed, additional measures are added to these plans to complete the resource management system. In the formulation process, the goal is to minimize conflicts and maximize compatibility of measures by adding (or deleting) measures to the alternative plans. The National Economic Development (NED) plan which emphasizes maximum net benefits and an Environmental Quality (EQ) plan which emphasizes positive environmental measures are identified.

The Objective of Impact Assessment, Task 3, is to identify and measure the probable economic, social, and environmental effects of each alternative plan. Activities consist of analyzing each measure to determine potential sources, the incidence, and the magnitude of the environmental and social impacts of each plan. Impacts to be addressed include, but are not limited to, the following parameters: noise, displacement of people, aesthetic values; community cohesion, community growth, tax revenues, property values; public facilities and services, employment/labor force, business and industrial activities, man-made resources; natural resources, air quality, water use and quality, and regional growth.

Both quantitative and qualitative measurement of effects may be necessary to evaluate the impacts of decisions on the environmental quality objective. The evaluation of qualitative measures lies within the domain of public



GENERAL RELATIONSHIP OF PLAN DEVELOPMENT STAGES AND FUNCTIONAL PLANNING TASKS

Plate 2

perception. The public involvement and participation program, conducted during this study, will be used to assess public perception concerning the quality parameters.

During Task 4, the impacts of each alternative plan are compared to those for the "without project" condition to determine the contributions, both beneficial and adverse, of each plan. Activities during evaluation include: selection of the alternative plans that best reflect criteria for the NED and EQ plans; determination of the Federal interest in each plan; and performance of a trade-off analysis to determine the contributions of the alternative plans.

SECTION B
PROBLEM IDENTIFICATION

GENERAL

The purpose of this section is to inform the reader of the problems concerning commercial navigation, recreational navigation, and erosion and sedimentation in the Lorain Harbor area for which this study seeks a solution(s). This section presents information concerning the existing physical and human environment in the general area; discusses the need for identifying methods of improving the ease and safety for navigation; reviews the planning constraints under which this study was conducted; discusses the specific planning objectives of the study; and reviews the conditions that would exist if no Federal action was taken.

EXISTING CONDITIONS

REGIONAL GEOLOGY

Physiography - Lorain Harbor is at the mouth of the Black River at Lorain, OH. The Black River drains a portion of the Central Lowlands Physiographic Province. This is an area characterized by a flat lying lake plain crossed by sandy ridges of former glacial lakes and by gently rolling moraines. The greatest relief occurs along the Lake Erie shoreline where bluffs rise 30 to 50 feet, and in the major stream valleys.

Bedrock Geology - Bedrock in the region consists of Paleozoic shale, siltstone, sandstone, and carbonate rock. In western Ohio, there is a broad low dome known as the Cincinnati Arch which has a north trending axis. The rocks in the vicinity of the structure have a gentle southeastward dip of about 20 feet per mile.

Surficial Geology - Unconsolidated material consists of glacial till, glaciofluvial and lacustrine deposits, and alluvium. Much of this material was deposited during the Late Pleistocene.

LOCAL GEOLOGY

Bedrock Geology - Bedrock is exposed throughout most of the Black River Valley. From Elyria downstream, the Devonian Cleveland Shale is exposed. When freshly exposed it is bluish black to brownish black and turns coffee brown upon weathering. In fresh exposures, the shale is very compact and massive to platey but after slight weathering it becomes thinly laminated, fissle, and brittle. Upon extreme weathering it turns dark gray and breaks down into flakey pieces but does not acquire the real plasticity of a clay shale. Primary and secondary deposits of pyrite are present in considerable quantities along the laminae as concretionary masses or as finely disseminated pyrite. When the shale is chipped it gives off a gaseous odor. Borings taken in the Lorain Harbor vicinity show that usually the upper 10 feet of rock is weathered and that some vertical jointing is evident.

Upstream of Elyria are rocks of Mississippian Age. The oldest of these is the Bedford shale. This is a grayish to dusky red shale with abundant gray shale or sandstone and siltstone lenses. The shale weathers rapidly to a sticky red mud and forms outcrops that are obscured by slumping and soil creep.

Surficial Geology - The unconsolidated deposits of the Black River Basin consist mostly of till. Goldthwart and others (1965) characterize till in this area as brown clay till. Overlying the till in many areas is a lacustrine clayey silt and sandy beach ridges. These ridges are conspicuous remnants of former glacial lakes. Forsyth (1959) has identified the major ridges as those of Lakes Lundy, Wayne, Warren, Whittlesey, and Maumee I, II, and III.

Alluvial sand and gravel deposits are not as common in the Black River as in other Ohio streams. Most of the alluvium is found in the lower reaches and in the headwaters of its tributaries where the stream cuts through gravelly morainal deposits.

Borings taken by others in the lower reach of the river at Lorain show the soil to consist of alluvial clays with low plasticity and containing traces of sand and organic matter. This is underlain by a dense, silty gravel which directly overlies rock.

FLUVIAL PROCESSES

Most of the Black River and its two major tributaries, the East and West Branches, is incised in bedrock. Most of the other tributaries are short and join the Main, East, and West Branches at relatively steep junctions. Much of the soil in the drainage basin except for the beach ridges have some cohesion and are not easily eroded. Evidence of severe bank and bed erosion is absent. The area of greatest bank erosion occurs in the tributary area upstream of Grafton, OH, where the stream cuts through gravelly morainal hills.

The USGS in 1978 compiled sediment data collected intermittently at the Elyria gage. Their data provide some interesting information into the sedimentological behavior of the stream.

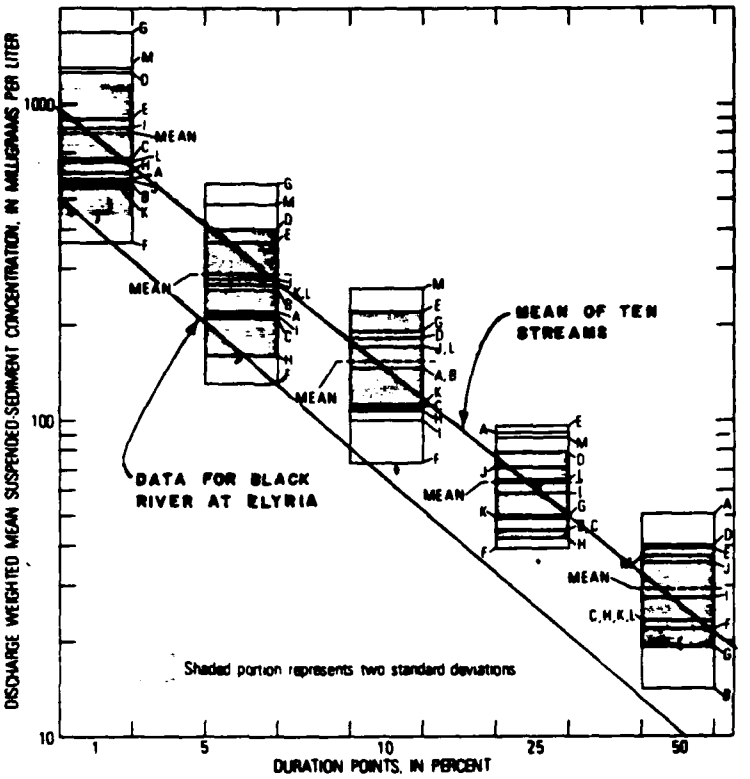
a. There is less than 1 percent bedload discharge in terms of annual suspended load discharge.

b. Seventy-five percent of the sediment discharged is clay.

c. Sediment discharge at Elyria is about 84,000 tons/year.

d. Sediment concentration is considerably lower than the mean of 10 other Ohio streams (Figure 1).

d. The suspended sediment transport curve is steep at low discharges (Figure 2) indicating that soil is rapidly entrained.



EXPLANATION

Symbol	Station No	Location
A	03139000	Killbuck Creek at Killbuck
B	03159500	Hocking River at Athens
C	03229000	Alum Creek at Columbus
D	03234000	Paint Creek near Bourneville
E	03234500	Scioto River at Higby
F	03240000	Little Miami River near Oldtown
G	03244000	Todd Fork near Rosebaster
H	03265000	Stillwater River at Pleasant Hill
I	03267800	Mad River at Eagle City
J	04193500	Maumee River at Waterville
K	04195500	Portage River at Woodville
L	04198000	Sandusky River near Fremont
M	04208000	Cuyahoga River at Independence

FIGURE 1.—Discharge-weighted mean sediment concentrations at selected duration points.

SOURCE: ANTILLA, P.W. AND TOBIN, R.L., 1978, FLUVIAL SEDIMENT IN OHIO U.S.G.S. WATER SUPPLY PAPER 2040

FIGURE 1

SUSPENDED-SEDIMENT DISCHARGE

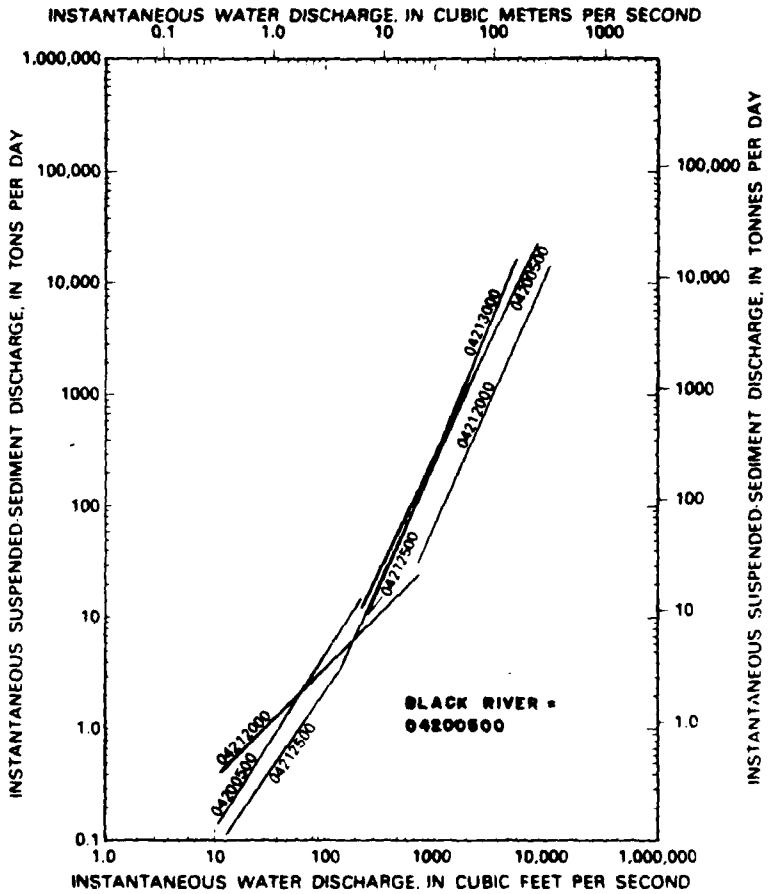


FIGURE 2.—Instantaneous suspended-sediment transport curves for inventory network stations on streams tributary to Lake Erie from and including the Black River to Conneaut Creek.

SOURCE: ANTILLA, P.W. AND [illegible], R.L.,
1978, FLUVIAL SEDIMENT IN OHIO
U.S.G.S. WATER SUPPLY PAPER 2046

FIGURE B2

These data show that sediment transport is probably more dependent on the availability of sediment rather than on the hydraulic characteristics of the stream. In such a case, sheet erosion from diffuse areas is a primary source of material, as there is little material to be stored in the stream to be reentrained at a later time.

The Table below shows the volume of material dredged at Lorain Harbor. The decline in recent years is probably the result of decreases in industrial discharge.

Sedimentation within the harbor appears to be greatest in the vicinity of the upper turning basins. This can be observed by a noticable decrease in turbidity downstream of the basin. Much of the banks in the harbor are composed of bedrock, however, there are some areas of erosion, especially in stockpiles of sand, slag, and other materials along the bank.

Summary of Historical Dredging at Lorain, Ohio

Year	Hauled Volume in Cubic Yards
1979	192,048
1978	-
1977	30,420
1976	42,290
1975	136,298
1974	498,586
1973	83,922
1972	143,598
1971	136,021
1970	189,414
1969	142,456
1968	230,857
1967	106,713
1966	546,444
1965	87,210
1964	201,131
1963	-
1962	312,422
1961	161,202
1960	234,458
1959	345,655
1958	196,567
1957	251,808
1956	219,701
1955	193,456
1954	146,167

BOTTOM SEDIMENT ANALYSIS

A bottom sediment sampling program was conducted during September 1979 in the Lorain navigation channel. Thirteen bottom sediment samples were obtained using Ponar dredge sampler.

Laboratory analysis of bottom sediment samples was performed to determine (1) the physical characteristics of the sediment, (2) nature of some pollution parameters in the sediment, and (3) the probable sources of channel sediments requiring annual maintenance dredging.

Physical Characteristics of the Sediments - The grain size distribution of each collected sample was determined by laboratory analysis. The grain size distributions are summarized on Table 1a. In general, the sediment samples are fine grained with a large percentage passing the No. 200 sieve. There is no apparent trend towards decreasing grain size in a downstream direction.

Nature of Pollution - The U. S. Environmental Protection Agency (ESEPA), under their Harbor Sediment Sampling Program, tested sediment samples from the Lorain navigation channel in 1975. The results of testing indicated the sediment dredged from the navigation channel is polluted and unsuitable for open-lake disposal.

As part of the present study of bottom sediments, the two pollutant parameters, oil and grease, and volitile solids were analyzed for in the laboratory. Test results are summarized on Table 1b. The test results indicate an overall decrease in each of the two pollutants from the 1975 USEPA values.

Source of the Sediments - Petrographic examination of 6 of the 13 sediment samples was performed to distinguish between material sediments derived from streambank/upland erosion and artificially introduced sediments. Artificially introduced sediments are defined for purposes of this examination as those sediments *not normally* present in nonpolluted river sediments, and which are the products of industrial processes along the banks of the Black River. The results of the petrographic analyses are summarized on Table 1c through 1H. The test results indicate that the samples examined are predominantly natural sediment with only minor amounts of introduced material (0.25 percent to 6.7 percent).

The introduced sediment constituents consist of opaque metallic minerals (iron, chromium and titanium oxides), fly ash, slag, and glass. Opaque materials were found to predominate introduced materials in all samples and consisted of two types. One is anhedral structureless material of uncertain origin. The second type consists of grains exhibiting well developed cubic and/or octahedral crystal faces. Possible compositions are those of magnetite, ilmenite, chromite and spinel. These materials are interpreted to be a product of industrial processes, although it is possible that some of the opaque material may consist of transported naturally occuring metallic minerals.

Fly ash present in the samples also consists of two types. The first type is spherical, opaque or semiopaque fly ash and the second in an aggregate of such grains. Aggregates of fly ash particles usually contain individual grains of widely varying size. Most of the naturally occurring sediments in certain sieve sizes contain minute amounts of fly ash in available pore

spaces. Minute fly ash particles can also be found adhering to particle surfaces due to an electrical change buildup on the individual fly ash particles.

Glass and slag were both found to occur in trace amounts and represent only minor constituents of the introduced sediment fraction. Either may be present in certain sieve sizes, but glass is slightly more predominant in the samples than slag.

From an analysis of the test results, a trend toward increasing concentration of introduced sediments with decreasing grain size is quite apparent. Maximum concentrations of introduced sediments usually, though not always, occurs in the No. 325 and No. 400 sieve sizes. For those samples having a significant portion passing the No. 400 sieve, the true percent of introduced sedimnent of the entire sample is most likely somewhat greater than the test results indicate.

Table 1a - Gradation Analysis
Total Percent Finer

Sieve Size	Sample Number 1A	1B	2	3	4	5	6	7	8	9	10	11	12
3 in.													
2						100							
1-1/2						98.34		100				100	
1						92.27		92.45				89.86	
3/4						84.41		89.55				87.74	
1/2						64.08		79.69				81.89	
3/8						50.41		72.38				77.11	
No. 3		100	100		100	-		-		100	100		100
4	100	78.99	99.11	100	52.05	25.99	100	57.76	100	98.87	98.86	66.66	99.13
6						-		-				-	
8						16.38		48.48				57.95	
12						-		-				-	
16						10.92		40.19				47.29	
20						-		-				-	
30						8.09		35.29				37.01	
40						7.43		32.89				31.59	
50						6.97		28.69				26.73	
70						6.64		23.13				23.11	
100						6.30		18.38				20.87	
140						6.02		11.86				18.09	
200	98.88	64.70	69.88	91.35	46.40	5.75	94.72	9.65	89.53	83.86	86.92	16.48	90.30

Table 1b - Analysis for Oil and Grease and Volitile Solids

Sample Number	Percent Oil and Grease	Percent Volitile Solids
1A	.7	9.8
1B	2.7	7.8
2	1.8	6.4
3	1.3	7.5
4	.1	6.6
5	< 0.1	4.3
6	.7	6.4
7	< 0.1	3.2
8	.7	6.8
9	.7	5.7
10	.3	5.6
12	.6	6.7

TABLE 1c

Petrographic Examination Report
Sample #1A

Sieve Size	% -4 Size Fraction	% Total Sample	% Natural Sediments In Sieve Size	% Introduced Sediments In Sieve Size: Fly ash, Slag, etc.	% Introduced Sediments In -4 Size Fraction	Introduced Sediments, % Of Total Sample	BLACK RIVER #1A
#200		38.3	100.0	-	-	-	op = opaque material
#235		17.7	100.0	-	-	-	f = fly ash
#270		14.2	95.7	4.3 op, f, s	→	0.62	s = slag and/or glass
#325		17.3	98.2	1.8 op, f, s	→	0.32	Symbols after % are given in decreasing order of abundance.
#400		12.5	96.4	3.6 op, f, s	→	0.45	
						1.39 = 1.4%	

TABLE 1D

Petrographic Examination Report
Sample #3

Sieve Size	% -4 Size Fraction	% Total Sample	% Natural Sediments In Sieve Size	% Introduced Sediments In Sieve Size: Fly ash, Slag, etc.	% Introduced Sediments In -4 Size Fraction	Introduced Sediments, % Of Total Sample	BLACK RIVER #3
#200		29.4	97.7	2.3 op, f	→	0.69	op = opaque materia
#230		18.4	95.7	4.3 op, s	→	0.80	f = fly ash
#270		17.5	90.6	9.4 op, s	→	1.64	s = slag and/or glass
#325		20.8	90.4	9.6 op, s, f	→	2.00	Symbols after % are given in decreasing order of abundance.
#400		13.9	88.9	11.1 op, s, f	→	1.54	
						6.67 = 6.7%	

TABLE 1E

Petrographic Examination Report
Sample #5

Sieve Size	% -4 Size Fraction		% Total Sample		% Natural Sediments In Sieve Size	% Introduced Sediments In Sieve Size: Fly ash, Slag, etc.	% Introduced Sediments In -4 Size Fraction	Introduced Sediments, % Of Total Sample
#8	34.2		8.9		100.0	-	-	-
#16	19.4		5.0		100.0	-	-	-
#30	10.1		2.7		100.0	-	-	-
#50	4.0		1.0		100.0	-	-	-
#100	2.4		0.6		100.0	-	-	-
#200	1.9		0.5		99.0	1.0 op	0.02	0.005 (tr)
#230	6.5		1.7		98.3	1.3 op	0.08	0.02
#270	7.4	28.0	1.9	7.3	95.5	4.5 op	0.33	0.09
#325	8.8		2.3		96.8	3.2 op, f	0.28	0.07
#400	5.3		1.4		95.0	5.0 op	0.26	0.07
							0.98 = 1%	0.25%

BLACK RIVER #5

op = opaque material

f = fly ash

s = slag and/or glass

Symbols after % are given in decreasing order of abundance.

TABLE 1F

Petrographic Examination Report
Sample #7

Sieve Size	% -4 Size Fraction	% Total Sample	% Natural Sediments In Sieve Size	% Introduced Sediments In Sieve Size: Fly ash, Slag, etc.	% Introduced Sediments In -4 Size Fraction	Introduced Sediments, % Of Total Sample
#8	15.8	9.1	100.0	-	-	-
#16	14.0	8.1	100.0	-	-	-
#30	8.3	4.8	100.0	-	-	-
#50	4.1	2.4	99.0	1.0 op, s	0.04	0.02
#100	24.6	14.2	98.0	2.0 op, s	0.49	0.28
#200	14.8	8.6	91.0	9.0 op, s, f	1.33	0.77
#230	5.8	3.4	63.7	36.3 f	2.11	1.23
#270	5.1 } 18.4	2.9 } 10.6	94.5	5.5 op, f	0.28	0.16
#325	5.1	2.9	89.5	10.5 op, f	0.53	0.30
#400	2.4	1.4	90.0	10.0 op, f	0.24	0.14
					5.02 = 5%	2.9%

BLACK RIVER #7

op = opaque material

f = fly ash

s = slag and/or glass

Symbols after % are given in decreasing order of abundance.

TABLE 16

Petrographic Examination Report
Sample #9

Sieve Size	% -4 Size Fraction	% Total Sample		% Natural Sediments In Sieve Size	% Introduced Sediments In Sieve Size: Fly ash, Slag, etc.	% Introduced Sediments In -4 Size Fraction	Introduced Sediments, % Of Total Sample
#8		9.3		100.0	-	-	-
#16		3.2		100.0	-	-	-
#30		1.4	16.1	100.0	-	-	-
#50		0.9		100.0	-	-	-
#100		0.6		100.0	-	-	-
#200		0.6		95.2 op	4.8 op, f	→	.03
#230		20.1		93.3	6.7 op, f, s	→	1.34
#270		18.5	83.9	95.1	4.9 op, f	→	0.91
#325		24.2		93.2	6.8 op, f	→	1.66
#400		24.1		91.7	8.3 op, f	→	1.74
							5.68 = 5.7%

BLACK RIVER #9

op = opaque material

f = fly ash

s = slag and/or glass

Symbols after % are given in decreasing order of abundance.

TABLE IH

Petrographic Examination Report
Sample #11

Sieve Size	% -4 Size Fraction		% Total Sample		% Natural Sediments In Sieve Size	% Introduced Sediments In Sieve Size: Fly ash, Slag, etc.	% Introduced Sediments In -4 Size Fraction	Introduced Sediments, % Of Total Sample
#8	12.9		8.6		99.0	1.0 op	0.13	0.09
#16	15.7		10.5		99.7	0.3 op	0.52	0.35
#30	15.2	74.2	10.1	49.5	99.3	0.7 op	0.11	0.07
#50	15.2		10.1		100.0	-	-	-
#100	8.7		5.9		98.7	1.3 op	0.11	0.08
#200	6.5		4.3		96.6	3.4 op, f	0.22	0.14
#230	6.6		4.4		93.0	7.0 op, f	0.43	0.29
#270	6.2		4.1		97.2	2.8 op, f	0.17	0.11
#325	6.6	25.8	4.4	17.2	94.6	5.4 op, f	0.35	0.24
#400	6.4		4.3		96.8	3.2 op, f, s	0.21	0.14
							2.35 = 2.4%	1.51 = 1.5%

BLACK RIVER #11

op = opaque material

f = fly ash

s = slag and/or glass

Symbols after % are given in decreasing order of abundance.

· Water Bodies - Lake Erie is the shallowest of the Great Lakes, with a depth of less than 80 feet over 90 percent of its entire surface area of 9,919 square miles. Maximum depth is 210 feet and the average depth is 60.7 feet. The lake is divided into three basins: western, central, and eastern, as shown on Figure B3. The central basin extends along the northeast Ohio shore, adjacent to the project area and is by far the largest of the three, covering approximately 6,300 square miles. Its average water depth is 60 feet, with a maximum of about 84 feet. The shores are generally high clay banks with narrow beaches.

In winter, the central basin becomes entirely ice covered with 95 percent coverage of the entire lake during some severe winters.

Because of the central basin's large cross section, its flow-through current is immeasurably slow and circulation is controlled by the wind. Although reversals are common with wind shifts, the predominant surface water movement, as shown on Figure B1, is eastward, angling away from the north shore toward the south shore. The predominant bottom water flow is southwestward.

Lorain Harbor is situated at the mouth of the Black River. The Black River, including the East and West Branches, has a total drainage area of 470 square miles. The East Branch of the Black River, which originates just south of the Lorain County line, flows through hilly terrain, which is predominantly farmland. The West Branch meanders through forest land before merging with the East Branch in Elyria. The mainstream, flowing northward, divides the city of Lorain and empties into Lake Erie at Lorain Harbor.

A U. S. Geological Survey recording gage is located on the Black River at Elyria, OH, and measures 396 square miles of drainage upstream of this location. The average stream flow as recorded at this gage is 314 cubic feet per second and the maximum discharge was 51,700 cubic feet per second in July 1969.

Water Levels and Fluctuations - The water levels at Lorain's outer harbor and in the lower Black River to the upper limit of the Federal project (approximately to stream mile 3) vary with and are approximately the same as the levels of Lake Erie. All project depths at Lorain Harbor refer to Low Water Datum (LWD) for Lake Erie, except for high flows on the Black River, which is 568.6 feet above mean water level at Father Point, Quebec (International Great Lakes Datum 1955 (IGLD-1955)). (Figure B4)

The water surface elevations of Lake Erie vary irregularly from year to year and are subject to seasonal changes. In addition to the seasonal variations, fluctuations due to changes in wind and barometric pressure cause occasional oscillations of short duration. These fluctuations have been known to cause pronounced surges and currents moving upriver in the Black River channel. Flood flows in the Black River cause temporary increases in the water surface elevation in Lorain Harbor. On the basis of interviews with vessel operators, these have little effect on commercial navigation. Table 2 notes seasonal variations during the past 70 years at Cleveland, OH, which are also representative of Lorain Harbor.

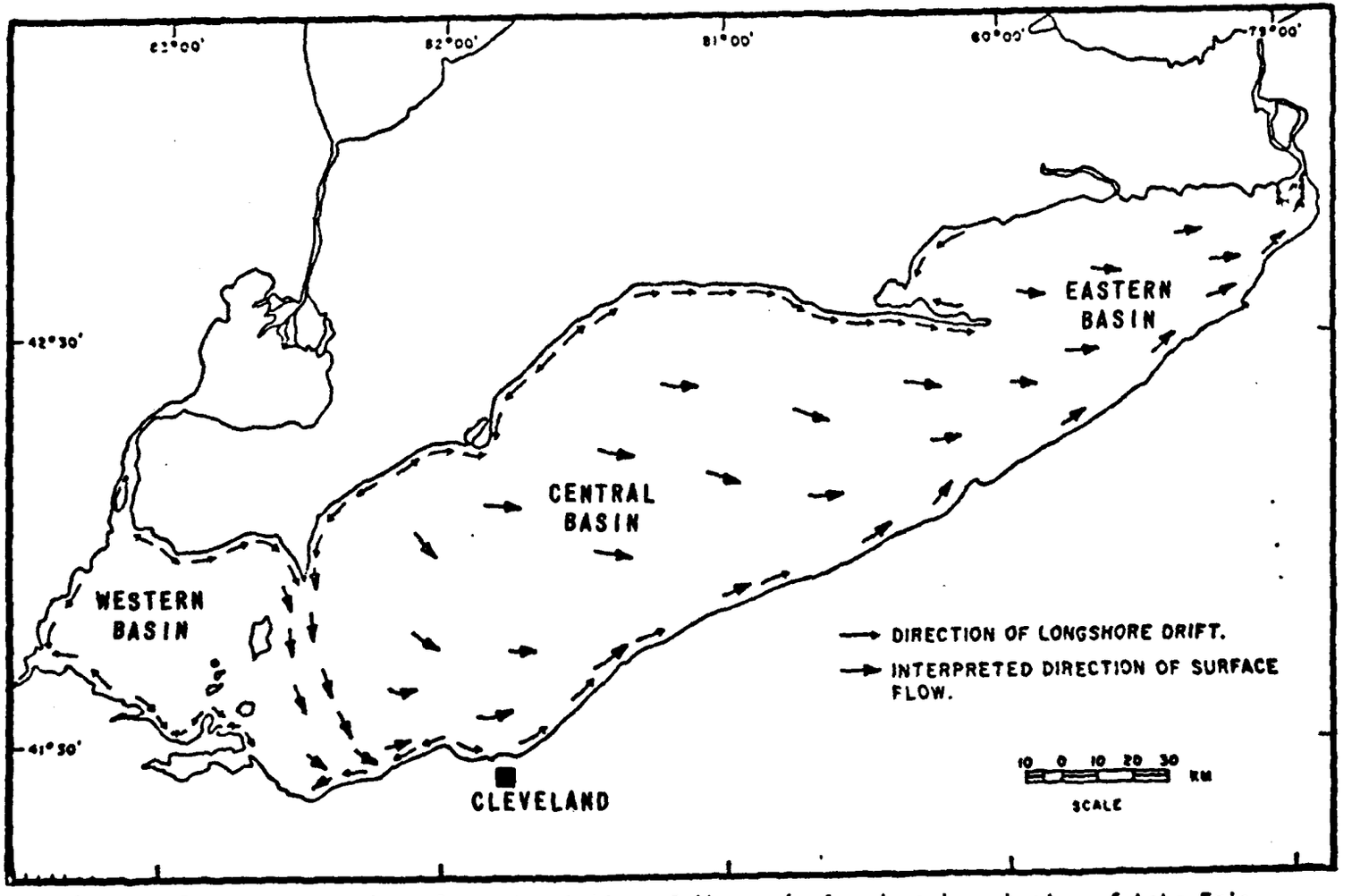
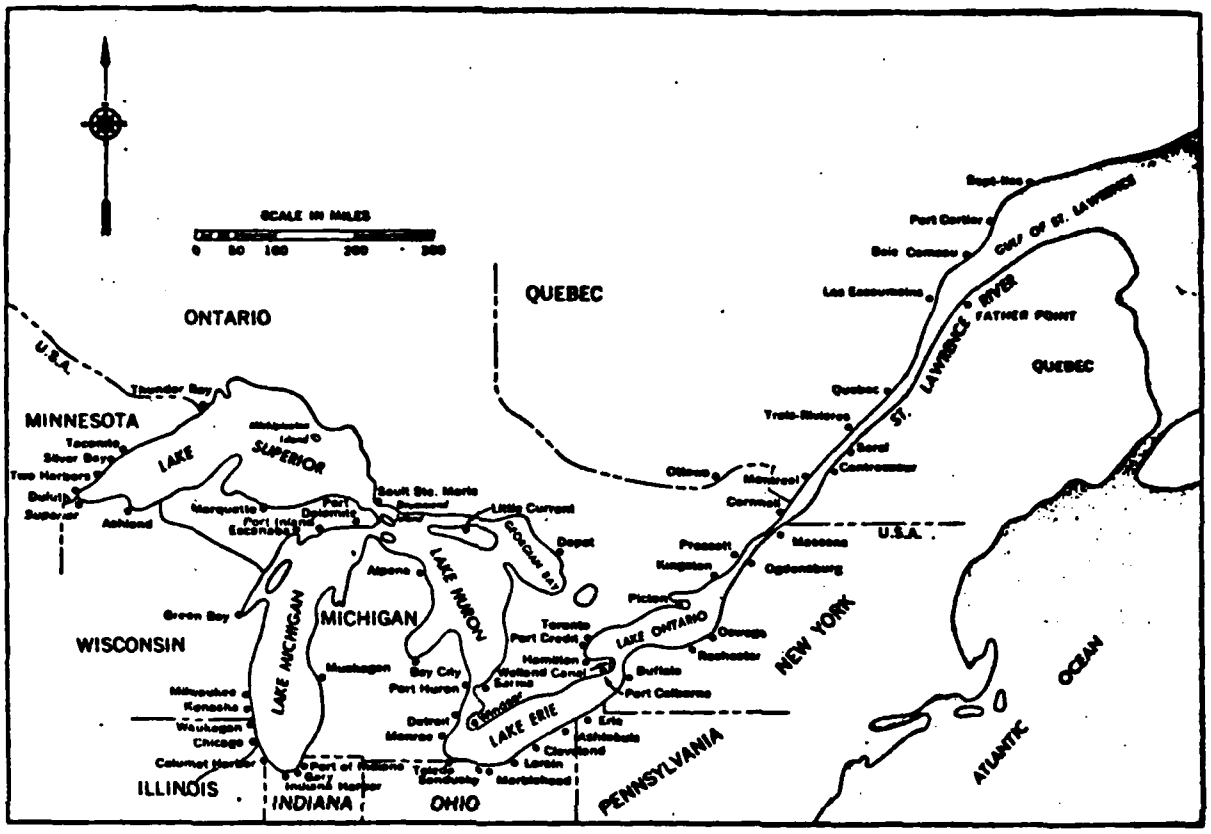


FIGURE 63 The permanent surface circulation of the central and eastern basins of Lake Erie.

SOURCE: "Final Environmental Statement, Cleveland Harbor Operations and Maintenance, Cuyahoga County, O' ", U.S. Army Engineer District, Buffalo, N.Y., April 1974.

FIGURE B4 THE GREAT LAKES-ST. LAWRENCE NAVIGATION SYSTEM
GEOGRAPHIC EXTENT AND PROFILE



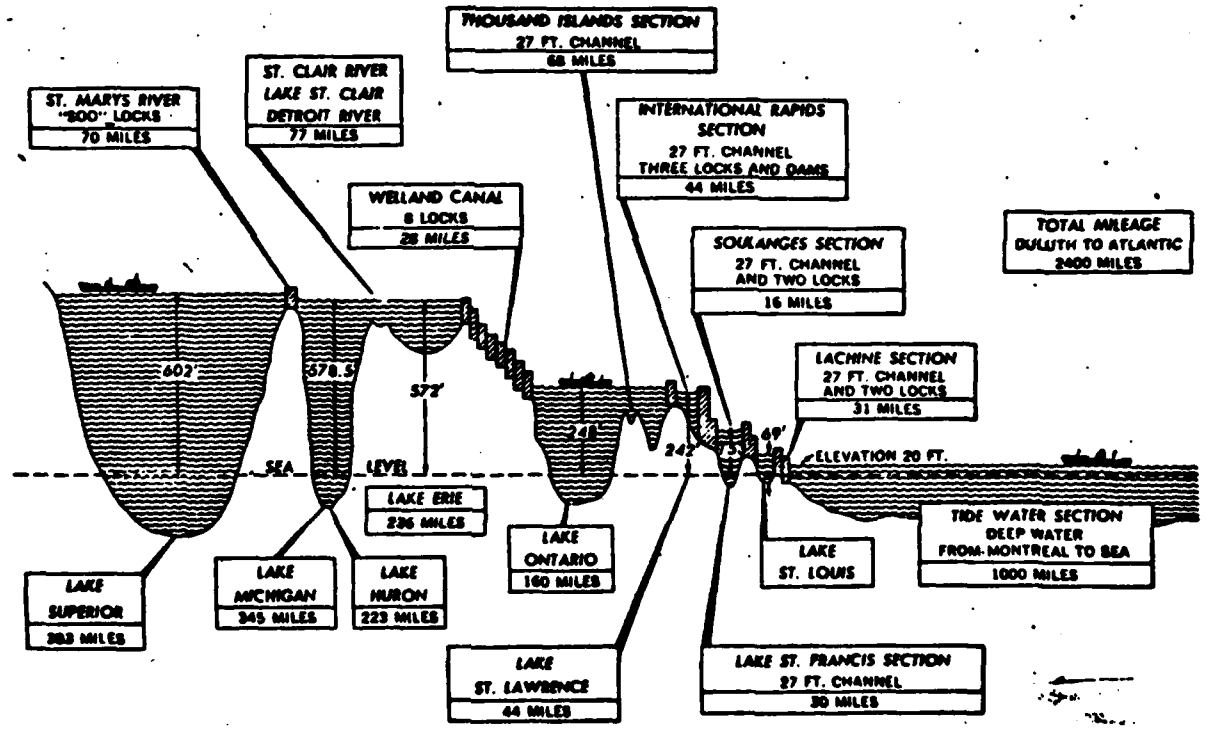


Table 2 - Water Level Variations
Lake Erie - Cleveland, Ohio 1/
1907 - 1977

Season	(Date)	Max.	(Date)	Min.	Variations
			Monthly Mean		
Summer	(6/73)	573.51	(6/34)	568.46	5.05 feet
Winter	(11/73)	571.77	(2/36)	567.49	4.28 feet
Max.	(6/73)	573.51	(2/36)	567.49	6.02 feet
			Daily Mean		
Summer	(6/17/73)	573.82	(7/8/34)	568.58	5.24 feet
Winter	(12/6/73)	571.41	(12/4/34)	567.11	4.30 feet
Max.	(6/17/73)	573.82	(12/4/34)	567.11	6.71 feet
			Instantaneous		
Summer	(6/16/73)	574.48	(8/2/34)	570.34	4.14 feet
Winter	(12/6/73)	574.48	(1/17/35)	566.06	4.58 feet
Max.	(6/16/73)	574.48	(1/17/35)	566.06	8.48 feet

1/ Condition is also representative at Lorain Harbor.

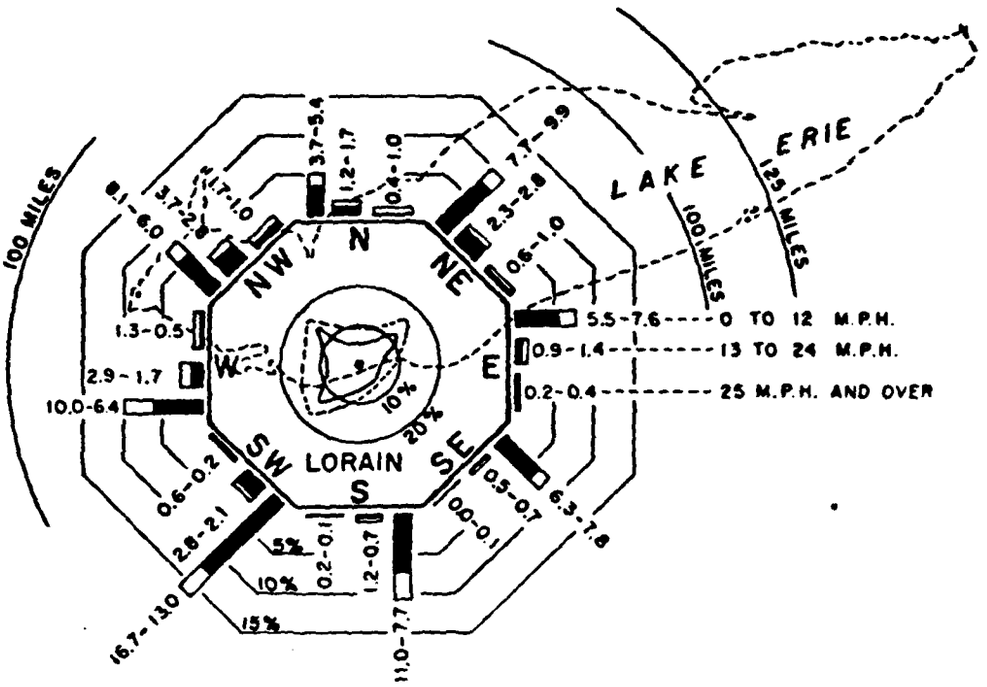
Wind and Waves - No actual wave records are available in the immediate vicinity of Lorain Harbor.

Wind velocity generally is moderate, averaging 12.8 miles per hour; the prevailing wind directions are west and southwest, as shown on Plate 4.

The predominant littoral drift is from east to west, with a small amount of drift occurring west to east due to the sheltering effect of the West Breakwaters.

Water Depths - The outer harbor and Black River navigation channel depths, based on Low Water Datum, 568.6 feet above LWD, are maintained by the Corps dredging program as follows (Plate 1):

Lake Approach Channel	29 feet
Channel Across Outer Harbor	28 feet
Turning Area in Outer Harbor	25 feet
Approach Channel to Municipal Pier	16 feet
Channel at River Entrance	28 feet
Black River Channel	27 feet
Lower Turning Basin	20 feet
Upper Turning Basin	17-21 feet



WIND DIAGRAM FOR LORAIN HARBOR, OHIO

NOTES

INDICATES DURATION FOR ICE-FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE-FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE-FREE PERIOD AND COMBINED ICE-FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U.S. COAST GUARD AT LORAIN HARBOR, OHIO FOR PERIOD 1 JAN. 1938-31 DEC. 1971

Exposure and Effect of Storms - The Outer Harbor entrance opening to the northwest is protected by a detached outer 2,180-foot-long breakwater lying in an east-west direction. This Outer Breakwater affords protection to the harbor entrance from northerly winds; however, its detached location exposes the harbor entrance to southwesterly, westerly, and easterly storms. These storms cause heavy wave action and currents at the harbor entrance which, when coupled with the wind forces against the large, exposed superstructure area of the larger vessels, could impose formidable navigational problems.

Within the outer harbor, wave reflections from the east breakwaters have also made unassisted docking at the outer harbor facilities hazardous. Navigation difficulties have been experienced by the "Roger Blough," a Great Lakes bulk freighter 858 feet in length and 105 feet wide. Therefore, it may reasonably be assumed that larger vessels presently operating on the Great Lakes (i.e., up to 1,000 feet in length, 105 feet in width), would also experience similar difficulties.

Water Quality - The U. S. Environmental Protection Agency (EPA) conducted numerous water quality surveys in the Black River Basin from 1972 to 1979. An intensive survey of the lower Black River was completed from 16-19 July 1979 and included most of the sampling points employed in the 23-26 July 1974 intensive surveys. Since there were no significant differences in waste treatment at the Elyria Sewage Treatment Plant (STP) and U. S. Steel, the stream quality data obtained are quite similar to those obtained in 1974. The data from this survey demonstrated the significant increase in stream temperature caused by the U. S. Steel-Lorain Works and highlighted the impact of the Elyria STP and U. S. Steel discharges on dissolved oxygen levels in the lower river. Concentrations as low as two to three milligrams per liter were recorded despite a river flow of 168 cfs. Problems with ammonia, cyanide and phenolics were also noted in the river. A total cyanide concentration of 230 μg/l was recorded near U. S. Steel while the present water quality standard is 25/μg/l. Relatively high levels of metals were also detected. An intrusion of lake water into the Black River was demonstrated.

States are required to classify streams or segments of streams as either "water quality" or "effluent" limiting. Effluent limiting segments are those where applicable water quality standards are being met, or there is certainty that these standards will be achieved by application of effluent limitations. Water quality limiting segments are those where standards are not being achieved and where application of the above treatment levels is not sufficient to achieve water quality standards. The Black River main stem from the mouth of the confluence of the East and West Branches, has been classified as water quality limiting. (Source: Black River Water Load Allocation Report, prepared by U.S. Environmental Protection Agency, 1980).

Sediment Quality - Sediment testing in Lorain Harbor was conducted by the U. S. Environmental Protection Agency (USEPA) in 1975. The results of these tests are shown in Table 3 while Plate 3 shows the location at which sediment samples were taken.

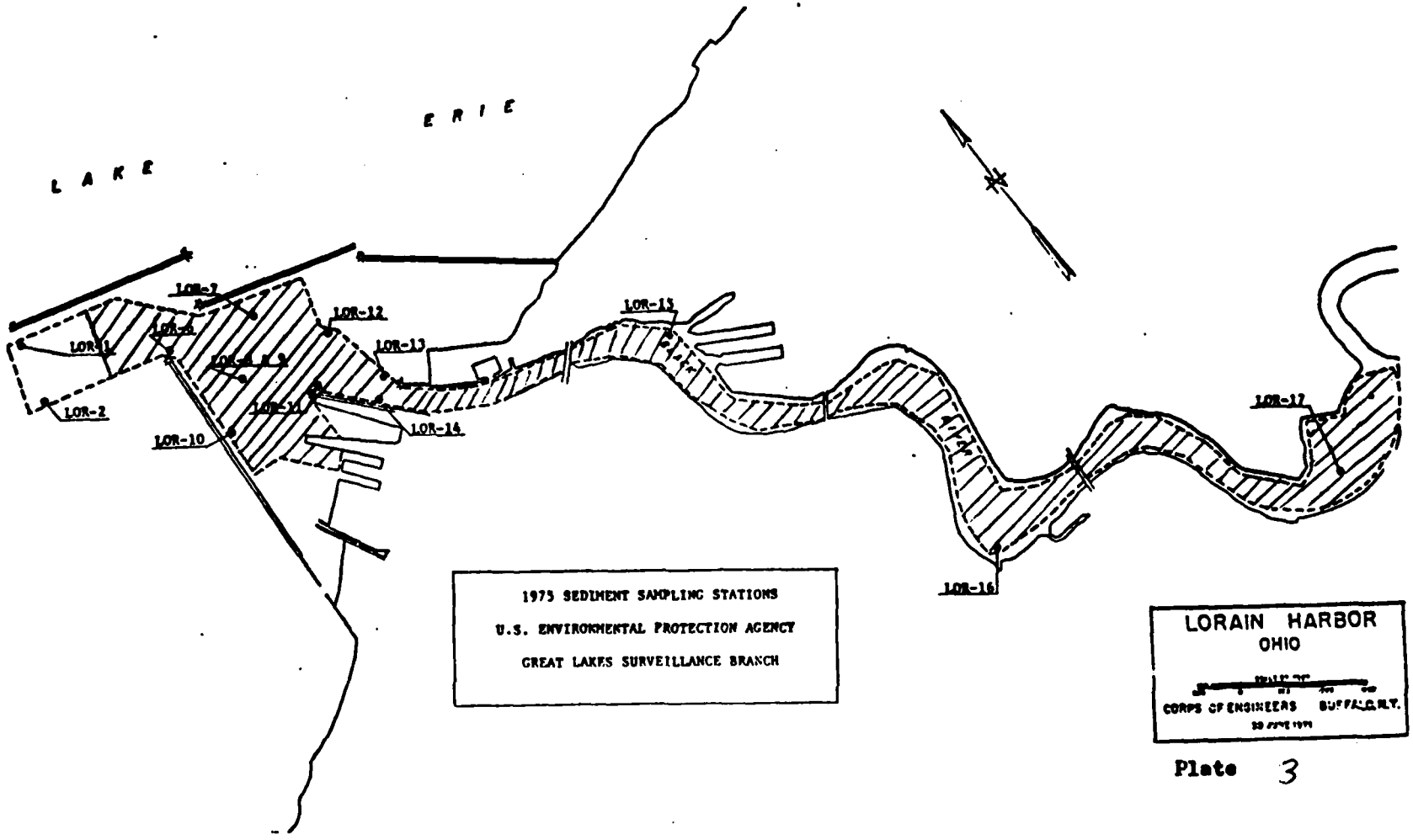
Table 3 SEDIMENT POLLUTION EVALUATION

HARBOR: Lorain

STATE: Ohio

SAMPLED: February 25, 1975

Evaluation Parameter	Guideline Values	Value at Each Station as a Percent of Dry Weight									
		LOR-6	LOR-8	LOR-9	LOR-10	LOR-11	LOR-12	LOR-13	LOR-15	LOR-16	LOR-17
Volatile Solids	6.0	7.43	6.77	6.29	5.33	8.12	4.37	8.53	8.78	9.07	9.94
Chem. Oxy. Demand	5.0	8.50	8.40	9.10	4.80	11.60	6.20	12.10	14.50	13.00	15.00
T. Kjel. Nitrogen	0.10	0.2700	0.2200	0.1800	0.1600	0.2500	0.1200	0.3200	0.3300	0.2400	0.3000
Oil - Grease	0.15	0.3000	0.4500	0.2800	0.1700	0.8400	0.1800	0.9000	0.9700	1.5000	2.3000
Mercury	0.0001	0.00001	0.00001	0.00002	0.00001	0.00002	0.00001	0.00003	0.00003	0.00004	0.00003
Lead	0.005	0.0062	0.0079	0.0069	0.0044	0.0120	0.0056	0.0164	0.0160	0.0216	0.0177
Zinc	0.005	0.0415	0.0470	0.0460	0.0360	0.0700	0.0370	0.0770	0.0900	0.1230	0.0980
Supplementary:											
T. Phosphorous		0.0930	0.1300	0.1100	0.1000	0.1500	0.0950	0.2500	0.2300	0.2200	0.1900
Ammonia Nitrogen		0.0240	0.0280	0.0230	0.0200	0.0400	0.0120	0.0670	0.0340	0.0240	0.0310
Cyanide		0.000091	0.00031	0.000038	0.000056	0.00037	0.000066	0.0005	0.00023	0.00056	0.00177
Manganese		0.0840	0.0800	0.0740	0.0710	0.0860	0.0625	0.0885	0.0780	0.1010	0.1105
Nickel		0.0040	0.0035	0.0055	0.0060	0.0070	0.0050	0.0065	0.0085	0.0100	0.0075
Arsenic		0.0013	0.0016	0.0013	0.0012	0.0013	0.0013	0.0011	0.0016	0.0019	0.0015
Barium		0.0073	0.0070	0.0051	0.0052	0.0091	0.0042	0.0143	0.0125	0.0113	0.0034
Cadmium		0.00025	0.00077	0.00042	0.00058	0.0015	0.00046	0.0016	0.0018	0.0029	0.0023
Chromium		0.0061	0.0076	0.0064	0.0059	0.0125	0.0060	0.0126	0.0134	0.0182	0.0146
Magnesium		0.8200	0.7800	0.8300	0.8000	0.1200	0.7000	0.7100	0.5000	0.5900	0.5800
Copper		0.0133	0.0112	0.0117	0.0114	0.0182	0.0124	0.0325	0.0165	0.0268	0.0225
Iron		4.0800	4.0900	4.0700	4.1700	4.7600	3.2500	4.8100	4.7100	6.5500	6.0400



1975 SEDIMENT SAMPLING STATIONS

U.S. ENVIRONMENTAL PROTECTION AGENCY

GREAT LAKES SURVEILLANCE BRANCH

LORAIN HARBOR
OHIO

CORPS OF ENGINEERS BUFFALO, N.Y.

Plate 3

That portion of the harbor that is shaded on Plate 3 has been determined to be polluted and therefore unacceptable for open water disposal. Dredgings from the remaining portion of the outer harbor may be disposed of at the designated open lake site. This decision made by USEPA was based on chemical and biological data as well as field observations.

Maintenance Dredging - The Federal project at Lorain Harbor is dredged periodically by Corps of Engineers hopper type dredges. Historical quantities removed during these operations are summarized in Table 4 for the period 1967 through 1979. The mean annual volume dredged has been approximately 171,000 C.Y. and is normally performed during a 2 to 4 week period between April and June. Occasionally, dredging operations have extended into November. Since 1978 polluted dredged material has been deposited in a confined disposal area adjacent to the East Breakwater shorearm. This structure has an estimated capacity equivalent to 10 years of normal dredging activity. This design standard is based on the assumption that after 10 years water treatment plants located upstream will help upgrade the quality of existing bottom sediments and implementation of land conservation measures will reduce the quantity and/or increase the quality of sediments within Federal channels to an acceptable level which will permit the resumption of open lake and/or shore area dumping.

Table 4 - Summary of Historical Dredging at Lorain, Ohio

Year	Cubic Yards	Year	Cubic Yards
1967	106,713	1973	83,922
1968	230,857	1974	498,586
1969	142,456	1975	136,298
1970	189,414	1976	42,290
1971	136,021	1977	30,420
1972	143,598	1979	192,048
		Total	1,932,623

Climate - The climate of Lorain can be described as humid and temperate. The climate in the region is characterized by large annual and daily temperature ranges, although the presence of Lake Erie tends to moderate these temperature changes. The average January temperature is 27.7°F and July temperature is 72.9°F. The highest temperature recorded is 105°F and the lowest is -23°F.

Cold air masses move down from Canada during the winter months but are modified by the relatively warm waters of Lake Erie, resulting in cloudiness and frequent snow from November through March.

Precipitation is well distributed throughout the year. The annual average precipitation is 35 inches, with about 17 inches occurring as rainfall during the growing season.

Air Quality - According to an Ohio EPA publication titled "Ohio Air Quality - 1978," numerous substances are emitted into the air each year through human activities. Those substances which are added to the ambient (outside) air in quantities sufficient to cause harmful effects on humans are considered pollutants. At present, there are six substances whose effects are known to be harmful at concentrations above the National Ambient Air Quality Standards. These six are Total Suspended Particles (TSP), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Photochemical Oxidants (Ozone) and Lead. These substances are referred to as Criteria Pollutants, that is, substances for which air quality standards have been adopted by the U. S. Environmental Protection Agency. Air quality standards are also in effect for a seventh class of substances known as Nonmethane Hydrocarbons (NMHC). Though NMHC themselves are not considered harmful, guidelines have been established in an attempt to control their involvement in the formation of dangerous Photochemical Oxidants such as Ozone. Table 5 shows the air quality standards in effect for these seven pollutants.

Air quality data for the City of Lorain collected during 1978 indicated violations of air quality standards for sulfur dioxide and total suspended particles.

When pollution levels exceed the established standards, a Health Advisory is issued to the public. Air pollution episodes in 1978 are summarized in Table 6. As indicated in the table, Lorain County experienced only one day when the level of ozone was over alert level. An official Air Pollution Alert was not called for on that day, however, due to a favorable dispersion forecast within the following 24 hours. Based on these data, Lorain County, in comparison to the rest of Ohio, has relatively minor air quality problems.

HUMAN ENVIRONMENT

Land Use - The banks of the Black River and the lakefront at the entrance to the harbor are characterized by high intensity industrial and related transportation uses, commercial docking facilities, utility uses, and recreation use activities. There remains, however, a significant amount of vacant or unused land available for industrial development along the 3-mile navigation channel. The Port Authority of Lorain is the local agency responsible for promoting the industrial development of these waterfront properties. The Authority holds leases on various industrial properties that have been newly developed or expanded in recent years. The junction of the lake, river, and railroads have established the pattern of land use development for the remainder of the City of Lorain. In recent years, the City, in conjunction with local civic organizations, has embarked on an ambitious program of renewal and restoration that employs the beneficial aspects of the rail-river transportation network, while minimizing the barrier effect these networks have upon "free movement" within the city.

Table 5 - Air Quality Standards, The State of Ohio

Pollutant	Duration	Restriction	Ohio EPA Standards	USEPA Air Quality Standards Primary	Secondary
Suspended Particulates	Annual Mean (G)	Not to be exceeded	60	75	60
Suspended Particulates	24-hour concentration	Not to be exceeded more than once per year	150	260	150
Sulfur Dioxide	Annual Mean (A)	Not to be exceeded	60 (.02)**	80 (.03)	--
Sulfur Dioxide	24-hour concentration	Not to be exceeded more than once per year	260 (.10)	365 (.14)	--
Sulfur Dioxide	3-hour concentration	Not to be exceeded more than once per year	--	--	1,300 (.50)
Carbon Monoxide	8-hour mean (A) concentration	Not to be exceeded more than one 8-hour period per year	10* (9.0)	10* (9.0)	10* (9.0)
Carbon Monoxide	1-hour mean (A) concentration	Not to be exceeded more than once per year	--	40* (35.0)	40* (35.0)
Photochemical Oxidants	1-hour mean (A) concentration	Not to be exceeded	119 (0.06)	160 (.08)	160 (.08)
Photochemical Oxidants	4-hour mean (A) concentration	Not to be exceeded more than one consecutive 4-hour period per year	79 (0.04)	--	--
Photochemical Oxidants	24-hour mean (A) concentration	Not to be exceeded more than 1 day per year	40 (0.02)	--	--
Nonmethane Hydrocarbons	3-hour mean (A) concentration	Not to be exceeded between 6 a.m. and 9 a.m.	126 (0.19)	160 (.24)	160 (.24)
Nonmethane Hydrocarbons	24-hour mean (A) concentration	Not be exceeded more than 1 day per year	331 (0.50)	--	--
Nitrogen Dioxide	Annual mean (A)	Not to be exceeded	100 (.05)	100 (.05)	100 (.05)
Lead	Quarterly mean (A)	Not to be exceeded	- -	1.5	- -

(A) Arithmetic (G) Geometric

* Only standard expressed in milligrams per cubic meter

** Values in parentheses are equivalent values in parts per million

Values not in parentheses are in micrograms/cubic meter

Primary Standard - For Protection of Public Health

Secondary Standard - For Protection of Public Welfare

Coast Guard Station at Lorain - A U. S. Coast Guard Station is located on the east shore of the Black River at river mile 0.5. The station is a continuously manned facility providing navigation regulation enforcement and surveillance, rescue and assistance operations for water craft, and maintenance of harbor navigational aids.

Cultural Resources - In order to assess the impacts of the proposed project on significant cultural resources, the 18 March 1980 edition of the National Register of Historic Places and all subsequent revisions were consulted. While several properties were listed for the city of Lorain, only one, the Lorain Lighthouse, is located in close proximity to the Environmental Impact Area of the proposed study. This structure will sustain no direct impacts as a result of this study, but may be subjected to visual impacts resulting from nearby construction. Based on a cultural resources report completed for the area in 1975 entitled: Inventory of Cultural Resources: Diked Disposal Site No. 7, Lorain Harbor, Ohio, by Dr. Don Dragoo, there are no potentially significant sites which would be impacted by any of the project alternatives. This report is contained in The Cultural Resources Appendix.

Water Use: Commercial - Lorain Harbor is a deep draft commercial harbor serving the Port of Lorain which is almost exclusively a bulk commercial port. Over the 10-year period 1969-1978, waterborne commerce at Lorain averaged 8,561,662 tons annually with peak volumes of 10,173,023 tons in 1972 and 11,584,368 tons in 1973. Waterborne commerce at Lorain in 1978 totaled 8,236,264 tons consisting principally of iron ore and concentrates and limestone.

While not extensively used as a commercial fishing harbor, it has been reported that five commercial fishing operations are gill netters and that their average annual catch of fresh fish is between 150-200 tons.

Water Use: Recreational - The harbor includes two recreational boating marinas. One, owned by the City, is located between the City's Water Pollution Control Plant and the U. S. Coast Guard Station and has a berthing capacity for 70 boats. The other, privately owned, is located upriver adjacent to the Erie Sand and Gravel facility and below the N&W Railroad Bridge and has a berthing capacity of 23 boats. Due to the limited berthing capacity available at Lorain, trailering has been necessary. The demand for recreational boating facilities is so great that the Lorain planning agencies, Lorain Port Authority, and private interests are constantly seeking additional locations and financial aid to provide new facilities. A current plan of the City is to use the recently constructed diked disposal area for a large recreational-marina complex after the anticipated 10-year fill-in period. This area could provide dock space for approximately 300-400 boats and additional boat-launching ramps. The Port Authority has recently constructed a temporary rubber-tire floating breakwater at the location that will provide dockage for recreational craft until permanent facilities are constructed.

Ohio Department of Natural Resources has entered into an agreement with the City of Lorain for the City to study and develop a plan outlining the recreational potential of Lorain's Harbor area and to initiate a study regarding the feasibility for development of a small-boat marina within the Lorain Harbor area.

Duck hunting from the breakwater and sportfishing at most any place accessible to the lake and harbor waters are popular water recreation activities at Lorain. During the Initial Public Meeting, City officials expressed a desire for improved safer access to and along the breakwater for increased sportfishing opportunities. Immediately west of Lorain Harbor is Lakeview Park. Approximately a third of a million people used the 1,300-foot park last summer and the City of Lorain has used the beach as a focus for park development and growth.

Population - Lorain County experienced a tremendous growth during the 1950's. Between 1950 and 1960, the population grew from 148,200 to 217,500, a 47 percent increase. Although the rate of growth decreased during the next decade, population grew by 18 percent, an annual growth rate of 1.6 percent for the decade compared with 3.9 percent during the 1950's. The area experienced rising unemployment during the 1960's with resulting curbs on population growth. Since the era of rapid growth (i.e., the 1950's) was a time of industrial expansion in the area, it is probable that future increases in population will be contingent on increasing industrialization.

Lorain County's population growth during the years 1970 to 2020 is estimated, at an annual rate of 0.8 percent, to reach 355,000 people. Northeast Ohio Demographic and Economic Projections 1970-2020 indicates that population growth in Lorain County will not keep pace with the projections for the Northeast Ohio region (Table 7).

The population of the city of Lorain has increased at a lower rate than that of Lorain County. During the 1960's population of the City grew by 13 percent, compared with 18 percent for the County, which indictes suburban development in this region. By 1990 the population of the City is projected to be about 96,000 (Table 7).

Table 7 - Population Projections

Years	Lorain County	City of Lorain
Historical		
1960	217,500	68,932
1970	255,884	76,733
Forecast Period		
1980	297,800	86,800
1990	334,600	96,100
2000	355,100	101,200
2010	362,800	103,000
2020	355,800	100,800

Employment and Income - Expanding at an average rate, Lorain County's employment population is predicted to reach 107,300 in the year of 2020 (Table 8) notwithstanding the influence of Greater Cleveland. In Lorain County in 1970, a population of 255,884 and 63,024 families with the head of house employed (Table 9) earned an average income of $11,574.

Many industries, such as construction, manufacturing, transportation and utilities, which had reached their peak of rapid growth in the 1950's leveled out in the 1960's and are projecting little net growth between now and the year 2020. Manufacturing will continue to be the dominant feature of Lorain's employment profile. However, manufacturing employment will represent 10 percent less of the total employed population in 2020 (Table 10). In 1960, Lorain had two major manufacturing industries, primary metal manufacturing, and transportation equipment manufacturing (shipbuilding), which employed 30 percent of the total workforce. Primary metal manufacturing, which employed 11,000 workers in the 1960's, is expected to employ approximately the same number throughout the projected 60-year period. Transportation equipment manufacturing is expected to gain little in absolute employment over the same projected period. Total manufacturing growth in Lorain will tend to be inhibited by this no-net change in employment in the two major industries.

While manufacturing is expected to stabilize through the year 2020, employment in the fields of service, government and education is expected to increase from 14,400 in the 1960's to a peak of 25,500 persons by the year 2000 then this employment growth will moderate.

As of the 1970 census (Table 11), the labor force consisted predominantly of crafts, and related work such as construction, mechanical, repair, and metal crafts. The female work force of about 30,000 were primarily clerical and sales personnel. A large older work force, ages 45 to 60, of nearly 24,000 were employed in 1969 as compared to the total employment of 63,000. The median income for the head of the family was $10,977 (Table 9).

Table 8 - Employment Projections for Lorain County

Historical		Forecast Period				
1960	1970	1980	1990	2000	2010	2020
75,758	82,804	91,300	99,600	104,600	107,500	107,300

Table 9 - Income in 1969 of Family by Age of Head of Household

Total Families	Number of Households	Median Income Dollars	Mean Income Dollars
		$	$
Head, Total	63,024	10,977	11,574
Head, under 25 years old	4,485	8,209	7,961
Head, 25 to 34 years old	14,483	10,589	10,642
Head, 35 to 44 years old	14,092	12,016	12,570
Head, 45 to 60 years old	23,753	12,243	13,169
Head, 60 to 64 years old	4,167	10,356	11,381
Head, 65 years old and older	6,211	6,102	7,999

Source: Detailed characteristic of Ohio
U. S. Department of Commerce
Social and Economic Statistic Administration
Bureau of the Census

TABLE 10 - INDUSTRY GROUP OF THE EMPLOYED, SUBREGION 11: LORAIN/ELYRIA LABOR MARKET AREA: 1960-2020

	1960	1970	1980	1990	2000	2010	2020
				Number Employed			
Agriculture, Forestry, & Fishing	2,303	2,292	2,281	2,270	2,559	2,248	2,238
Mining	419	457	507	557	588	608	608
Construction	3,629	3,954	4,388	4,827	5,094	5,263	5,267
Manufacturing	36,160	36,872	37,671	38,479	39,151	39,750	40,223
Transportation, Communication & Utilities	4,719	5,142	5,705	6,277	6,624	6,844	6,849
Trade, Wholesale & Retail	12,065	14,435	17,294	20,022	21,589	22,388	22,097
Finance, Insurance & Real Estate	2,097	2,509	3,006	3,480	3,752	3,891	3,841
Services	8,680	10,385	12,442	14,404	15,532	16,106	15,897
Government & Education	5,686	6,760	8,054	9,289	10,005	10,377	10,260
Total	75,758	82,804	91,346	99,604	104,595	107,473	107,279
				Percentage Distribution			
Agriculture, Forestry & Fishing	3.04	2.77	2.50	2.28	2.16	2.09	2.09
Mining	.55	.55	.56	.56	.56	.57	.57
Construction	4.79	4.78	4.80	4.85	4.87	4.90	4.91
Manufacturing	47.73	44.53	41.24	38.63	37.43	36.99	37.49
Transportation, Communication, & Utilities	6.23	6.21	6.25	6.30	6.33	6.37	6.38
Trade, Wholesale & Retail	15.93	17.43	18.93	20.10	20.64	20.83	20.60
Finance, Insurance, & Real Estate	2.77	3.03	3.29	3.49	3.59	3.62	3.58
Services	11.46	12.54	13.62	14.46	14.85	14.99	14.82
Government & Education	7.51	8.16	8.82	9.33	9.57	9.66	9.56
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: Number employed may not add to total because of rounding. Percentages derived from unrounded absolutes.

Source: 1960: U. S. Census of Population; 1970 to 2020: Battelle projections.

TABLE 11 - OCCUPATION OF EMPLOYED PERSONS BY CLASS OF WORKER

	Male Total Employment	Female Total Employment
Male 16 years old and older	63,947	
Female 16 years old and older		31,438
Professional, Technical	7,237	4,590
Managers and Administrators (Except Fam.)	4,627	926
Sales Workers	3,031	3,127
Clerical and Kindred Workers	4,027	9,955
Craftsmen and Kindred Workers	16,530	652
a. Construction Craftsmen		
b. Foremen, nec		
c. Mechanics & Repairmen		
d. Metal Craftsmen (Except Mechanics)		
Operative Except Transport	16,014	3,882
Transport Equipment Operatives	3,258	245
Labor Except Farm	4,269	330
Farmers and Farm Managers	645	076
Farm Laborers & Farm Foremen	466	263
Service Workers (Except Private Household)	3,823	6,731

SOURCE: Detailed characteristics, Ohio, U. S. Department of Commerce, Social and Economic Statistics Administration, Bureau of Census.

Business and Industry - Manufacturing plays a major role in Lorain's economy and 37,280 people or 44.5 percent of the labor force are employed by the 55 diversified manufacturing industries in the area. The 10 largest industries, located along the banks of the Black River in the immediate steel area, provide employment for 12,300 people. Employment figures for the top five industries in the harbor area are shown in Table 12.

Table 12 - Major Employers at Lorain Harbor (1974)

Company	Number of People Employed
U. S. Steel	10,000
American Ship Building Co.	1,000
Griffith and Sons	500
U. S. Gypsum	300
Falbo Construction	100

Source: Personal communication, John Sulpizio, Director, Lorain Port Authority, Lorain, Ohio.

Others with less than 100 employees are:

Allied Oil Co., Erie Sand and Gravel Co.; and Lorain-Elyria Sand Co.

Lorain Harbor, upon which the city of Lorain is economically dependent, handles large quantities of iron ore and limestone. It has a breakwater-protected outer harbor and an excellent inner harbor. The Black River, on which the port is located, is navigable to large ships for 3 miles upstream and serves major industries with easy water transport, dry dock, and shipyards. The harbor is used principally for the handling of bulk commodities.

Local Development - The Lorain Port Authority was created in 1964, its objective being to further Lorain's position as a world port, and has financed a $7,000,000 drydock and improvements for American Ship Building Co. through an Industrial Revenue Bond issue. The construction of a $5,000,000 terminal facility for Allied Oil Company has added to Lorain's water transportation resources.

In May of 1980, Republic Steel Corporation completed construction of a large iron ore transshipment dock adjacent to the outer harbor. The principal function of the terminal is transshipment of iron ore pellets to inland steel plants. The facility has accommodated 1,000-foot self-unloading bulk vessels, and is designed for an annual throughput of 9-10 million tons of iron ore.

In addition to expansion and improvement, Lorain has realized the importance of redevelopment in the downtown area and has begun a 5-year urban renewal project in a 17-acre site surrounding Lorain's new City Hall. Plans for

major retail, commercial, and housing facilities are included, along with a proposed parking structure and civic center for its citizens. South Lorain has an $11 million urban renewal project in the final stages of execution, and yet to be developed in south Lorain is an area zoned for residential development and an area for commercial expansion.

These projects have the cooperation of the Community Development Department which is working toward improving traffic circulation, light synchronization, mass transportation system, and beach improvement.

Transportation Facilities and Services - Lorain, OH, is served by three trunkline railroads. The Baltimore and Ohio Railroad (B&O) runs directly from the Port of Lorain into southern Ohio and western Pennsylvania. The Norfolk and Western Railroad (N&W) provides east-west service connecting with Cleveland and points east, as well as Chicago and St. Louis to the west. The third railroad serving Lorain is the Consolidated Rail Corporation.

The city of Lorain has east-west transportation via highway, U. S. Route 6, and south on State Routes 57 and 58. The Lorain-Elyria metropolitan area is served by Interstates 90 and 80, connecting between Toledo and Cleveland. Interstate 71, which provides access to the north and south, is about 15 miles east of Lorain-Elyria.

The Lorain City Airport, formerly located in the southwest quadrant of the intersection of State Routes 611 and 58, has been moved to the Lorain County Airport approximately 8 miles south of the City. The County airport can accommodate smaller commercial aircraft, however, no commercial airlines utilize this facility on a regularly scheduled basis.

Cleveland Hopkins International Airport, located less than 20 miles from the Port of Lorain on the west side of the city of Cleveland, is the principal facility servicing the area.

Docks and Terminal Facilities - There are 18 wharves and docks within the Federal project limits at the Port of Lorain, OH. One is located on the outer harbor, six are situated on the left bank, and 11 on the right bank of the Black River within the city of Lorain. Table 13 summarizes the commercial dock facilities at Lorain Harbor (Plate 1). The principal commodities in terms of annual tonnage are iron ore and concentrates, and stone products.

Bridges - There are three bridges which cross the navigation section of the Black River. The Erie Avenue Bridge, constructed in the late 1930's, has a total length of about 1,050 feet and consists of a twin-leaf bascule main span with eight steel-girder approach spans on the west and one approach span on the east. The structure carries two, 22-foot roadways separated by a 3-foot median and two, 7-foot-wide sidewalks. The main span is 295 feet long and provides approximately 147.5 feet horizontal clearance, with 96 feet of vertical clearance above mean water elevation when in the open position. The Norfolk and Western vertical lift railroad bridge provides an understructure clearance of 123'-8" and channel width of 205 feet. It was reconstructed in the 1940's as part of the Federal project. The 21st Street Bridge, constructed in the 1940's, is a six span 1,700-foot through truss with a

400-foot river crossing span. The understructure clearance, based on Lake Erie Low Water Datum of 568.6 feet, is 99.6 feet for approximately 250 feet in the center river crossing span. Piers are twin reinforced concrete columns on piling with a reinforced concrete strut connection near the top. The five piers range in height from 43 feet to 79 feet. The roadway is 42 feet curb to curb and there is a 7-foot sidewalk on the west side.

Extended Season - The Port of Lorain navigation season averages about 34-37 weeks. Since 1971, an extension of the navigation season has been attempted with varying success, depending on the severity of the weather. The Detroit District, Corps of Engineers, has prepared a feasibility study of extending the Great Lakes - St. Lawrence Seaway Navigation season which recommends a plan of operation for a 12-month navigation season on the upper three Great Lakes and their connecting channels, up to 12-month navigation on the St. Clair River - Lake St. Clair - Detroit River System and Lake Erie, and up to 10-month navigation on Lake Ontario and the St. Lawrence River to be accomplished concurrently with an Environmental Plan of Action.

Table 13- Commercial Dock Data - Lorain Harbor

Dock Name and Location	Material Handled	Operator	Dock-side Equipment	Loading Capacity	Dock Length Ft.	Depth at Dock Ft.	Storage Capacity Tons	Land Service
Republic Steel Corp. Lorain Pellet Terminal Mooring Basin Outer Harbor	Mooring Vessels	Republic Steel Corporation			1,095	25		Rail, Veh.
Republic Steel Corp. Lorain Pellet Terminal Wharf below Erie Ave. Bridge Left Bank	Ore Unloading	Republic Steel Corporation	Transshipment Facility	2,500 Rail 5,000 Ship	1,200	27	532,000	Rail, Veh.
Lorain Works Md. Black River	Ore Unloading	U.S. Steel Corporation	3-20T Hullets	4,800	2,490	26	3,000,000	Rail, Veh.
Erie Sand, Ft. E. 9th St.	Unloading Sand and Gravel	Erie Sand and Gravel Co.	Self-Unloaders Only	-	460	19	65,000	Veh.
Griffith, Dock No. 1, Upper Turning Basin	Unloading Gravel, Sand	Griffith Blacktop Inc.	Self-Unloaders Only	-	400	27	75,000	Veh.
Lorain Slag, above 21st St. Bridge	Unloading Slag, Dry Bulk Materials	U.S. Steel Corporation	Self-Unloaders Only	-	220	20	18,000 Slag 12,000 Coke	Rail, Veh.
Gold Bond Building Products Above 21st St. Bridge East Bank	Unloading Gypsum	National Gypsum Co.	Self-Unloaders Only	100	750	20	120,000	Rail, Veh.
Adams, above N & W R.R. Br.	Unloading Sand Stone & Gravel	North Ridge Trucking Inc.	Self-Unloaders Only	-	300	27	22,000	Veh., Rail
Terminal Ready Mix, above N&WRR Br.	Unloading Sand & Stone	Terminal Ready-Mix, Inc.	Self-Unloaders Only	450	500	24	30,000 Stone 20,000 Sand	Veh.
Allied, above 21st St. Bridge	Unloading #2 Fuel Oil	Allied Oil Co. Div. Ashland Oil	16" Pipeline	-	185	23	500,000 Bls.	Veh.
Am. Ship Bldg. Boiler Stop Dock below N&WRR Br.	Build & Maintain Vessels	American Ship Building Co.	-	-	900	18-25	-	Rail, Veh.
Republic Steel Corp. Mooring Wharf, between 14th and 15th St.	Mooring Vessels During Closed Navigation Season	Republic Steel Corporation	-	-	880	24	-	Veh.
Griffith Dock No 2, below 21st St. Bridge	Unloading Sand Pig Iron, and Steel Products	Griffith Blacktop Incorporated	One 150-T Crawler Crane	-	200	27	120,000	Veh.
American Ship Bldg. Pipe Shop Dock below N&WRR Br.	Mooring Vessels for Repair	American Ship Building Company	-	-	325	18-24	-	Rail, Veh.
American Ship Bldg. North Wharf, above Erie Ave. Br.	Mooring Vessels for Outfitting and Repair	American Ship Building Company	-	-	535	18-27	-	Rail, Veh.
Reagan Marine Supply Wharf, above Erie Ave. Bridge	Mooring Vessels	Reagan Marine Supply	-	-	78	8-10	-	Veh.
Corps of Engrs. Dredge Pumpout Facility Mooring below Erie Ave. Bridge	Mooring Dredge for Pipeline Discharge of Dredged Material to Spoil Area	U. S. Army Corps of Engineers	Two 16-inch Pipelines	-	200	27	-	Veh.
U. S. Coast Guard Lorain Station Slip	Mooring U. S. Coast Guard Vessels	U. S. Coast Guard	-	-	92	0-9	-	Veh.

Source: United States Ports on Lake Erie, Port Series No. 42 Revised 1980, Corps of Engineers, U. S. Army

Historical Tonnage - There are many active docks within the Federal project limits. Two iron ore receiving docks and the U. S. Steel Corporation limestone dock account for the majority of domestic bulk receipts in recent years. Several other smaller docks that receive refined petroleum products, gypsum rock, sand and gravel, and limestone account for the remainder of the annual traffic volume.

Table 14 - Historical Tonnage of Major Bulk Commodities
Lorain Harbor, OH

Year	Iron Ore	Limestone	Sand and Gravel	Gypsum Ore	Coal	All Others
1966	3,529,042	709,865	513,579	94,508	1,636,170	137,819
1967	2,998,893	458,603	525,060	150,869	1,387,883	32,130
1968	4,026,139	768,858	513,850	94,964	5,146,995	73,878
1969	4,420,521	729,719	504,016	131,385	3,303,811	23,368
1970	3,421,070	1,255,077	582,014	125,616	3,127,335	61,986
1971	3,238,738	1,235,734	442,116	120,879	2,407,446	38,876
1972	4,214,292	1,372,711	410,929	168,627	3,933,568	72,896
1973	5,626,470	1,738,988	410,183	172,472	3,569,843	66,412 1/
1974	4,709,615	1,599,868	503,533	120,614	2,033,309	109,951 1/
1975	4,337,928	1,379,981	402,071	111,816	1,268,731	149,814 1/
1976	4,557,441	1,277,691	285,672	146,612	1,061,407	110,290 1/
1977	3,085,136	1,235,005	485,971	112,786	1,262,936	105,079 1/

1/ Increase since 1973 is attributed to petroleum receipts at Allied Oil Terminal.

Source: Waterborne Commerce of the United States, Part 3, Great Lakes.

Historical Fleets - Iron Ore - Historical fleets used to ship ore which originates from U. S. harbors to Lorain, OH, are shown in Table 15. This fleet summary excludes the Canadian iron ore receipts. However, since the historical Canadian ore has averaged about 215,000 tons per year during the interval 1968 through 1977, this is only about 5 percent of the total ore receipts and should not significantly distort average fleet characteristics.

Table 15 - Historical Iron Ore Fleets 2/
Lorain Harbor, OH

Vessel Size	Period of Analysis				
	1976	1975	1974	1973	1972
Class III (500 to 549 feet)	1%	0%	0.5%	1/	1%
Class IV (550 to 599 feet)	0%	0%	0.5%	1/	2%
Class V (600 to 649 feet)	97%	87%	94%	86%	88%
Class VI (650 to 699 feet)	2%	10%	2%	5%	2%
Class VII (700 to 730 feet)	0%	2%	1%	1/	3%
Class VIII (731 to 849 feet)	0%	1%	2%	8%	4%
Total Domestic Traffic	4,130,128	4,223,464	4,637,571	5,479,991	4,088,498

1/ Less than 0.5 percent.
2/ Average for all docks receiving iron ore.

Source: Waterborne Commerce of the United States, Part 3, Great Lakes, Corps of Engineers.

Historical Fleets - Limestone - Limestone traffic is presently moving in self-unloading bulk vessels to docks along the Black River. U. S. Steel Corporation dominates the traffic flows within the harbor in terms of annual limestone receipts. Therefore, the composition of the historical limestone fleet serving this harbor has been heavily influenced by the vessel types and sizes in the U. S. Steel Corporation's Great Lakes self-unloading fleet. An overview of the distribution of vessels and their sizes used at Lorain Harbor between 1972 and 1976 is shown in Table 16.

Table 16 - Historical Limestone Fleet Summary
Lorain Harbor, OH

Vessel Size	1976	1975	1974	1973	1972
Class IV (550 to 599 feet)	19%	19%	6%	28%	19%
Class V (600 to 649 feet)	43%	45%	56%	72%	79%
Class VI (650 to 699 feet)	26%	24%	32%	0%	0%
Class VII (700 to 730 feet)	12%	12%	5%	0%	0%
Total Domestic Traffic 1/	1,277,691	1,379,981	1,599,868	1,738,988	1,372,711

1/ Tonnage statistics represent vessel movements to all limestone docks.

Source: Waterborne Commerce of the United States, Part 3, Great Lakes, Corps of Engineers

U. S. Steel Corporation operates its own Great Lakes fleet and is capable of moving most of its annual limestone requirements from Port Dolomite and Calcite, MI, to its upriver steel plant.

NATURAL ENVIRONMENT

Fish and Wildlife - An inventory of aquatic and terrestrial habitat and of the fish and wildlife species associated with Lorain Harbor and the Black River is to be prepared by the U. S. Fish and Wildlife Service. This information has not been provided at this time but is expected in the fall of 1980.

PROBLEMS, NEEDS AND OPPORTUNITY

This subsection of the report describes the present harbor and harbor maintenance operations, sedimentation, and small boating activity within the limit of the navigation project. It then defines current commercial and recreational navigation and sedimentation problems and needs at Lorain. This

section also discusses pertinent future developments which may affect navigation and sedimentation and summarizes the improvements desired by local interests.

THE PRESENT HARBOR

Use - The present harbor is used both by commercial and recreational vessels. The commerical vessels trade primarily in bulk iron ore, ore concentrates and limestone. With Republic Steel obtaining ownership of the coal docks, and with no demand for high-sulphur coal, the exporting of coal has stopped altogether. Iron ore is delivered to both the Republic Steel lakefront transshipment facility and upriver to the U.S. Steel docks. Stone products are delivered to various docks along the channel. Recreational boating facilities are all presently located along the river.

There is also an active shipyard located at Lorain. This shipyard has launched at least three of the "super jumbo" (1,000-foot) vessels (See article "Big is Bountiful" in Appendix E for details on 1,000-foot vessels) and has received orders for construction of additional maximum size vessels for delivery in the near future. It is one of only two active shipyards on the American side of the Great Lakes with a dry dock of sufficient size to accommodate construction and maintenance for this size ship.

Physical Properties - The harbor consists of a breakwater protected lakefront harbor in Lake Erie and an improved navigation channel which extends 3 miles into the head of navigation on the Black River. The harbor is Federally improved and is shown on Plate 1 earlier in this report. The lakefront harbor encompasses an area of about 60 acres and extends for a distance of approximately 1 mile into Lake Erie from the mouth of the Black River.

Five separate breakwaters comprise the breakwater system at Lorain; the outer breakwater, east breakwater, east breakwater shorearm, west breakwater, and west breakwater shorearm (see Table 17 for elevations). The Outer Breakwater and the East Breakwater Shorearm were constructed using steel sheet pile cells filled with granular fill and topped with a 2-foot thick concrete cap. The East Breakwater and West Breakwater are constructed of a quarry chip core, an underlayer of stone (averaging 2 ton) and a laid up armor stone layer (minimum 3 tons). The West Breakwater Shorearm is of rubblemound construction with an underlayer of stone (500 pound minimum with not more than 50 percent less than 2 ton) and an armor layer (minimum 2 tons). All authorized Federal navigation improvements to the lakefront harbor are completed. Authorized depth throughout the Federal project limits are shown below.

29 feet in lake approach channel,

28 feet in 800-foot wide channel through the outer harbor,

25 feet in remainder of outer harbor except the 16-foot deep area in the west outer harbor in the channel to the municipal pier,

28 feet in completed portion of the lower 2,200 feet of the river channel,

27 feet in the remainder of the river channel, except in the vicinity of the Norfolk and Western Railroad bridge and at cut number 1 to within 500 feet of the upstream project limit and 24 feet in the remainder,

17 and 21 feet in the upstream turning basin,

20 feet in the downstream turning basin.

Table 17

Elevations at tops of breakwaters with respect to International Great Lakes Datum - 1955 (IGLD - 1955) are as follows:

Outer Breakwater	578.6 Feet
East Breakwater Shorearm	578.6 Feet
East Breakwater	578.8 Feet
West Breakwater	578.8 Feet
West Breakwater Shorearm	572.5 Feet

Uncompleted authorized improvements to the Black River consist primarily of improvements in the area on the west bank just upstream of the Erie Avenue Bridge known as Cut Number 1 (Plate 1). Those incomplete improvements consist of bank stabilization and dredging, were authorized by the 1965 R & H Act. The authorized river channels were designed for 730-foot vessel operation.

Harbor Maintenance Operations - The Corps of Engineers is responsible for repairing the breakwaters and for dredging the river channels and lakefront harbor to authorized depths.

Corps of Engineers derrickboats are currently used to maintain the breakwaters. Repairs to the East and West Breakwter include periodic rearrangement of the existing armor stone and additions of new armor or core stone where required.

Corps of Engineers hopper-type dredges are used to maintain authorized depths within the Federal project limits. This dredging is normally performed during a 2 to 4-week period between April and June. Beginning in 1978 dredged material has been deposited in a confined disposal area adjacent to the East Breakwater Shorearm.

IMPROVEMENTS DESIRED

Correspondence - On 4 March 1970, the Lorain Port Authority requested the Buffalo District to make a technical review of the Lorain Harbor project to determine if the new "super jumbo" vessels being built at that time could be accommodated within the authorized channels. The District responded on 13 March 1970. In part, the response stated that "Although it would be physically possible for vessels up to 1,000 feet long and 105 feet wide to navigate the Black River channel with the use of tugs and thrusters, it would be inadvisable. Extreme care would have to be exercised and vessel speed reduced to a minimum which would make the vessel vulnerable to sudden gusts of wind or changes in river currents and could cause the vessel to ground or strike shore facilities."

Following the technical review response noted above, a series of meetings were held by the Lorain Port Authority to map a course of further action for improvement at Lorain Harbor. With the Erie Avenue Bridge being identified as the major problem for shipyard and iron ore shipments to U.S. Steel, U.S. Steel Corporation publicly announced on 7 July 1976, its planned facility expansion at Lorain. The result of the meetings and public announcement was a resolution by the Port Authority, and supported by the City Council that was sent to Congressman Charles A. Mosher. The resolution requested that the U.S. House of Representatives Public Works and Transportation Committee authorize the Corps of Engineers to make needed improvements to the Port to accommodate the passage and safe navigation of new and larger ships operating on the Great Lakes. This authorization was adopted by the U.S. House of Representatives Committee on Public Works and Transportation on 23 September 1976. A copy of the study resolution is included in Appendix .

Meetings - On 27 April 1978 an Orientation Workshop was held in the Council Chambers at the Lorain City Hall. The commercial interests expressed concerns dealing with navigation safety and channel efficiency. The major concerns identified were: (1) the constricted outer harbor entrance; (2) the channel alignment through the Erie Avenue Bascule Bridge; (3) the clearance under the 21st Street Bridge; (4) restrictive width of the existing channel, which allowed one-way movement of traffic except in the turning basins; (5) and increased evidence of bank erosion and dock damage, both attributed to movement of Great Lakes vessels equipped with bow and stern thrusters. Turbulence generated by these thrusters has been correlated to increased stream bank erosion at or near bends in the river channel.

Other interests expressed a need and desire for additional recreational boating and fishing facilities and the elimination of vehicular traffic delays caused by the opening of the Erie Avenue Bridge. The local officials concurred with these needs and with the concerns expressed by the commercial interests.

At the Initial Public Meeting held on 31 May 1978, the commercial navigation interests reiterated their needs and concerns as expressed at the earlier Orientation Workshop meeting. Interested citizens and local officials restated their desires for expanded recreation boating and fishing facilities. The U.S. Fish and Wildlife Service stated their opposition to

any project work which would diminish or adversely alter any existing marsh or wetland areas thereby adversely impacting wildlife habitat.

Based on these meetings and communications, the improvements desired by local interests are summarized as follows:

a. Improvements to the lakefront harbor entrance to permit safe navigation of the harbor for the new larger vessels,

b. Improvements to the Erie Avenue Bridge to permit launching of American Shipbuilding Co. 1,000-foot vessels without the use of tugs.

c. Improvements to the Black River channel for safe navigation and to accommodate larger vessels or lakefront construction of a transshipment facility with alternative modes of transportation (conveyor, special purpose vessel, rail or truck) for the upriver movement of ore and stone which will permit the utilization of larger more economical vessels at Lorain Harbor.

d. Adequate provision for future protected small-boat berthing facilities and consideration of the use of the protected harbor area by recreational craft.

e. Improvement in water quality in the Black River. Two technical workshops and a number of informal meetings with local officials and industry representatives were held during the course of the Stage 2 Study. These meetings are discussed later in this Stage 2 report.

NAVIGATION PROBLEMS

There are both commercial and recreational navigation problems at Lorain. This study will primarily address improvement alternatives for commercial navigation as related to the newer, larger class of bulk carriers and will discuss recreational navigation only as impacted upon by commercial navigation. Specific problem identification and improvements for recreational boating are presently being evaluated by a consulting firm under contract to Buffalo District and the results of this preliminary feasibility report will be presented in a separate report currently scheduled for completion in last quarter of FY 1981.

Design Vessel Drafts and Required Channel Depths - The fundamental commercial navigation problems are to move bulk cargo more economically through Lorain harbor and to permit safe and efficient passage of vessels upriver to both the American Shipbuilding and U.S. Steel facilities. For the existing harbor conditions, design criteria, incorporated into the last Federally-funded improvement in 1965 has resulted in large self-unloading 1,000-foot vessels to enter "light loaded" i.e., at less than the system draft of 25.5 feet at LWD. Depth requirements were determined using the following criteria (see Pages 2-4 through 2-6 of Appendix A for design depth computations):

Design vessel static draft - to be determine-

Squat (lowering of water surface around a moving vessel which produces a relative change in the ship's position with respect to the bottom)

Roll (rotation of a vessel around a longitudinal axis, induced primarily by wave action - greatest when the hull is parallel to the wave crests)

Pitch (rotation of a vessel about its transverse axis, induced by wave action - greatest when the hull is normal to wave crests)

Bottom Clearance - assumed 2 feet.

The allowable drafts for 1,000-foot vessels operating in Lorain Harbor are summarized in Table 20, following. It should be noted that these results are based on depths as measured from Low Water Datum on Lake Erie. Using the values calculated based on the design criteria, Class X vessels can safely and efficiently operate in the lake approach channel at a draft of only 21.5 feet, 4 feet less than system draft of 25.5 feet. However, once the ship entered the harbor channel and the river approach channel, it would decrease speed and would also experience negligible pitch or roll due to the protection afforded by the breakwaters. Therefore, there is presently enough depth in the harbor channel and the river approach channel to allow operation of Class X vessels with no further deepening.

Design Vessel Dimensions - The comparison of dimensions between the 1,000- and 1,200-foot vessels are shown below:

	Length	Width
1,000	1,000 Feet	105 Feet
1,200	1,200 Feet	130 Feet

The Maximum Ship Size Study released by North Central Division, Corps of Engineers, evaluated the needs for Class X vessels on the Great Lakes for the project period. The study concluded that future demand for larger vessels could range from 40 and 50 additional Class X vessels by the year 2040 (see Table 18). Since AmShip dry docks upstream of the Erie Avenue Bridge are one of only two locations that can accommodate these vessels, it is reasonable to assume that the Lorain AmShip facility will participate in the construction and inspection of these ships during the project evaluation period.

Table 18 - Estimated Vessel Requirements

Year	Required Maximum Size Vessels[1/]
1980-1990	15
1991-2000	9
2001-2010	5
2011-2020	8
2021-2030	3
2031-2040	4
Total	44

1/ Demand for vessels is derived demand which considers growth in bulk material flows within the GL/SLS and the physical age distribution of the existing Great Lakes fleet.

Table 19 - Depth Criteria Assumptions

	Vessel Speed	Channel Area
Lake Approach Channel	12 mph (17.6 ft/sec)	550 X 29
Harbor Channel	9 mph (13.2 ft/sec)	800 X 29
River Approach	4 mph (5.9 ft/sec)	200 X 28

Table 20 - Allowable Draft Calculations
for 1,000-Foot Vessels

Lake Approach Channel	
Authorized Depth Below Low Water Datum	29.0 feet
Squat @ 12 mph	3.0 feet
3° roll, 0 pitch	2.7 feet
Bottom Clearance	2.0 feet
Draft Allowed (Approximate)	21.5 feet
Additional Draft Required	4.0 feet
Harbor Channel	
Authorized Depth Below Low Water Datum	28.0 feet
Squat @ 9 mph	1.3 feet
0° roll, 0 pitch	0.0 feet
Bottom Clearance	2.0 feet
Draft Allowed (Approximate)	25.7 feet
Additional Draft Required	0.0 feet
River Approach Channel	
Authorized Depth Below Low Water Datum	28.0 feet
Squat @ 4 mph	0.7 feet
0° roll, 0 pitch	0.0 feet
Bottom Clearance	2.0 feet
Draft Allowed (Approximate)	25.5 feet
Additional Draft Required	0.0 feet
River Channel	
Authorized Depth Below Low Water Datum	27.0 feet
Squat @ 4 mph	0.7 feet
0° roll, 0 pitch	0.0 feet
Bottom Clearance	2.0 feet
Draft Allowed (Approximate)	24.5 feet
Additional Draft Required	1.0 feet

Class X vessels have been operating in Lorain Harbor only since May 1980, therefore the ability of these larger ships to safely navigate the restricted harbor entrance in all weather conditions remains to be verified.

Forecasts for the future only compound the problem. Bulk cargo tonnages will increase at the Republic Steel and U.S. Steel docks as both companies expand within their industry. Republic will be handling approximately in excess of 6 million tons of iron ore annually, the majority of this volume is expected to be delivered in Class X vessels to service Cleveland area mills and inland areas in Pennsylvania and Ohio. U.S. Steel has stated an interest in taking advantage of the economies of maximum size vessels at Lorain Harbor, OH. Harbor modifications are also beneficial to American Shipbuilding Co., which is one of only two shipyards on the U.S. side of the Great Lakes. More vessels will be built and launched from the Lorain facility in the future. Vessel movements to the shipyard will also be supplimented by an increasing number of hull inspections being performed. Vessel inspections are a mandated activity by the U.S. Department of Transportation and require dry docking of a vessel for several days.

If the harbor and river were modified to prevent delays in entering and to permit transit by vessels loaded to system draft, the transportation savings could be in the order of millions of dollars. A discussion of needed improvements follows.

Lakefront Harbor - All commodities received at or shipped from Lorain Harbor pass through the breakwater protected outer harbor. A new lakefront transshipment facility constructed by Republic Steel became operational at Lorain in May 1980. This facility is slated to handle in excess of 6,000,000 tons annually to be transhipped either by rail inland or by vessel to the IR Cleveland, OH, steel plant. This dock has been and will be receiving 1,000-foot vessels on a regular basis. The existing 500-foot width of the outer harbor entrance makes operation of maximum size vessels difficult except in good weather conditions or during seasonally high lake levels.

The outer harbor entrance is protected by a 2,180 foot breakwater lying in an east-west direction. This outer breakwater affords protection from northerly winds. However, its detached location exposes the harbor entrance to the southwesterly, westerly, and easterly storms. These storms cause heavy wave action and currents at the entrance which, when coupled with the wind forces against the large exposed super structure area of the larger vessels, could impose formidable navigational problems. Therefore, some modifications to the Outer Breakwater are required to provide an "all weather" entrance for 1,000-foot vessels.

Another area where improvement is necessary to allow greater utilization of Class X vessels is depth. Vessels operating in the GL/SLS system wide (the upper four Great Lakes and connecting channels) can load to a maximum static draft of 25.5 foot draft. Due to design criteria and operating characteristics of Class X vessels such as pitch, roll, squat, etc. defined previously, these vessels can enter Lorain Harbor at a draft of only 21.5 feet. These calculations are based on Low Water Datum (LWD) which for Lake Erie is 568.6 feet above mean water level at Father Point, Quebec (IGLD,

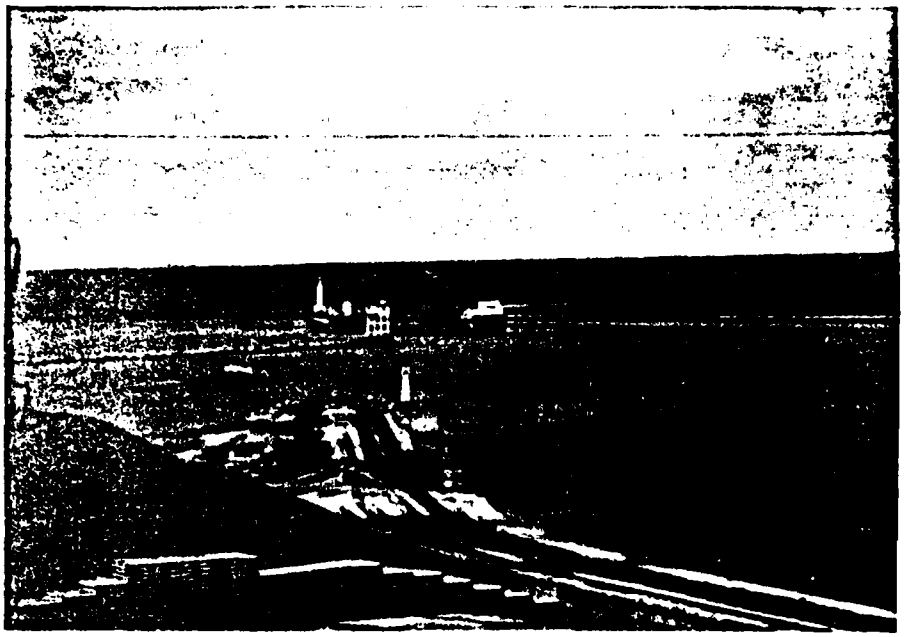


Photo 1 - 640 ft. Irving S. Olds entering outer harbor.

Photo 2 - 1000 ft. Mesabi Miner entering outer harbor.

1955). Class X vessels are now utilizing current high lake stages to load to static drafts of greater than 21.5 feet. However, since all design depths at Great Lakes harbors are based on LWD, cost estimates and benefits used in this report will be based on LWD. Therefore, the base case vessel (the largest vessel that can operate under present conditions) for the outer harbor is a "light-loaded" Class X (1,000 X 105 X 21.5 feet draft).

In summary, the fundamental needs related to the lakefront harbor are modifications to the breakwaters and/or dredging to greater depths. This Stage 2 Study will determine whether such modifications are economically justified.

Black River Improvements - Approximately 8.2 million net tons of cargo were shipped to docks along the Black River in 1978. The majority of this material was iron ore destined for the U.S. Steel plant located at the upper limit of the Federal project. Other bulk commodities transported on the Black River were gypsum, limestone, petroleum products, sand, gravel, and crushed stone.

The bulk of this material was moved in Class V and VI vessels. However, limestone is delivered to U.S. Steel in Class VII vessels (see Table 21 for Vessel Class and Size).

Table 21 - Physical Characteristics of the Great Lakes Fleet

Vessel Class	Overall Length	Mid-Summer Draft (Feet)	Mid-Summer Capacity (Net Tons)	Capacity Per Inch of Draft (Net Tons)
V	600 to 649	26'0"	22,000	106
VI	650 to 699	26'11"	26,000	123
VI(w)	650 to 699	30'7"	37,900	169
VII	700 to 730	29'1"	30,350	135
VII(w)	700 to 730	30'7"	39,400	171
VIII	731 to 849	27'0"	29,700	134
VIII(w)	731 to 849	30'0"	49,300	198
IX	850 to 949	27'11"	49,840	202
X	950 to 1,000	20'9"	69,000	244

Source: Maximum Ship Size Study, December 1977, North Central Division, Corps of Engineers

Modifications are necessary to the Black River chanel and to bridges crossing the river before Class X vessels can safely and efficiently navigate to the upper limit of the Federal project. The major areas of needed improvements to allow Class X transit upriver are outlined above.

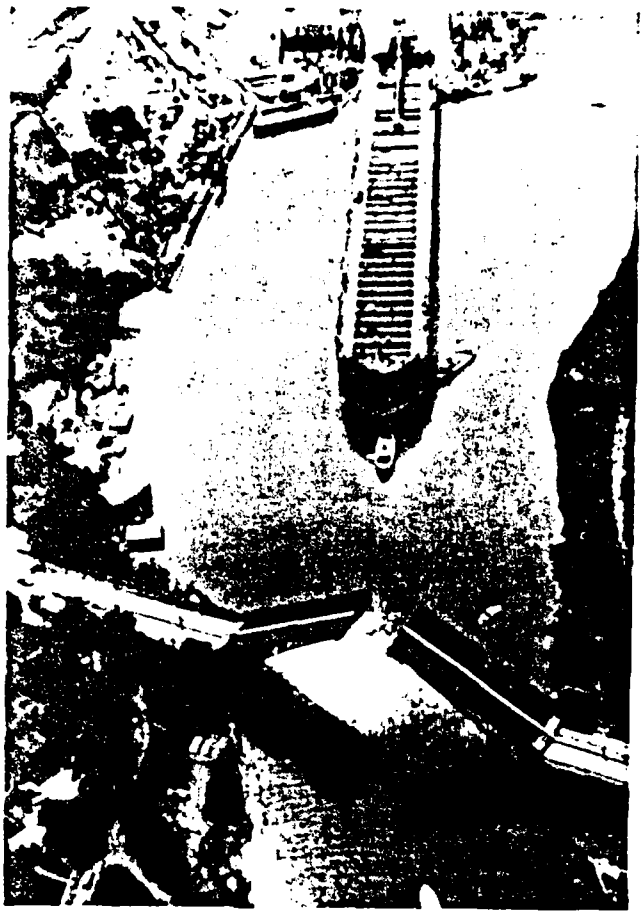


Photo 3 - Launching of 1000 ft. J.R. Barker at Lorain Harbor. Erie Avenue Bridge being opened. (Photo courtesy of Elyria Chronical Telegram).

Photo 4 - 1000 foot Mesabi Miner unloading at Lorain Pellet Terminal.

a. Erie Avenue Bridge - The Erie Avenue Bridge, built in the late 1930's, is located approximately 1/2-mile upstream from the mouth of the Black River. The existing structure has a total length of about 1,050 feet and consists of a twin-leaf bascule main span with eight steel girder approach spans on the west and one on the east. The main span is 295 feet long and provides approximately 147.5 feet horizontal clearance when open (see photo). Because this bridge is at an angle to the river and because it is necessary to turn a vessel immediately after passing through the bridge when upbound, it is not possible for Class X vessels to safely transit this bridge without tug assistance. Three Class X vessels have passed through the bridge to date. All three were constructed at the AmShip Lorain facility and were launched and passed through the bridge with the aid of six tugs one or more times. Coast Guard regulations requiring that the ship's bridge extend to the edge of the vessel makes passage even more difficult. When the Erie Avenue Bridge is open the leaves are not perpendicular to the water surface. Thus there is less room for passage of the wider ship's bridge, with only minimal clearance available at the ship superstructure while in the open position. Therefore improvements must be made to the Erie Avenue Bridge to allow passge of any vessels larger than Class VII without tug assistance.

There are presently two users upstream of the Erie Avenue Bridge who would benefit from improvements to the channel to allow safe and efficient passage of Class X vessels.

The first is the American Shipbuilding (AmShip) facility located just upstream of the Erie Avenue Bridge. This facility is one of only two active shipyards on the Great Lakes capable of building or inspecting Class X vessels. Thus far three Class X vessels have been built and launched from this facility.

The U.S. Steel Lorain Cuyahoga Works is also located upstream of the Erie Avenue Bridge and is located at the upstream limit of the Federal project approximately 3 miles from the mouth of the Black River. This company is one of the few domestic steel producers which owns and operates a captive Great Lakes fleet. The bulk of the iron ore delivered to this facility is delivered in Class V and VI vessels which comprise a large percentage of the U.S. Steel fleet. Even though predominantly Class V and VI vessels are utilized, Class VII limestone vessels also have navigated the river to the U.S. Steel facility. U.S. Steel has begun updating the fleet with the purchase of Class X vessels to compensate for the annual transport capacity lost due to vessels scrapped or otherwise removed from service. They have expressed interest in utilizing Class X vessels for direct delivery of ore to the Lorain facility.

b. Channel Improvements on Black River - The Black River Channel contains a number of curves in the 3-mile reach to the head of commercial navigation. Channel improvements on the Black River are necessary if the larger vessels operating on the Great Lakes are to navigate the river. These improvements include both major channel widening and deepening due to the increased length and width of these 1,000-foot vessels. However, the extremely good maneuverability of the design vessels with twin screws and bow and stern thrusters reduce the extent of channelization for these cuts.

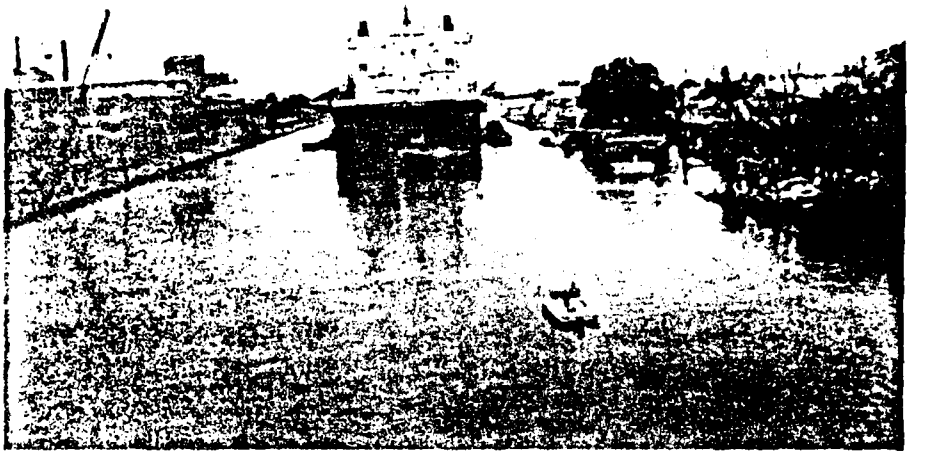
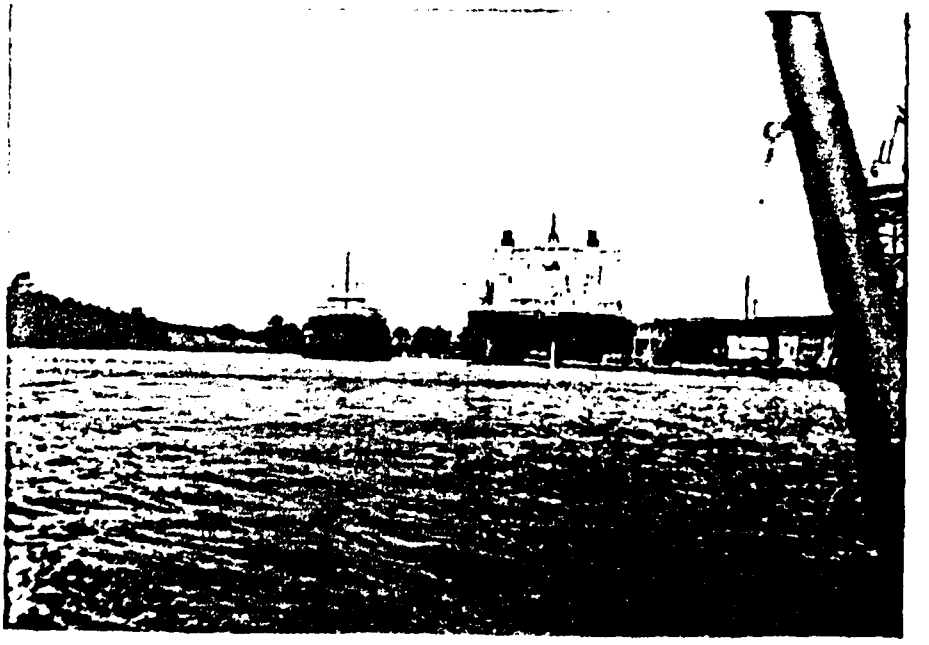
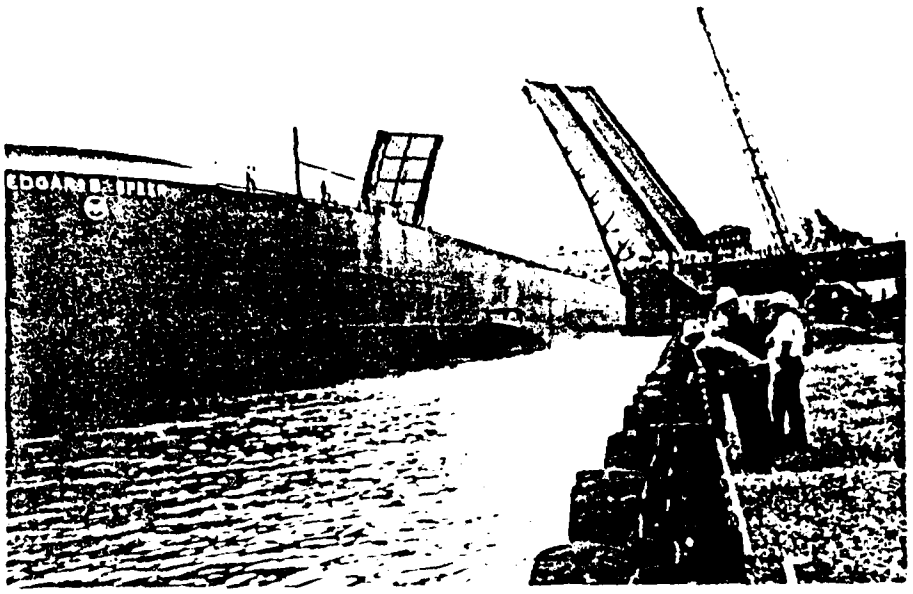


Photo 5 - Launching of the Edgar Speer (August 15, 1980) (Note amount of available river width occupied by the vessel).

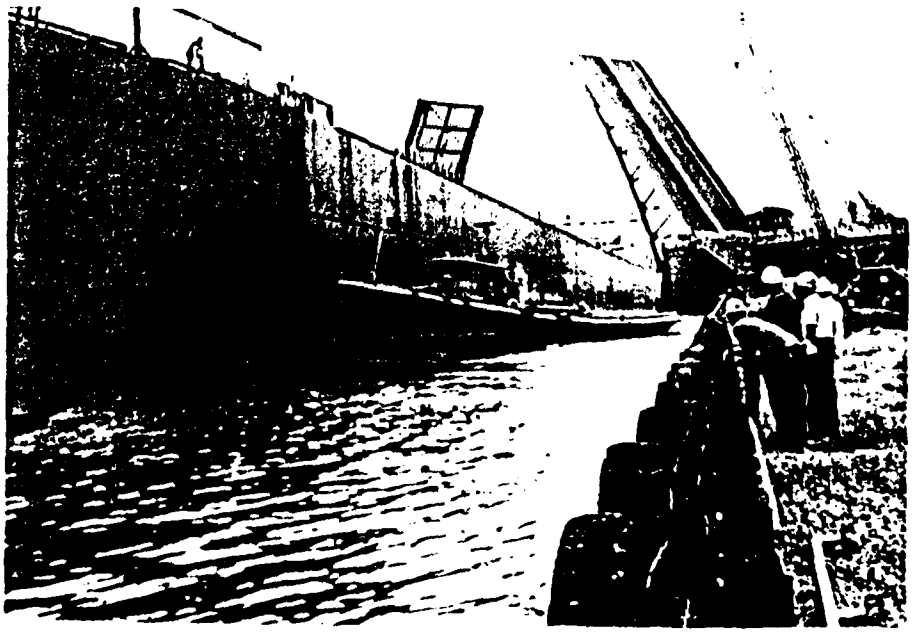


Edgar Speer docked at AmShip being passed by a 630 foot vessel. (Note constricted channel).

LAUNCHING OF THE EDGAR SPEER
August 15, 1980



Note lack of clearance between the ship and the bridge.



The channel improvements may be separated into three basic categories: (1) channel deepening, (2) channel widening and (3) erosion protection for channel banks. The existing navigation channel of the black river is dredged to a depth of 27 feet below Low Water Datum (568.6 feet on International Great Lakes Datum - 1955). With the larger design vessels (1,000 and 1,200-foot), the channel depth required would be 28 feet as shown in Table 14. Therefore, an additional 1 foot of dredging would be necessary for the entire channel. The larger beam and greater length on the design vessels require a wider channel for safe navigation and therefore extensive channel widening would be necessary.

Required channel widths are comprised of a maneuvering lane width, a width for bank clearance on each side of the maneuvering lane, and additional widening for bends. The maneuvering lane width is required for the vessel to maneuver without encroachng on the safe bank clearance. The width for bank clearance is necessary to reduce the bank suction force between the vessel and the channel banks. Also, due to the waves created by the design vessels with bow and stern thrusters, bank protection must be provided in the critical areas subject to these waves and their velocities.

c. 21st Street Bridge - The existing 21st Street Bridge is a six span 1,700-foot through truss with a 400-foot river crossing span. The superstructure clearance, based on a Lake Erie Low Water Datum of 568.6 feet, is 99.6 feet for approximately 250 feet in the center river crossing span. Piers are twin reinforced concrete columns on piling with a reiforced concrete strut connection near the top. The five piers range in height from 43 feet to 79 feet. The roadway is 42 feet curb to curb and there is a 7-foot sidewalk on the west side (see photo). The roadway width is inadequate by today's standards. Plans were approved in 1939 from which it is concluded the structure is in the order of 37 to 39 years old.

A Class X vessel requires an superstructure clearance of 125 feet above the river's surface. The existing clearance of 99.6 feet would therefore prevent passage of Class X vessels beyond the bridge without a major modification or replacement of the existing bridge.

Congestion Problem - A problem concerning vessel congestion was identified in late summer of 1980. Whenever a Class X vessel is unloading at the Republic Steel dock it encroaches into the Federal navigation channel. A vessel utilized to shuttle iron ore to Cleveland will also be using this dock on a regular basis. The Captains of vessels bound for the U.S. Steel facility believe that there is not enough channel width left for safe passage when a vessel is at the Republic Steel dock and because of this have asked the Captains of the Class X vessels to move their ship to allow passage. The Class X vessel Captains did this for the first few months but because of the amount of moving that was required soon started to refuse stating that the channel was not blocked. Because this problem did not come to light until very recently, this congestion problem will be investigated in Stage 3 to determine the impact delays caused by congestion have on the plans carried forward.

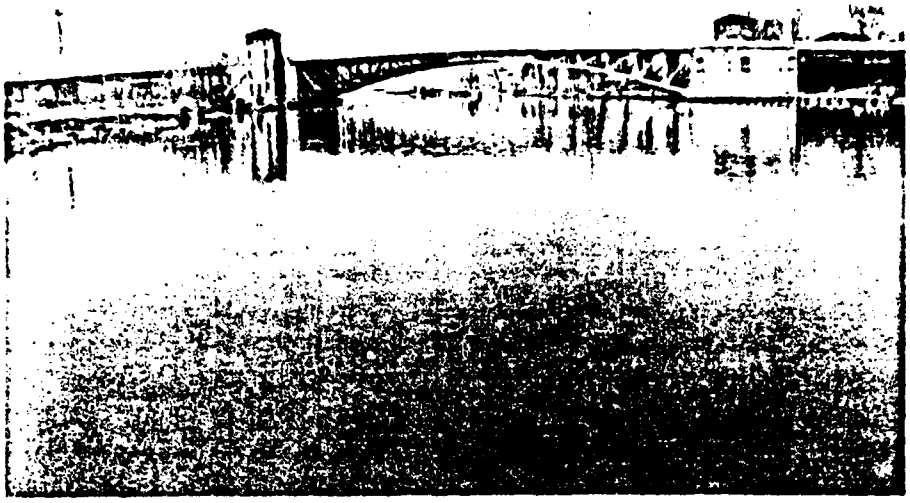


Photo 7 - Erie Avenue Bridge looking downstream.

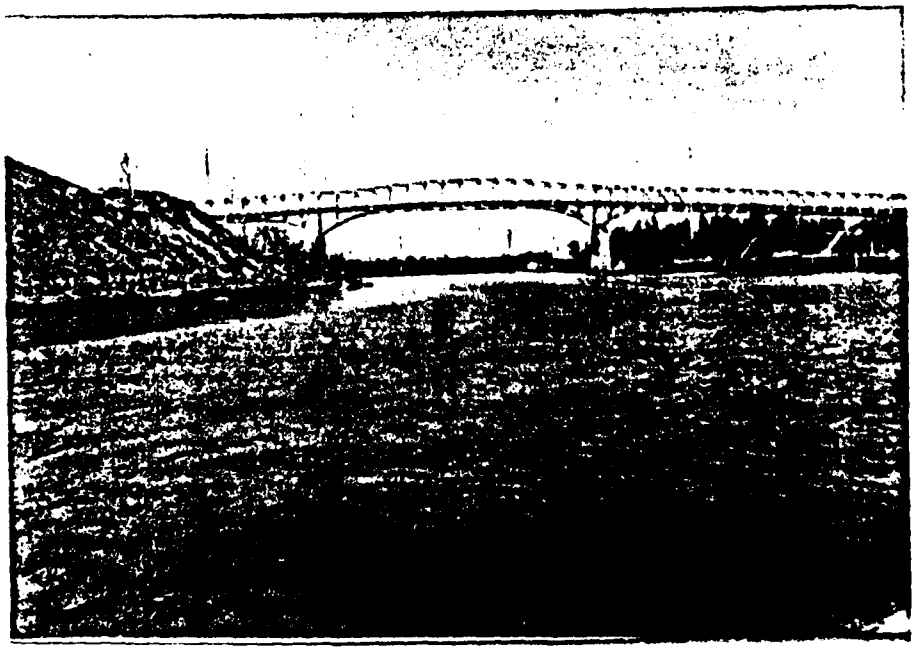


Photo 8 - 21st Street Bridge looking downstream. Petroleum unloading facility on the east bank.

EXISTING MARINAS WITH THE LORAIN HARBOR STUDY AREA

Photo 11 - Kramer Boat House located on the west bank at approximately river mile.

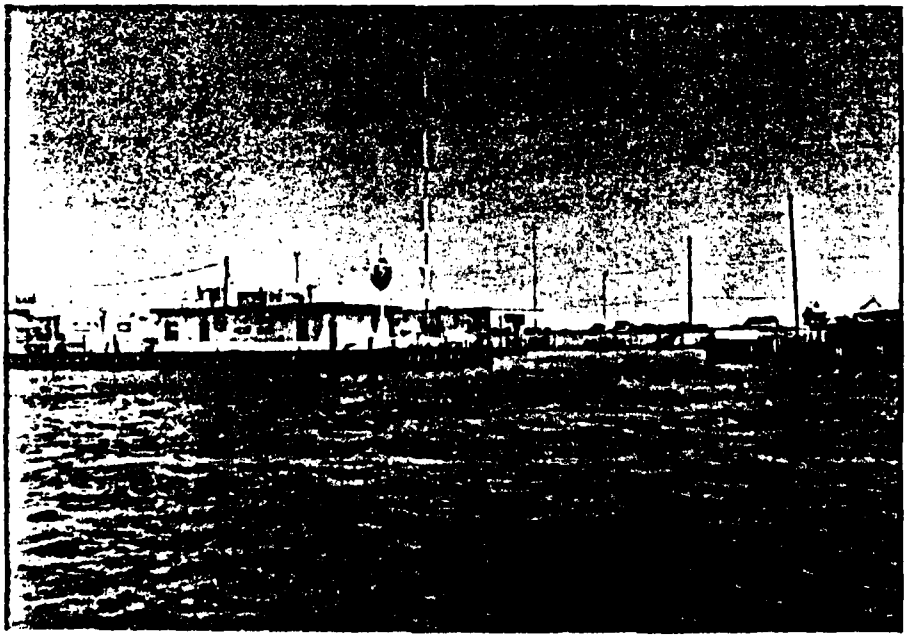


Photo 12 - Lorain Yacht Club located on the east bank.

Photo 13 - Streambank Erosion on East Branch Black River south of Elyria, Ohio.

Photo 14 - Streambank erosion on the East Branch Black River south of Elyria, Ohio.

Photo 15 - Typical channel West Branch Black River south of Elyria, Ohio.

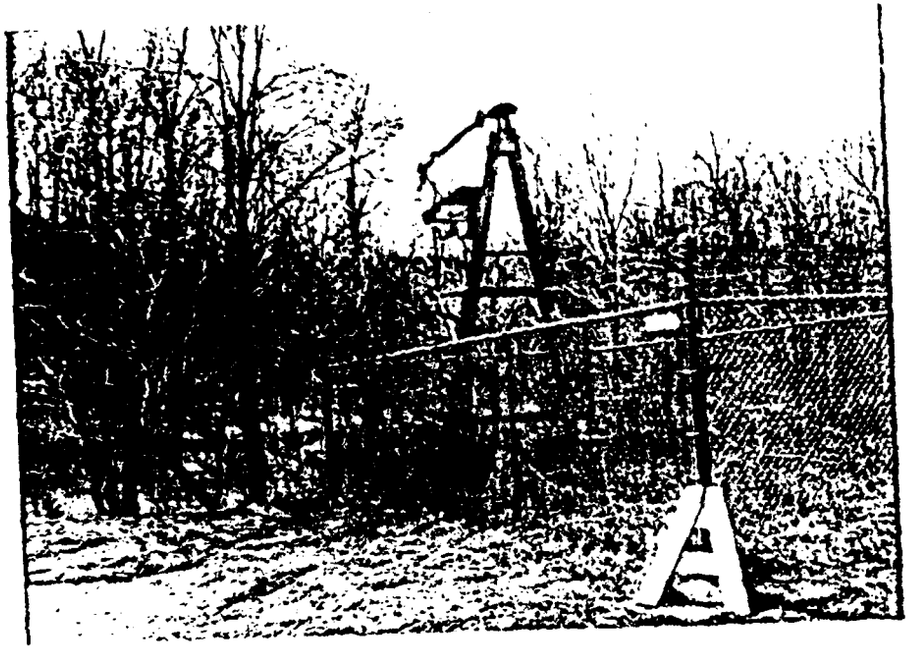


Photo 16 - Location of U.S.G.S. Permanent Stream Gage on Main Stem Black River at Cascade Park, Elyria, Ohio.

Photo 17 - Location of Permanent U.S.G.S. Stream Gage on West Branch Black River at Elyria, Ohio, upstream of Rt. 57 bridge.

Photo 18 - Location of Wire Weight Gage on West Branch Black River near French Road (similar location and bridge on East Branch).

RECREATIONAL BOATING

At the Initial Public Meeting held on 31 May 1978, local interests expressed their desires for additional facilities to accommodate small-boat operators at Lorain. They stated that there is presently an unfulfilled demand for additional permanent mooring facilities in the area and for additional public launching facilities. To evaluate this need, the Buffalo District has entered into a contract with a consulting engineering firm to: Eevaluate the demand for small-boat facilities in the Lorain area; perform a site selection investigation to determine the optimum location for a small-boat harbor in the Lorain area; and prepare preliminary alternatives, including designs and cost estimates, for the selected site. This consultant will also perform an economic analysis and environmental assessment for each alternative and prepare a Preliminary Feasibility Report (PFR) on Recreational Navigation. This PFR is scheduled to be completed in September 1981.

REDUCTION OF MAINTENANCE DREDGING

The Federal project at Lorain Harbor is dredged periodically by Corps of Engineers hopper type dredges. Historical quantities removed during these operations are summarized in Table 4 for the period 1967 through 1979. The mean annual volume dredged has been approximately 171,000 cubic yards and is normally performed during a 2- to 4-week period between April and June. Occasionally, dredging operations have extended into November. Beginning in 1978, polluted dredge material has been deposited in a confined dike disposal area adjacent to the East Breakwater shorearm. This structure has an estimated capacity equivalent to 10 years of normal dredging operation. This design standard is based on the assumption that after 10 years water treatment plants located upstream will upgrade the quality of existing bottom sediments and implementation of and conservation measures will reduce the quantity and/or increase the quality of sediments within Federal channels to an acceptable level which will permit the resumption of open lake and/or shore area dumping.

The major source of sediment at Lorain Harbor is from streambank and upland erosion. In evaluating the feasibility of reducing the amount of sediment entering Lorain Harbor, the predominant source(s) of the sediment must be identified. The study of this problem is an interagency effort involving Buffalo District, the U.S. Geographical Survey (USGS), and the U.S. Soil Conservation Service (SCS).

An interagency agreement has been signed with the USGS for a 1-year sediment data and analysis program on the Black River. The goal of this program is to obtain a qualitative estimate of annual suspended, bed, and total sediment load for the Black River and its principle branches. This data collecting program is scheduled to be completed in the summer of 1981.

To address the need to reduce maintenance dredging, a study is presently being conducted by the U.S. Soil Conservation Service under an interagency agreement with the Corps of Engineers to study streambank erosion on the Black River and its major tributaries. If this study concludes that streambank erosion is a major contributor to sediment in the harbor, a detailed

investigation will be initiated to determine methods of controlling streambank erosion or controlling the sediment once it enters the stream.

Buffalo District is also conducting a study on upland erosion to determine quantities of soil delivered to the river and methods to reduce this quantity. These two studies will be combined into a Preliminary Feasibility Report on Erosion and Sedimentation on which a determination will be made as to the feasibility of reducing the sediment carried by the river and deposited in the harbor.

PLANNING OBJECTIVES

NATIONAL OBJECTIVES

The national objectives are set forth in the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources."

The two national objectives are to enhance National Economic Development (NED) by increasing the value of the nation's output of goods and services and improving the value of the nation's output of goods and services and improving national economic efficiency, and to enhance the environmental quality (EQ) by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

PLANNING OBJECTIVES

Based on the study objective explicitly stated in the authorizing resolution, the principal planning objective of this study is the determination of the nature, extent, and feasibility of improvements for commercial navigation at Lorain Harbor. Other planning objectives which have been identified through an intensive public involvement program and Corps experience are improved recreational navigation and commercial fishing facilities and reduction of maintenance dredging. Including commercial navigation, the goal is to select the best plan of action, limited action, or no action after considering measures to provide:

a. Safe and efficient commercial navigation to, within, and from the harbor, with the emphasis on modifications to the existing harbor needed to accommodate the new class of 1,000-foot and larger vessels now operating on and contemplated for the Great Lakes;

b. Streambank erosion control in the navigation portion of the Black River to reduce harbor sediment from this source and to reduce the loss of valuable commercial and industrial lands;

c. Additional opportunities for land-based recreational fishing from the harbor structure;

d. Additional opportunities for recreational boating and commercial fishing;

e. For preservation of wetlands as waterfowl habitat;

f. Identify the source of and quantity of sediments entering the Black River upstream from the harbor with the objectives of improving the existing water quality in the Black River and reducing annual maintenance dredging in Lorain Harbor using management and structural measures to reduce erosion at its source. Federal involvement would be limited to implementing structural measures for controlling streambank erosion, if justified. Implementation of management measures to control upland erosion would be a local responsibility. The objective of this study is to identify the nonpoint sources of this sediment in the Black River Watershed, and to recommend the "best management practice" for controlling erosion from these locations.

SUMMARY OF RECONNAISSANCE REPORT

The Reconnaissance Study was initiated by the Buffalo District in January 1978 and was performed for the District by the consulting firm of Berger Associates. Based on the authorizing resolution, the main planning objective was to identify the present and desired physical, economic, social, and environmental conditions which need further in-depth evaluation to enable safe and efficient operation of the largest commercial vessel (1,000 feet and larger) operating on the Great Lakes. Other planning objectives determined to warrant consideration were recreational navigation and reduction in maintenance dredging.

The initial emphasis of the Reconnaissance Study coincided and emphasized the commercial navigation features of the harbor closely with the intent of the authorizing resolution. One nonstructural and 10 structural alternatives were identified and preliminary cost estimates developed. A preliminary benefit analysis was made and a benefit/cost ratio was calculated for each alternative to determine which, if any, alternatives should be carried into the next phase of study. It was concluded that further study of the commercial navigation needs at Lorain Harbor should be undertaken.

The Reconnaissance Study also investigated recreational navigation and reduction in maintenance dredging, needs, and it was concluded that these needs should be carried forward into the Preliminary Feasibility portion of the study. Material in the Reconnaissance Report has been updated and portions relevant to the Preliminary Feasibility Report provided the basis for more detailed investigations.

CHANGES SINCE THE RECONNAISSANCE REPORT

Proper planning requires that any change that takes place in the study area be assessed as to its impacts upon the study. Major changes have recently taken place in the Lorain Harbor study area. Republic Steel Corporation has purchased approximately 91 acres of riverside and lakefront property from the Chessie Railroad System and have constructed a lakefront iron ore transshipment facility. This firm now has the capability to transship iron ore by rail or by ship (see photo). Their dock became operational in May 1980 and several one-thousand foot vessels have been unloaded since this date (see photo). Prior to 1978 the largest vessel that operated safely and efficiently in the outer harbor was about 800 feet in length. Class X vessels now operate on a regular basis in the harbor area, the base case vessel for

the harbor area for this study is a light-loaded Class X vessel. Due to pitch, roll and bottom clearance requirements the Class X vessels can only load to a draft of 21.5 feet (at Low Water Datum).

This change is applicable to the base case vessel for the outer harbor only. For any alternative involving transit of the Black River beyond the lakefront, the base case vessel remains a Class VIII.

CONDITIONS IF NO FEDERAL ACTION TAKEN (WITHOUT CONDITION PROFILE)

Lorain Harbor received approximately 8,200,000 tons of cargo in 1978. The majority of dock operators are not experiencing any difficulty operating within the present Federal harbor project. These dock operators were surveyed about future requirements and responded that there was no need for improvements in the immediate future. Most docks are serviced by much smaller vessels relative to the iron ore and limestone docks.

There are, however, three dock operators who could benefit from improvements to the harbor and river channel. They are Republic Steel, American Shipbuilding, and United States Steel. Republic Steel and American Shipbuilding are presently operating Class X vessels and U.S. Steel has expressed interest in delivering iron ore in Class X vessels to their Lorain facility. The effects of no Federal action on these operators will be discussed separately and then the combined impact on the entire harbor will be discussed.

Republic Steel - Republic Steel began operations in Lorain in 1980 at the newly constructed Lorain Pellet Terminal. This facility has the capability of transshipping iron ore by either rail or vessel and will handle between 1,000,000 and 2,000,000 tons of iron ore in 1980. Predictions by Republic are that between 6,000,000 and 7,000,000 tons will be handled annually with approximately 3,000,000 tons being transshipped inland by rail to Ohio and Pennsylvania and the remainder moving by water to the Republic docks on the Cuyahoga River in Cleveland. Based on information provided by Republic Steel officials, the annual capacity of this facility is approximately 8 million tons.

The bulk of the iron ore for Republic delivered to Lorain will be moved in Class X vessels. It is anticipated that to service this facility, two Class X vessels will be utilized full-time and other smaller vessels part-time with a Class VII vessel also required full-time to accomplish shuttling of ore between Lorain and Cleveland.

Republic is now operating these maximum size vessels in the Outer Harbor only. It is anticipated that these large vessels will continue to operate in the Outer Harbor area for the life of the project, but will experience operating difficulties or restricted drafts during periods of low lake levels.

Class X vessels have been entering the harbor fully loaded during the 1980 shipping season by utilizing the current high lake level on Lake Erie. Over time, Lake Erie may return to levels closer to Low Water Datum and inefficiencies Republic Steel will experience by light loading to allow the

vessel to enter the harbor. A fully loaded Class X vessel can deliver approximately 3,000,000 tons to Lorain during each shipping season. Therefore, two Class X vessels fully loaded each trip could handle the bulk of the Republic future tonnage projections at Lorain with occasional deliveries from other vessels. The more trips that the two Class X vessels must light load, this increases the number of deliveries required by other vessels. Therefore improvements to allow Class X vessels to enter the harbor fully loaded at all times would maximize the benefits of using these large vessels.

American Ship Building Company (Am Ship) - The Lorain shipyard operation consists of two dry docks, one of which can accommodate vessels up to 1,000 feet long. The other dry dock is presently being renovated to accommodate vessels up to 767 feet long. This shipyard is one of only two shipyards on the Great Lakes capable of drydocking the Class X vessels, and launched their first Class X vessel, the JAMES R. BARKER, in 1977. Since that time, two other Class X vessels have been constructed and launched, the MESABI MINER in 1977 and the EDGAR SPEER in 1980 (see photos). The Lorain AmShip facility is also actively involved in the construction of smaller vessels, repairs and modifications to existing vessels, and inspections of existing vessels.

A recent study by the North Central Division Corps of Engineers, the Maximum Ship Size Study, (October 1977), estimated that the projected level of bulk tonnage in 2040 will require a fleet of between 40 and 50 vessels of Class X vessels. In light of this projection it seems safe to assume that Lorain would continue to be involved in the construction of Class X vessels in the future.

Coast Guard regulation Title 46, CFR, Part 91 "Inspection and Certification" (Sept 77; Coast Guard rules and regulations for cargo and miscellaneous vessels, U.S. DOT, requires that all Great Lakes vessels be drydocked at least every 5 years for a thorough inspection. Because of the large drydock available at Lorain, the AmShip facility will become more and more involved in these inspections as the number of Class X vessels increase. Since this drydock is also used in construction of Class X vessels, scheduling problems may result.

Even if no Federal action is taken, AmShip should continue to be an active productive shipyard. However, movements of the Class X vessels into and out of the dry docks will require tug assistance. These costs may be avoided if bridge or channel modifications are implemented.

U.S. Steel Corporation - The U.S. Steel Lorain Cuyahoga Works is located at the upstream limit of the Federal project approximately 3 miles above the mouth of the Black River. Approximately 3,000,000 tons of iron ore are delivered to their dock annually (see photos). This company announced plans in 1976 to expand their steel plant and increase raw material to approximately 5,000,000 tons annually. However, company officials stated that this growth would be contingent upon improvements to allow Class X vessels to transit the Black River to the U.S. Steel plant. U.S. Steel presently operates a fleet of vessels consisting of primarily Class V and VI vessels. These vessels are approaching the end of their design life and will need to be replaced in the foreseeable future. The Huelett ore unloaders used at the Lorain dock to

unload bulk freightors are also nearing the end of their useful life. Self-unloading vessels have been making the slower and more labor-intensive Huelett unloaders obsolete and most new Great Lakes vessels are being constructed as self-unloaders. Conversion of existing ships to self-unloaders is also increasing.

Whether improvements are made to the Federal project or not, U.S. Steel will not continue the present methods of operation for much longer. Since the Huelett unloaders and the Class V and VI vessels are becoming outdated, there are two alternate methods that they might utilize. The first would be continued direct delivery by the largest self-unloading vessels capable of transmitting the Black River. The other alternative would be to use Class X vessels for delivery to the lakefront harbor and then to transship to the U.S. Steel facility. U.S. Steel presently has the capability to receive Class X vessels and transship ore at both Ashtabula, OH, and Conneaut, OH. Other transshipment facilities are presently operating at various other harbors including Republic Steel's transshipment facility at Lorain. Considering the potential economies of scale enabled by Class X vessels and that recent vessels constructed by U.S. Steel, is is expected that transshipment is the most probable future direction.

Combined Impacts on Entire Project - Vessel traffic will increase at Lorain Harbor in the future. As Republic Steel transshipment facility nears capacity, the harbor area will become more and more congested. With Republic Steel operating two Class X vessels plus a shuttle vessel full-time, AmShip launching and inspecting Class X vessels as well as smaller vessels, and U.S. Steel operating its present fleet, delays to these users and the other smaller users because of congestion are probable. This congestion problem will be studied in Stage 3 of the Lorain Harbor Feasibility Study. At this time it appears that encroachment of the 1,000-foot vessels at the Republic transshipment facility into the Federal channel is the primary cause of harbor congestion, if congestion is a problem at Lorain Harbor. A probable solution would be to provide a new river entrance channel that would permit upbound and downbound river traffic to bypass the transshipment facility at the mouth of the Black River. A new land cut to the east of the existing river entrance channel would also provide a better approach to the Erie Avenue Bridge, thus reducing this hazard to larger vessels using the river.

Port Authority - The Lorain Port Authority is actively engaged in inducing industry to locate in the Lorain Harbor area. The Port Authority in August 1980 issued industrial development bonds for Republic Steel's pellet terminal. Similar bonds have been issued in the past for AmShip, Ashland Oil, and U.S. Steel. The Authority has studied the possibility of making the Port of Lorain a general cargo transfer center. They also are applying for assistance to study the feasibility of a coal blending plant to blend low sulfur western coal with high sulfur eastern coal to produce an environmentally acceptable combination. Depending upon the success of the Port Authority, vessel traffic might increase substantially in Lorain Harbor in the future. Because these possibilities are highly speculative at this time, they have not been considered in establishing the "most probable future" for this Stage 2 study. However, they will be incorporated into the Stage 3 analysis, as appropriate.

SECTION C
FORMULATION OF PRELIMINARY PLANS

This section documents the formulation and evaluation of various alternatives considered during the Preliminary Feasibility Study to meet the current and future commercial navigational needs of Lorain Harbor. Objectives and criteria to develop and evaluate the alternative solutions are described. This section then identifies and screens alternative plans for bulk cargo movement at Lorain Harbor. Small-boat recreation and maintenance dredging are not considered here except where they might impact upon, or be constrained by, possible improvements for commercial navigation. Instead, they will be addressed fully in separate studies presently underway.

MANAGEMENT MEASURES

All possible management measures available to solve a given water resources related problem must be identified during the initial stage of the study. These management measures are then combined into different alternative plans of improvement and evaluated. Based on the results of this evaluation the best alternative(s) will then be identified.

Management measures identified for this Preliminary Feasibility Report on Commercial Navigation were divided into: (1) nonstructural measures, and (2) structural measures. The specific management measures are listed below:

a. Nonstructural

(1) Delivery in Class X vessel and open-lake transfer of ore to smaller vessels that can be safely and efficiently accommodated at the existing harbor at Lorain, and

(2) Delivery in Class X vessel and open-lake transfer to barges bound for Lorain Harbor.

b. Structural

(1) Barging from originating harbor to Lorain Harbor,

(2) LASH (lighter aboard ship) system,

(3) Rail car ferries from originating harbor to Lorain Harbor,

(4) Rail from source to Lorain Harbor,

(5) Tractor trailer from source to Lorain Harbor,

(6) Rail transshipment from another Lake Erie Port to Lorain Harbor,

(7) Tractor trailer transshipment from another Lake Erie Port to Lorain Harbor,

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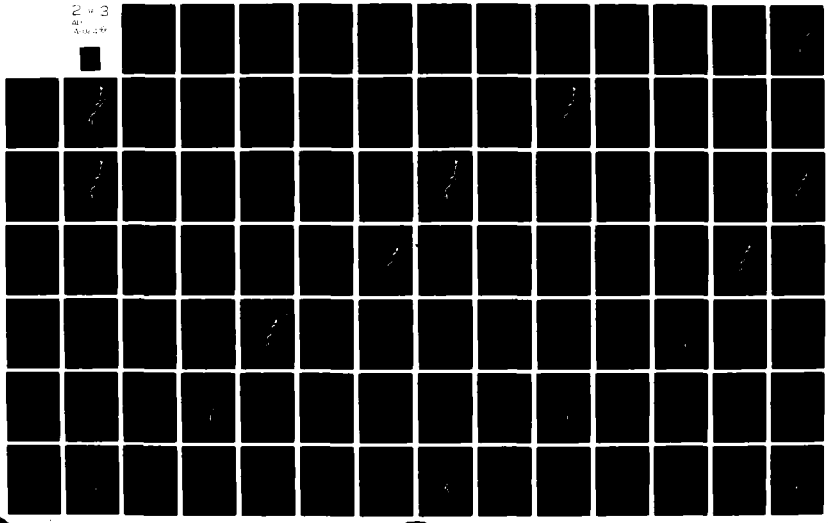


(8) Direct Class X vessel delivery to U.S. Steel or the Black River,

(9) Delivery in Class X vessel to the Lorain Harbor Lakefront and transshipment upriver and into the hinterland.

PLAN FORMULATION AND EVALUATION RATIONALE

The formulation, evaluation, and screening of alternative plans has been done within the context of the planning objectives and technical, economic, environmental, and other criteria described in this portion of the report. These, and other intangible considerations, permit the development of a range of feasible and economically justifiable plans which best respond to the problems and needs of the area.

Objectives - In the formulation and evaluation of alternative navigation improvements to Lorain Harbor, consideration has been given to the planning objectives set forth in the Water Resource Council's "Principles and Standards for Planning Water and Related Land Resources."

The two principle objectives are to enhance National Economic Development (NED) by increasing the value of the nation's output of goods and services and improving national economic efficiency, and to enhance the Environmental Quality (EQ) by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems. Of secondary importance are objectives to enhance Regional Development (RD) and enhance Social Well-Being (SWB). More specifically those objectives are to:

a. Enhance National Economic Development

(1) Assist in the development, conduct, safety and efficiency of interstate and foreign commerce.

(2) Reduce the cost of moving bulk commodities and general cargo into, out of and through Lorain Harbor, with consideration for the value of resources required or displaced by a plan.

b. Enhance Environmental Quality

(1) Preserve or improve the quality of open and green space, wetlands, the Black River, Lake Erie, adjacent beaches and shores, and areas of natural beauty.

(2) Preserve or restore archeological, historical, biological, and geological resources and selected ecological systems.

(3) Preserve or improve the quality of water, land, and air resources.

(4) Improve the appearance of areas modified or created.

(5) Protect or reduce the depletion of nonrenewable resources including mineral and fuel resources.

c. Enhance Regional Development

(1) Increase output of goods and services within the Lorain area with consideration for the value of resources within the area required or displaced by a plan.

(2) Improve economic stability of the Lorain area by improving transportation access to Lorain Harbor.

(3) Maintain the economic viability and competitive position of the Port of Lorain relative to other Great Lakes ports.

(4) Increase the number and types of jobs in the area.

(5) Improve the environment in the area.

d. Enhance Social Well-Being

(1) Increase the real income of people affected by the plan.

(2) Protect public health and safety.

(3) Protect, enhance, and develop public recreational facilities.

Technical Criteria - These are the general technical criteria adopted for the Preliminary Feasibility Study.

a. Navigational channels and other improvements must be designed to promote safe vessel operations based on projected vessel sizes, drafts, and maneuvering capabilities if such improvements are economically justified.

b. Disruption of existing industrial, commercial, and residential development, and area of environmental concern should be kept to a minimum.

c. Development plans should be consistent with local and regional land use plans.

d. The selected plans should be consistent with local, regional, and State goals for ports and industrial growth.

e. Plans should incorporate the latest cargo handling technology.

Economic Criteria - The following economic criteria are used to measure the effectiveness of each alternative in meeting the objective to enhance National Economic Development.

a. Economic benefits should exceed economic costs and to the extent possible, being consistent with other criteria, net benefits should be maximized.

b. The ratio of benefits to costs will be used to evaluate conformance with the National Economic Development objectives. The plan which best meets

the objectives of the National Economic Development objectives is the least costly water or nonwater plan which meets those criteria regardless to the extent of Federal and non-Federal participation in implementation costs.

The plans developed during the Preliminary Feasibility Study are based on the National Economic Development objectives. The plans are then assessed to determine their effect on other objectives and criteria.

Environmental and Other Criteria - The following environmental and social evaluation criteria are adopted to evaluate alternatives which are developed in the Preliminary Feasibility Study:

a. Minimize the use of scarce natural resources to implement or operate the selected plans.

b. Incorporate in the selected plans measures which protect, preserve, or enhance the environmental quality in the project.

c. Minimize adverse impacts on areas of archeologic, historic, and cultural significance and to the extent possible preserve or enhance these areas.

d. Preserve natural areas.

e. Minimize the adverse social impacts such as displaced home sites and people, traffic congestion, noise, loss of aesthetic values, and health hazards.

f. Minimize any adverse impacts on local employment and business opportunities, and to the extent possible, enhance or preserve local job opportunities.

g. Minimize any adverse impacts on availability of water acreage for recreational boating, and to the extent possible, preserve or enlarge these areas.

h. Arrange the selected plans such that if one is implemented, the ancillary development following plan implementation would be compatible with activities of the surrounding area, and be environmentally and socially acceptable.

i. Minimize adverse effects on or improve air and water quality.

ITEMS OF LOCAL COOPERATION

Formal assurances of local cooperation are those that must be furnished by a municipality or public agency fully authorized under State laws to give such assurances and financially capable of fulfilling all items of local cooperation associated with the plan(s) of improvement selected for implementation. For commercial and recreational navigation improvements at Lorain Harbor, it is expected that the Lorain Port Authority would serve as the local cooperator.

As a minimum, the following items of local cooperation would be required for improvements in the interest of commercial navigation:

a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction and subsequent operation and maintenance of the project including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil and necessary retaining dikes, bulkheads, and embankments therefore, or the costs of such retaining works.

b. Hold and save the United States free from damages due to the construction works except damages due to the fault or negligence of the United States or its Contractors.

c. Accomplish without cost to the United States such relocations or alterations of utilities as necessary for project purposes.

d. Bear all costs of maintenance, operation, and replacement of those modifications for streambank erosion control within the limits of the commercial harbor.

POSSIBLE CONCEPTS FOR BULK CARGO MOVEMENT

A full range of concepts for movement of bulk cargo were considered during the Preliminary Feasibility Study. In general, these either provide for modification to the existing harbor to allow more economical waterborne movement, or provide for a land mode of transportation for all or part of the bulk cargo movement.

Development of Initial Concepts - Within the prescribed planning framework and established criteria, possible solutions were identified and will be evaluated in a three-stage iterative process to address the needs of the study area and overall planning objectives. Each stage includes four functional planning tasks: problem identification; formulation of alternatives; impact assessment; and evaluation. Each stage contains essentially the same sequence of tasks, but with differing emphasis.

This document reports the results of the Stage 2 evaluation. The level of study performed is consistent with the Stage 2 objective of evaluating a broad range of alternate modes of transporting bulk commodities to Lorain. In conformance with the directives of the authorizing resolution, direct shipment to Lorain Harbor in 1,000-foot and larger vessels was selected as the preferred mode, and alternative modes - i.e., rail, truck, vessel, etc. - were evaluated using the preferred mode as the basis of comparison. As possible solutions, the following structural and/or nonstructural concepts, in addition to the "no-action" option, were identified during the initial phase of this preliminary feasibility investigation:

Concept 1 - Movement of large vessels to the upstream limit of the Federal project at Lorain Harbor (direct delivery)

Concept 2 - Movement of large vessels to a transshipment facility on the Black River near the 21st Street Bridge (partial transshipment)

Concept 3 - Movement by large vessels to the Outer Harbor (lakefront transshipment)

Concept 4 - Delivery by Class X vessels to a designated location in Lake Erie and transfer of cargo to (1) smaller ships or (b) barges, this is considered a nonstructural alternative in the context of this overall study,

Concept 5 - Delivery to Lorain by barge from the originating harbor,

Concept 6 - Delivery by a "lighter-aboard-ship" or LASH system,

Concept 7 - Delivery by vessels or barges that carry railroad cars,

Concept 8 - Delivery by all rail movement from originating area,

Concept 9 - Delivery to another port in Class X vessels and transshipment to Lorain.

Initial Iteration For Nonstructural Concepts

Concept 4 - This nonstructural conceptual solution was eliminated in the early stages of study after preliminary consideration for economic or technical reasons. Following is a discussion of two variations of this concept and reasons for their elimination from further consideration.

a. Concept 4A - Ship to Ship Transfer

This nonstructural concept would involve delivery of ore in Class X vessels to a location in Lake Erie outside of Lorain Harbor. The ore would then be transferred into smaller vessels capable of safely and efficiently utilizing the existing harbor.

This concept was eliminated immediately due to environmental, economic, and operational considerations. Ships in the open-lake are subject to winds and waves that would make transfer of ore without spillage very difficult. The need for shifting of the smaller vessels during transfer would also greatly increase the possibility of collisions and damage to both vessels. Construction of any facilities to eliminate these problems is impractical in the open-lake area.

This concept is also impractical from an economic standpoint. It would require either three Class VI vessels to unload one Class X vessel or three trips by one Class VI vessel. If three vessels were used, the Class X vessel would not be delayed, but there would be considerable wasted time for the three Class VI vessels while waiting for the next vessel. If only one Class VI vessel were used, there would be considerable delay for the Class X while waiting for the Class VI vessel to unload and return. For these reasons this alternative was not considered further.

b. Concept 4B - Ship to Barge Transfer

Open-lake transfer of ore from Class X vessel to barges is similar to the concept discussed above. It would have many of the same problems associated with ship to ship transfer such as possible spillage, damage to the Class X vessel and the barges, wind and wave induced operational problems. There would also be a requirement for an extremely large number of barges to totally unload a Class X vessel. Because of these many problems, this alternative was not considered further.

Initial Iteration for Structural Concepts - Five of the structural conceptual solutions considered in a preliminary manner in the early stages of the study were abandoned as possible solutions for economic or technical reasons. Among these were the following, which either incorporated variations to the present mode of cargo transport to the harbor, or to the cargo movement within the harbor.

a. Concept 5

This concept considered interlake movement based on a barging system typically used on the inland waterway system. Direct barging of bulk materials could be accomplished with only minor change to the present harbor. Such an operation would in effect be similar to a direct vessel delivery by bulk carriers and a transfer of materials to barges for local distribution. Numerous questions regarding costs of modifying "source" harbor facilities and the efficiency and safety of barges on the open lakes were also considered in discontinuing evaluation of this alternative in its entirety. An alternative which includes bulk carrier delivery to the outer harbor and barge transshipment up the Black River was given further study.

b. Concept 6

Another possible concept for direct waterborne movement was a "lighter-aboard-ship" or LASH system similar to the Seabee system. These shipping methods utilize vessels constructed to carry lighters or barges within their hulls which are hoisted aboard the "Mother Ship" by a large gantry crane or an elevator mounted on the vessel. This shipping concept is now used at several ports on the Gulf Coast with vessels over 890 feet long and capable of carrying about 30,000 net tons of cargo. Applicability of such a shipping vehicle and system to the bulk cargo trade on the Great Lakes involves technical problems relating to the relatively high unit weights of iron ore and stone cargo. Physical changes in the configuration of the "Mother Ship" to conform to the locks and navigation channels in the Great Lakes would be required. The application of the LASH system at Lorain would be limited to moving cargo bound for upriver locations.

c. Concept 7

Another possible concept was the shipping of bulk cargoes on vessels capable of carrying railroad cars directly, e.g., railroad car ferries, from origin harbor to Lorain, Ohio. Such a system would require an inordinate number of railroad cars with the consequent deadweight. Further, the interlake movement of such a system could be hazardous during storm conditions.

Major terminal changes to handle the railroad cars would be required at each origin. This alternative was not considered further.

d. Concept 8

All-rail movement of iron ore from Lake Superior to Lorain was considered. U.S. Steel receives no major amount of iron ore in railroad cars. Sporadic receipts might be based on a need for an ores with a special analysis or raw materials necessary to supplement the inventory on a seasonal basis.

The rate for all-rail movement from the Mesabi Range to Lorain, OH, would be $20.50 per vessel. All water movements for the same commodity are estimated at $6.75. Unit train movements would undoubtedly be lower but would require installation of extensive unloading facilities at the upriver steel plant to efficiently unload and release unit trains.

It is unlikely that "all rail movements" will account for a large percent of total iron ore movements within the Great Lakes region because the substantial savings associated with the lake vessel mode and the financial investments in new facilities required at receiving plants to accommodate an all-rail mode of movement.

e. Concept 9

Another possible concept for moving iron ore to Lorain would be to ship iron ore by Class VI through Class X vessel to another Lake Erie port and then transship to Lorain by rail. This concept was recently implemented at Lorain where Republic Steel constructed a transshipment facility that can service 1,000-foot ore carriers economically. The ports of Toledo, Huron, Cleveland, Ashtabula, and Conneaut all have docks engaged in transshipping iron ore to inland plants. However, harbor and/or dock facility modifications would be required at each to service Class X vessels.

While this alternative is feasible for the smaller vessels (Class VI or Class VII), there would be about a $5.00 per ton line haul charge to rail each ton to the upland steel plant. This line haul cost is an estimated average rate based on published target rates for comparable hauls. The Lorain plant presently can accommodate coal receipts by rail and substantial investments in new facilities to handle in excess of 3 million tons of iron ore would be required. Transshipment of significant tonnages through other Lake Erie ports will probably not develop.

After eliminating the above concepts from further consideration in the Initial Iteration concepts (concepts 1, 2, and 3), the remaining concepts all involve shipment of iron ore to Lorain in Class X vessels. These remaining concepts were then developed into alternative plans of improvement for modifying the existing Federal harbor at Lorain to serve Class X vessels in the Second Iteration.

Second Iteration

Development of Alternatives - Each concept not eliminated in the Initial

Iteration phase was investigated in greater detail to determine what modifications would be necessary for implementation. It was determined that there are several alternatives that would fulfill the requirements of each concept.

The alternatives that are investigated in this preliminary feasibility report are:

Concept 1 (Direct Delivery Upriver)

Alternative 1 - Direct delivery by Class X to the upstream end of the Federal project including outer harbor modifications, Riverside Park cut, enlarged channel, enlarged upper turning basin, and new 21st Street Bridge.

Alternative 2 - Similar to Alternative 1 except instead of a Riverside Park cut, the Erie Avenue Bridge would be replaced with a high level bridge.

Alternative 3 - Similar to Alternative 2 except the Erie Avenue Bridge would be replaced with a movable bridge.

Alternative 4 - Similar to Alternatives 2 and 3 except the Erie Avenue Bridge would be replaced by a tunnel.

Concept 2 (Delivery in Class X Vessel to Transshipment Facility at 21st Street Bridge)

Alternative 5 - Delivery by a Class X vessel to a transshipment facility constructed just north of the 21st Street Bridge including outer harbor modifications, new channel through Riverside Park, enlarged channel, enlarged lower turning basin, transshipment facility, and conveyor upriver from 21st Street.

Alternative 6 - Similar to Alternative 5 except that instead of a Riverside Park cut, the Erie Avenue Bridge would be replaced by a high level bridge.

Alternative 7 - Similar to Alternative 6 except tha the Erie Avenue Bridge would be replaced with a movable bridge.

Alternative 8 - Similar to Alternative 6 except that the Erie Avenue Bridge would be replaced by a tunnel.

Concept 3 (Delivery in Class X Vessels to Lakefront Transshipment Facility)

Alternative 9 - Delivery to the Lakefront in Class X vessel to a newly constructed transshipment facility including outer harbor modifications, lakefront transshipment facility, and an upriver conveyor system.

Alternative 10 - Similar to Alternative 9 except instead of an upriver conveyor system a special purpose vessel would be used to transport the ore upriver.

Alternative 11 - Similar to Alternatives 9 and 10 except a rail facility would be utilized to move the ore upriver.

Alternative 12 - Similar to Alternatives 9, 10, and 11 except a truck system would be utilized to move the ore upriver.

Alternative 13 - Same as Alternative 9 except for the addition of a cut through Riversde Park.

Alternative 14 - Same as Alternative 10 except for the addition of a cut through Riverside Park.

Alternative 15 - Same as Alternative 11 except for the addition of a cut through Riverside Park.

Alternative 16 - Same as Alternative 12 except for the addition of a cut through Riverside Park.

Alternative 17 - No action, Do Nothing Plan.

These alternative plans are discussed in detail in Section D.

PLANS OF OTHERS

The Lorain Port Authority is actively engaged in an effort to attract industry and commerce to the Lorain harbor area. An example of this activity is the decision of Republic Steel to locate their new transshipment facility in Lorain. Other examples of efforts to attract new commerce and industry include a survey of area businesses to determine interest in a general cargo transfer center, application for grants to study the feasibility of a coal blending plant, and plans for a 600 slip marina to be built on the east side of the harbor near the dike disposal area in stages beginning in 1980.

Improvements to the harbor to aid safe and efficient navigation would be in line with the desires of the Port Authority to expand use of the harbor. None of the alternatives outlined in this report would interfere with the plans of the Port Authority.

Republic Steel has built-in capability for expansion of their new pellet terminal if the need arises. This would increase the frequency of deliveries by Class X vessels. Improvements to the harbor would benefit Republic even more if this were to happen.

U.S. Steel has stated that expansion of their facility in Lorain is a possibility, but that the expansion is contingent upon availability of low cost raw materials. Improvements to Lorain Harbor would help insure that U.S. Steel would be able to utilize the most efficient means of delivery of raw materials.

Improvements to the harbor as outlined in this report will not adversely impact upon plans of others, but plans of others will be enhanced by the improvements.

SECTION D
ASSESSMENT AND EVALUATION OF PRELIMINARY PLANS

The purpose of this section is to provide the reader of this report with a summary of the engineering design, economic evaluation, and environmental assessment associated with commercial navigation the alternatives that the initial screening of the wide range of possible solutions indicated had the greatest potential for meeting the planning objectives.

These alternatives are:

Alternative 1 - Direct delivery by Class X to the upstream end of the Federal project including outer harbor modifications, Riverside Park cut, enlarged channel, enlarged upper turning basin, and new 21st Street Bridge.

Alternative 2 - Similar to Alternative 1 except instead of a Riverside Park cut, the Erie Avenue Bridge would be replaced with a high level bridge.

Alternative 3 - Similar to Alternative 2 except the Erie Avenue Bridge would be replaced with a movable bridge.

Alternative 4 - Similar to Alternatives 2 and 3 except the Erie Avenue Bridge would be replaced by a tunnel.

Alternative 5 - Delivery by a Class X vessel to a transshipment facility constructed just north of the 21st Street Bridge including Outer Harbor modifications, new channel through Riverside Park, enlarged channel, enlarged lower turning basin, transshipment facility, and conveyor upriver from 21st Street.

Alternative 6 - Similar to Alternative 5 except that instead of a Riverside Park cut, the Erie Avenue Bridge would be replaced by a high level bridge.

Alternative 7 - Similar to Alternative 6 except that the Erie Avenue Bridge would be replaced with a movable bridge.

Alternative 8 - Similar to Alternative 6 except that the Erie Avenue Bridge would be replaced by a tunnel.

Alternative 9 - Delivery to the Lakefront in Class X vessel to a newly constructed transshipment facility including outer harbor modifications, lakefront transshipment facility, and an upriver conveyor system.

Alternative 10 - Similar to Alternative 9 except instead of an upriver conveyor system, a special purpose vessel would be used to transport the ore upriver.

Alternative 11 - Similar to Alternatives 9 and 10 except a rail facility would be utilized to move the ore upriver.

Alternative 12 - Similar to Alternatives 9, 10, and 11 except a truck system would be utilized to move the ore upriver.

Alternative 13 - Same as Alternative 9 except for the addition of a cut through Riverside Park.

Alternative 14 - Same as Alternative 10 except for the addition of a cut through Riverside Park.

Alternative 15 - Same as Alternative 11 except for the addition of a cut through Riverside Park.

Alternative 16 - Same as Alternative 12 except for the addition of a cut through Riverside Park.

In addition, the basis of comparison for the alternatives listed above is .

Alternative 17 - No Action, Do Nothing Plan.

Appendices A and B to this report provide details of the engineering and economic analyses associated with the alternatives. These appendices are:

Appendix A - Preliminary Engineering Design and Cost Estimates, prepared by Michael Baker, Jr., Inc., a consulting firm in Beaver, PA., under contract with Buffalo District.

Appendix B - Economic Evaluation, prepared by Buffalo District staff.

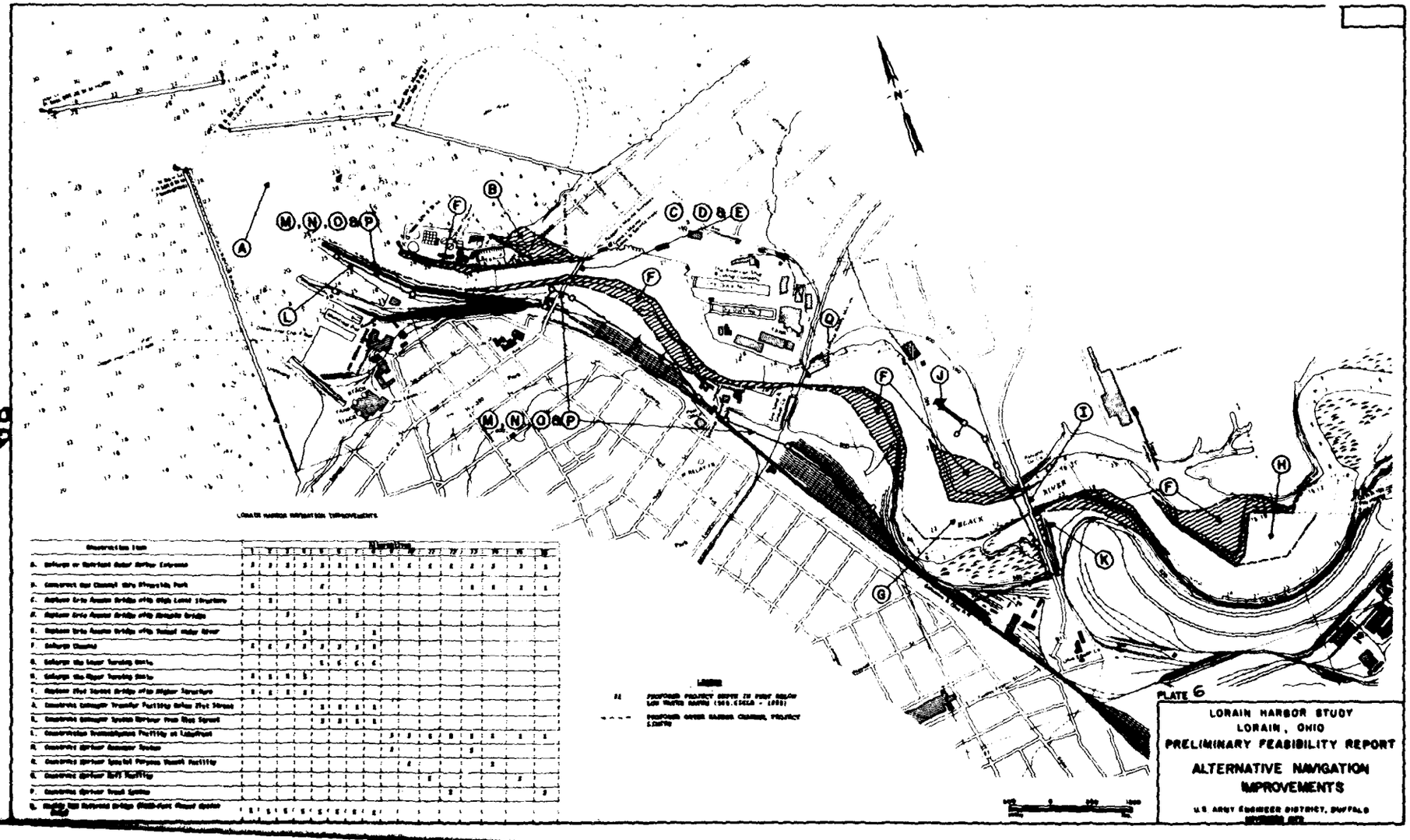
In developing these alternative plans of improvement, it was determined that a total of 17 principal construction items (or project features) would be required. These construction items are identified in Section 1 of Appendix A. Plate 6 shows the location of these construction items and provides a matrix showing the construction items common to each alternative.

It should be noted that designs and estimates were also prepared for a 1,200 x 130 foot vessel, which is the theoretical maximum vessel expected on the Great Lakes in the foreseeable future as determined by North Central Division. This theoretical vessel is identified as Option 2 in Appendix A. Construction items for Option 2 are discussed herein, as appropriate.

ALTERNATIVE 1 (DIRECT DELIVERY WITH RIVERSIDE PARK CUT)

Description of Alternative 1 - This alternative includes improvements for the entire authorized project area from the Outer Harbor to the Upper Turning Basin that would allow for passage of 1,000-foot vessels over the entire length of this area. Plate 7 shows the various construction items of this alternative (construction Items A, B, F, H, and I as listed in Plate 6

In the Outer Harbor, Item A, improvements would include removal of 600 feet of the East Breakwater and a 600-foot addition to the Outer Breakwater. A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RIVER
PLATE 6
LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE NAVIGATION IMPROVEMENTS
U.S. ARMY ENGINEER DISTRICT, BUFFALO

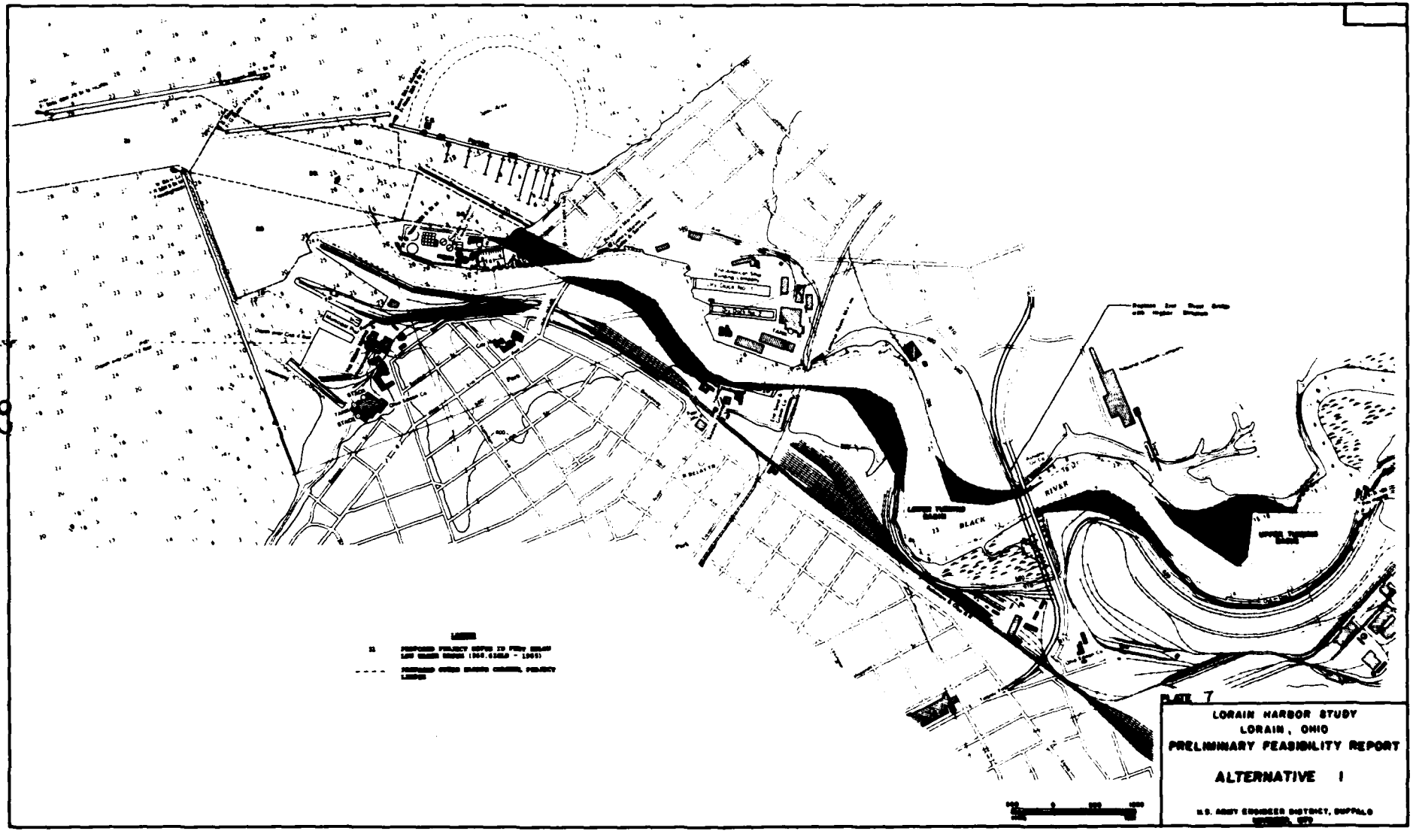
new Inner Harbor Breakwater would be constructed to protect a future small-boat marina along the East Shorearm Breakwater. The Outer Harbor would be dredged an additional 3 feet to allow larger vessels to enter at system draft under heavy weather conditions. Outer Harbor dredging would amount to about 220,000 cubic yards.

A new channel 300 feet in width to accommodate 1,000-foot vessels would be constructed through Riverside Park, construction Item B. This realignment of the entrance to the Black River would permit vessel passage more nearly normal to the leaves of the existing Erie Avenue bascule bridge. This would make passage of a 1,000-foot vessel under the Erie Avenue Bridge possible without tug assistance which would eliminate replacement of this bridge. In addition, cuts to widen the existing channel would be made to the Upper Turning Basin. These channel cuts (Item F) and Upper Turning Basin improvements (Item H) amount to approximately 1,200,000 cubic yards and would significantly improve maneuvering and bank clearance lanes for 1,000-foot vessels. The river channel would be deepened to 28 feet. Dredging quantities would amount to 2,500,000 cubic yards.

Upriver, the existing 21st Street high level bridge would be replaced with a high level three span continuous through truss bridge with a 600-foot main span over the river and the proper height clearance for 1,000-foot vessels. Slight relocation of the bridge would result in both local and through traffic moving more freely due mainly to the elimination of the complex 21st Street-Elyria Avenue intersection and street relocations. Some predominantly commercial areas would be permanently lost due to extended length of the new bridge, with no equivalent return upon removal of the existing bridge. The new bridge would meet current road width requirements.

Cost Estimate for Alternative 1 - The summary cost estimate for Alternative 1 is presented in Table 31. Table 32 summarizes the estimated project costs and annual charge and provide a breakdown of the Federal and non-Federal share of these costs for Alternative 1. From these tabulations, it is seen that the total project cost including land acquisition is $170.9 million (Table 32), the total investment cost, including interest during construction is $189.0 million (Table 33) and the total annual charges are $15.3 million (Table 33).

The apportionment of costs to Federal and non-Federal interests are shown in Table 23. Note that costs for general navigation features upstream from American Shipbuilding have been apportioned 50 percent Federal and 50 percent non-Federal because U.S. Steel would be a single user of 1,000-foot vessels upstream of AmShip. Table 24 summarizes the investment costs and annual charges, and provides the apportionment of these costs to Federal and non-Federal interests. From these tabulations, it is seen that the total project first cost, including land acquisition, is $170.9 million (Table 31); the total investment cost, including interest during construction, is $189.0 million (Table 33); and the total annual charges are $15.3 million (Table 33).


BLACK
RIVER
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U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 31 - Estimate of Navigation Project Costs for
Alternative 1, Option 1 (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges (4.3)*				41.2	41.2
Breakwaters	4.3				4.3
ınk Cuts & Deepening (2.5)	3.2	15.7	15.5	25.2	59.6
Building Demolition (2.5, 3.4)		1.1	.1		1.2
Conveyors (3.4)					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4)		1.1			1.1
Subtotal Direct Costs	7.5	17.9	15.6	66.4	107.4
Contractor's Overhead & Profit @ 15 percent					16.1
Subtotal					123.5
Contingency @ 15 percent					18.5
Subtotal					142.0
Engineering & Design, Supervision & Admin. @ 15 percent					21.3
Subtotal					163.3
Land (3.4, 4.3)		1.9	1.7	4.0	7.6
Total Navigation Costs					170.9

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 32 - Apportionment of Total Project Cost for Alternative 1, Option 1 (1,000-Footer)[1/]

Item	Cost (in Millions)				
	Federal	Non-Federal			Total Project Costs
		General Features	Single User Features[2/]	Total Non-Federal	
Bridges	20.6		20.6	20.6	41.2
Breakwaters	4.3				4.3
Bank Cuts & Deepening	39.3		20.3	20.3	59.6
Building Demolition		1.1	.1	1.2	1.2
Conveyors					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		1.1		1.1	1.1
Subtotal	64.2	2.2	41.0	43.2	107.4
Contractor's Overhead & Profit @ 15 percent	9.6	0.3	6.1	6.5	16.1
Subtotal	73.8	2.5	47.1	49.7	123.5
Contingency @ 15 percent	11.0	0.4	7.1	7.5	18.5
Subtotal	84.8	2.9	54.2	57.2	142.0
Engineering & Design, Supervision & Admin. @ 15 percent	12.8	0.4	7.1	7.5	18.5
Subtotal	97.6	3.3	62.3	65.7	163.3
Lands		1.9	5.7	7.6	7.6
Total	97.6	5.2	68.0	73.3	170.9

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Table 33 - Estimated Investment Cost and Annual Charges
For Alternative 1, Option 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	163.3
Interest During Construction	18.1
Lands	7.6
Total Investment, Including Lands	189.0
ANNUAL CHARGES FOR THE PROJECT	
Interest	13.9
Amortization	0.4
Operation and Maintenance	1.0
Future Replacements 2/	0.0
Total Annual Charge	15.3
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	97.6
Interest During Construction	10.8
Total Investment	108.4
ANNUAL CHARGES	
Interest	8.0
Amortization	0.2
Maintenance	0.5
Total Annual Charges	8.7
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	65.7
Interest During Construction	7.3
Lands	7.6
Total Investment Including Lands	80.6
ANNUAL CHARGES	
Interest	5.9
Amortization	0.2
Maintenance	0.5
Future Replacements 2/	0.0
Total Annual Charges	6.6

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B-46.

Economic Evaluation of Alternative 1 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 1 is presented in Appendix B - Economic Evaluation. Benefit categories included in the alternative are: (1) iron ore transportation savings, and (2) future vessel launching costs avoided. From Table B47 in Appendix B, the total average annual benefit for Alternative 1 is $17,400,000. The net benefit is $2,100,000 and the B/C ratio is 1.14. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 34 below.

Table 34 - Summary of Benefits and Costs for Alternative 1, Option 1 (1,000-Footer)

	Average Annual Charges 1/	Average Annual Benefits	Net Average Annual Benefits	Benefit/Cost Ratio
	($ million/yr.)	($ million/yr.)	($ million/yr.)	
Total Project	15.3	17.4	2.1	1.14

1/ Based on May 1980 price levels

Environmental Features/Assessment of Plan 1 - Removal of 600 feet of the East Breakwater would expose approximately .69 acre of substrate composed of silt, rock, and some exposed bedrock which could provide aquatic habitat, while a 600-foot addition to the Outer Breakwater would cover approximately 1.02 acres of substrate composed of silt, rock, and some exposed bedrock which had provided aquatic habitat. The breakwater extension would be constructed of cellular steel sheet pile with rubblemound toe protection. This stone would provide .56 acre of colonizable aquatic habitat. Removal of 600 feet of the East Breakwater, also constructed of cellular steel sheet pile with rubblemound toe protection, would remove .20 acre of colonizable aquatic habitat provided by this stone. A new 1,500-foot long Inner Harbor breakwater, constructed to protect a future small-boat marina, would be of rubblemound construction. The submerged rubblemound surface of this breakwater would provide approximately .99 acre of potentially colonizable aquatic habitat, however, approximately 2.11 acres of substrate, composed of silt and rock which had provided aquatic habitat; would be covered and destroyed by breakwater construction. The amount of habitat provided and destroyed is summarized in the following table:

	Habitat Provided	Habitat Removed
Remove 600 feet of East Breakwater	.69 acre	.20 acre
Add 600 feet to Outer Breakwater	.56 acre	1.02 acres
Construct 1,500 foot Inner Harbor Breakwater	.99 acre	2.11 acres

Reorientation of the Outer Harbor entrance channel would allow the larger vessels to easily and safely steer into position to move upriver or into a lakefront transshipment facility; however, the reorientation may have negative aesthetic impacts during construction on the West Breakwater Lighthouse, a structure listed on the National Register of Historic Places.

Temporary noise and air pollution would be experienced during construction; however, since this is a highly industrialized area, the effects should be minimal. The Outer Harbor would be dredged an additional 3 feet which would amount to about 220,000 cubic yards of material. This would result in a temporary increase in water pollution, turbidity, and sediment loads during dredging.

A new channel would be constructed through Riverside Park. This realignment of the entrance to the Black River would permit vessel passage more nearly normal to the leaves of the existing Erie Avenue Bascule Bridge and would, thereby, eliminate replacement of this bridge. This channel cut would be 300 or 370 feet wide for the 1,000 or 1,200-foot vessels, respectively, and would have vertical banks protected by steel sheet pile. This land area to be excavated for the channel would become aquatic, thereby, providing bottom habitat equal to the amount of land excavated, approximately 5.40 acres for Option 1. Steel sheet pile bank protection would not provide colonizable macrobenthos habitat.

A channel through this area would destroy a major part of Riverside Park, thus, negating the recreational opportunities offered by this park. It would also require relocation of the Coast Guard facility, possibly leeward of the diked disposal area, and relocation of utilities. Access to the water treatment plant could be provided by driving two sets of sheet pile and filling the existing Black River channel between them. Blocking the existing channel in this manner is recommended so that the main flow would exit through the new cut, thereby, reducing the sedimentation of the channel. A submerged culvert should be provided in the fill across the existing channel to avoid creating a stagnant pool in the existing channel along the west side of the treatment plant.

If the existing channel is filled in, a new outlet would have to be constructed to allow boats to enter and exit an existing small-boat harbor located between the water treatment plant and the Coast Guard station. If a new outlet is not constructed, this marina would no longer be able to operate.

With the larger design vessels (1,000- and 1,200-foot), the required river channel depth required would be 28 feet. [1/] Therefore, an additional 1 foot of dredging would be necessary. This would cause temporary turbidity and bottom habitat disturbance during dredging operations.

Channel widening at various points on both sides of the river would allow both 1,000- and 1,200-foot vessels to navigate to the Upper Turning Basin. The cuts would take land owned primarily by the railroads and U.S. Steel.

[1/] Below Low Water Datum (LWD) which for Lake Erie is 568.6 feet above mean water level at Father Point, Quebec (IGLD, 1955).

The land excavated for the bank cuts would provide an equal amount of aquatic habitat. The following table shows land acquisition in acres for each bank cut, under each option:

Bank Cut	Option 1	Option 2
C-1	5.20	5.20
C-2	15.27	15.84
D	12.51	12.51
E-1	6.54	16.39
E-2	10.79	16.39
F	10.27	10.27
G	16.70	17.77

Utilities would have to be relocated with cut C-2 for each option. Cut F may infringe on a small portion of wetland, however, the U.S. Fish and Wildlife Service has indicated that the wetland habitat is not as productive as originally contemplated; therefore, impacts may be minimal. This cut may also infringe on an existing small-boat harbor located north of the N&W Railroad Bridge. Steel sheet pile used as bank protection in critical areas subject to erosion would provide no colonizable aquatic habitat.

Enlarging the Upper Turning Basin would allow the design vessels to turn 180 degrees and return downriver.

Replacing the 21st Street Bridge with a higher structure would allow 1,000- and 1,200-foot vessels to navigate through this section of the channel. With the proposed structure, both local and through traffic could move more freely due to the elimination of the complex 21st Street-Elyria Avenue intersection and street relocations.

The existing structure would be kept in service until the new structure was open to traffic by staged construction and temporary access roads. Therefore, traffic disruption would be minimal.

Some predominantly commercial areas would be permanently taken with no equivalent return upon removal of the existing structure. This is due to the greater length of the new structure intruding into areas at both ends not affected by the existing structure.

The alignment downstream fully meets alignment criteria although the curves on the bridge are not particularly desirable. This alignment also crosses over the existing railroad underpass.

Evaluation of Alternative 1 - Alternative 1 fulfills the planning objective of improving Lorain Harbor for navigation by Class X or larger vessels. The average annual benefits exceed the average annual cost. However, under the criteria set forth in the "Digest of Water Resources Policies and Authorities" EP 1165-2-1, 28 September 1979, paragraph 5-8d states that project optimization occurs when "the level of resource use best satisfies all constraints while maximizing net benefits and assuring efficient project operation." Other alternatives in this study assure an efficient project operation as well as Alternative 1 and also have significantly higher net benefits. This alternative is also among the highest cost alternatives and requires the most disruption of existing conditions. Therefore Alternative 1 will not be considered further.

ALTERNATIVE 2 (DIRECT DELIVERY WITH NEW HIGH-LEVEL ERIE AVENUE BRIDGE)

Description of Alternative 2 - This alternative would be similar to Alternative 1, except in lieu of constructing the new channel through Riverside Park (construction Item B), the existing river entrance would be used and the existing Erie Avenue Bridge would be replaced with a high level structure (construction Item C). The construction items are shown on Plate 8. The Outer Harbor would not require a marina breakwater.

The proposed high level bridge replacement at Erie Avenue would be a three-span continuous, through truss structure that would allow passage of 1,000-foot vessels. The total length, which includes approach fills and spans, and the length of the three-span structure, would be approximately 5,000 feet. Large areas of predominantly residential land would be taken for construction and permanent easement. Traffic would move more freely over the new bridge, but local traffic would be adversely affected by the widely separated points of access to the bridge.

Cost Estimate for Alternative 2 - The summary cost estimate for Alternative 2 is presented in Table 35. Table 36 summarizes the estimated project costs and annual charges and provides a breakdown of the Federal and non-Federal share of these costs for Alternative 2. Table 37 summarizes the investment costs and annual charges, and apportions these costs to Federal and non-Federal interests. From these tabulations, it is seen that the total project cost, including land acquisition, is $221.0 million (Table 36), the total investment cost, including interest during construction, is $244.1 million (Table 37) and the total annual charges are $19.9 million (Table 37).

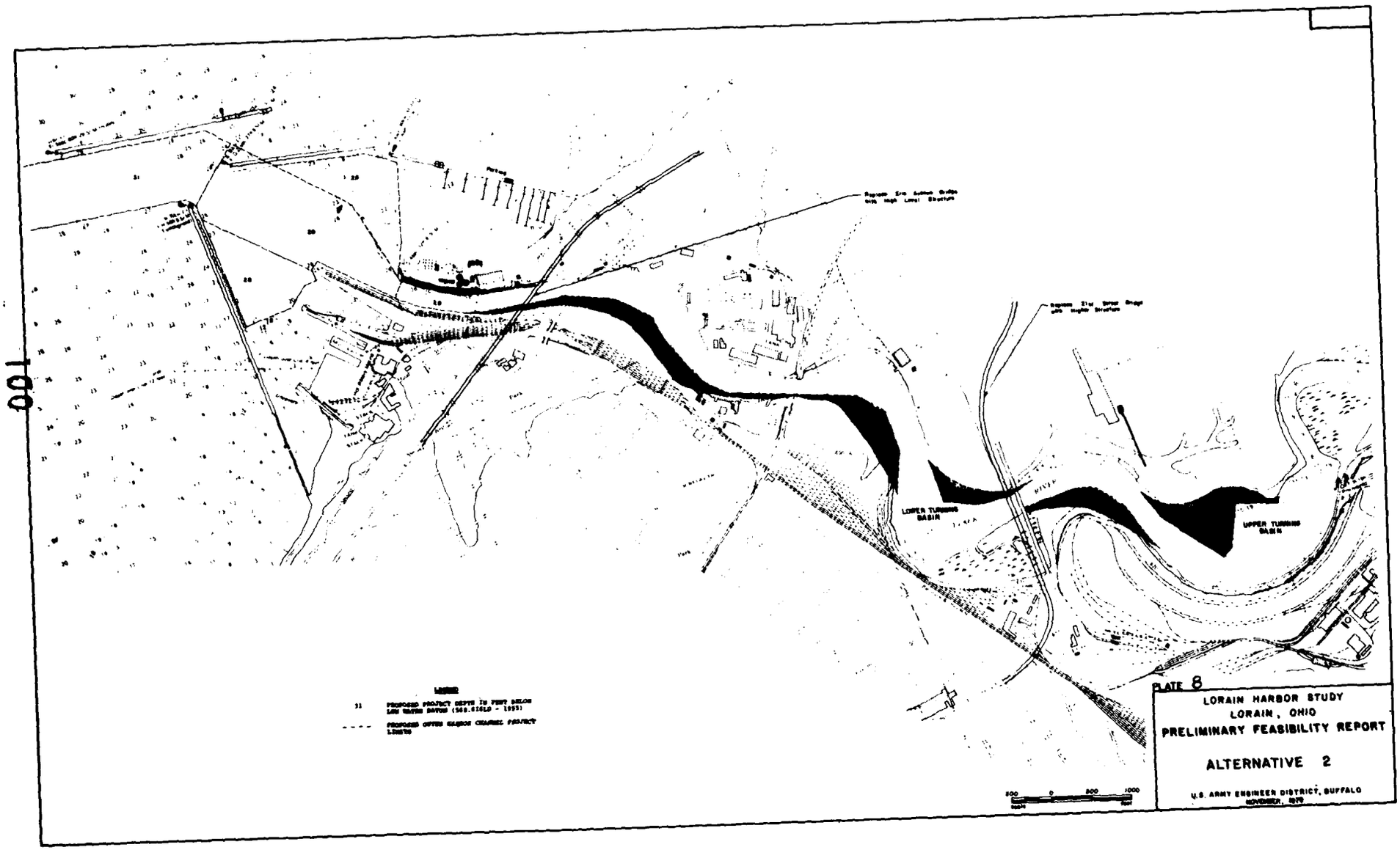


PLATE 8

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 2

U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER, 1979

Table 35 - Estimate of Navigation Project Costs for
Alternative 2, Option 1 (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges (4.3)*		35.7		41.2	76.9
Breakwaters (2.4)	2.8				2.8
‹k Cuts & Deepening (2.4, 3.4)	3.2	12.7	15.5	25.2	56.6
Building Demolition		0.1	.1		.1
Conveyors					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 4.1)		.8			0.8
Subtotal Direct Costs	6.0	49.2	15.6	66.4	137.2
Contractor's Overhead & Profit @ 15 percent					20.6
Subtotal					157.8
Contingency @ 15 percent					23.7
Subtotal					181.5
Engineering & Design, Supervision & Admin. @ 15 percent					27.2
Subtotal					208.7
Land (3.4, 4.1, 4.3)		6.6	1.7	4.0	12.3
Total Navigation Costs					221.0

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 36 - Apportionment of Total Project Cost for Alternative 2, Option 1 (1,000-Footer)[1/]

Item	Federal	Cost (in Millions)			Total Project Costs
		General Features	Single User Features[2/]	Total Non-Federal	
Bridges	56.3		20.6	20.6	76.9
Breakwaters	2.8				2.8
Bank Cuts & Deepening	36.3		20.3	20.3	56.6
Building Demolition			0.1	0.1	0.1
Conveyors					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		0.8		0.8	0.8
Subtotal	95.4	0.8	41.0	41.8	137.2
Contractor's Overhead & Profit @ 15 percent	14.3	0.1	6.2	6.3	20.6
Subtotal	109.7	0.9	47.2	48.1	157.8
Contingency @ 15 percent	16.5	0.1	7.1	7.2	23.7
Subtotal	126.2	1.0	54.3	55.3	181.5
Engineering & Design, Supervision & Admin. @ 15 percent	18.9	0.1	8.2	8.3	27.2
Subtotal	145.1	1.1	62.5	63.6	208.7
Lands	0.0	6.6	5.7	12.3	12.3
Total	145.1	7.7	68.2	75.9	221.0

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Table 37 - Estimated Investment Cost and Annual Charges
For Alternative 2, Option 1[1/]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	208.7
Interest During Construction	23.1
Lands	12.3
Total Investment, Including Lands	244.1
ANNUAL CHARGES FOR THE PROJECT	
Interest	18.0
Amortization	0.5
Operation and Maintenance	1.4
Future Replacements[2/]	0.0
Total Annual Charge	19.9
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	145.1
Interest During Construction	16.1
Total Investment	161.2
ANNUAL CHARGES	
Interest	12.0
Amortization	0.3
Operation and Maintenance	0.5
Total Annual Charges	12.8
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	63.6
Interest During Construction	7.0
Lands	12.3
Total Investment Including Lands	82.9
ANNUAL CHARGES	
Interest	6.0
Amortization	0.2
Operation and Maintenance	0.9
Future Replacements[2/]	0.0
Total Annual Charges	7.1

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amortization = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B-4b.

Economic Evaluation of Alternative 2 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 2 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, (2) future vessel launching costs avoided and (3) advance replacements. From Table B47 in Appendix B, the total average annual benefit for Alternative 2 is $17,600,000. The net benefit is -$2,300,000 and the B/C ratio is 0.88. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 38 below.

Table 38 - Summary of Benefits and Costs for Alternative 2, Option 1 (1,000-Footer)

	Average Annual Charges ($ million/yr.)	Average Annual Benefits ($ million/yr.)	Net Average Annual Benefits ($ million/yr.)	Benefit/Cost Ratio
Total Project	19.9	17.6	-2.3	0.88

Environmental Features/Assessment of Plan 2 - This alternative would be similar to Alterantive 1, except in lieu of constructing the new channel through Riverside Park, the existing river entrance would remain; and the existing Erie Avenue Bridge would be replaced with a high level structure. The Outer Harbor would not require a marina breakwater.

Cut B along the existing river entrance would allow 1,000- and 1,200-foot vessels to enter the river channel. Property taken for this cut would be commercial, primarily owned by the railroads. For the 1,200-foot option, 9.76 acres would become aquatic habitat. Utilities would have to be relocated with Cut B for each option. This cut may also infringe on an existing marina located between the water treatment plant and the Coast Guard facility. Steel sheet pile used as bank protection would not provide aquatic habitat.

Replacement of the Erie Avenue Bridge with a high level structure would allow through or crosstown traffic to move more freely over a route of virtually unchanged length. The structure grades would have some adverse effect, but there would be no intersections or stoppages for passage of river vessels. Local traffic would be adversely affected in some cases due to the widely separated points of access to the bridge. The existing structure would remain in service until the new bridge was open to traffic. Interference with traffic during construction would be minimal and mostly on side streets.

It is anticipated that the land under and immediately adjacent to the bridge would be permanently vacated, and could not be used for any commercial, industrial, or residential purposes. The amount of land so affected would be substantial, varying to some slight degree, depending on the exact location of the structure in relation to property lines. With 125- or 135-foot

clearance, the top of the center span truss would be in the order of 200 feet above water. The total structure would be in the order of 5,000 feet in length. In combination with the level terrain these factors indicate the structure would visually dominate the surrounding area. This may be aesthetically unacceptable to some.

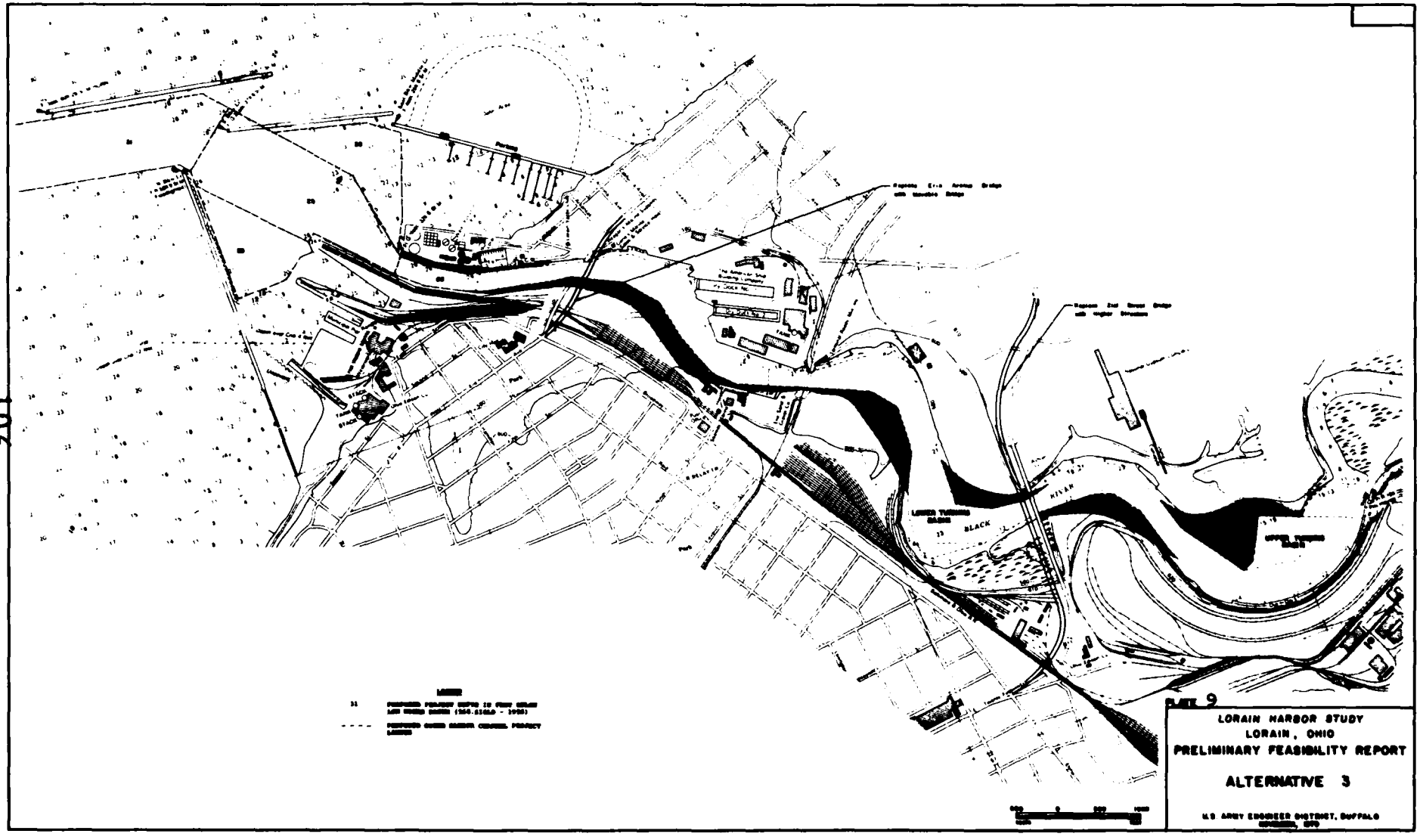
Evaluation of Alternative 2 - Alternative 2 fulfills the planning objective of improving Lorain Harbor for navigation by Class X vessels. However, the annual benefits do not exceed the average annual costs. It is the policy of the Corps of Engineers not to recommend projects for implementation where costs for the project exceed the benefits that would be realized unless there are overriding considerations of environmental quality or social impacts warranting a departure from economic decisions. Alternative 2 does not exhibit any such overriding considerations. Therefore since Alternative 2 does not exhibit economic efficiency, it cannot be recommended for implementation.

ALTERNATIVE 3 (DIRECT DELIVERY WITH NEW MOVABLE ERIE AVENUE BRIDGE)

Description of Alternative 3 - Instead of replacement of the Erie Avenue Bridge with a high level structure (construction Item C), a new movable bridge at Erie Avenue would be constructed (construction Item D). All other construction items in this alternative are identical to Alternative 2. The necessary changes to the harbor and channel for this alternative are shown on Plate 9.

The existing bascule structure would be replaced by a lift bridge similar in style to the N&W railroad lift bridge that is upriver of Erie Avenue. The new lift bridge would have 370-foot clear span and a maximum height clearance of 125 feet for Option 1 (1,000-foot vessel). Replacement of the Erie Avenue Bridge with a new movable bridge would minimize adverse impacts on traffic during construction and on relocation of residences. The new lift bridge would be located immediately upstream or downstream of the existing bridge. The lift bridge would have essentially identical functional characteristics and effects on traffic and land use as the existing structure. The principal permanent impact would be the presence of the lift bridge towers which would stand approximately 200 feet above the water.

Cost Estimate for Alternative 3 - The summary cost estimate for Alternative 3 is presented in Table 39. The apportionment of first costs to Federal and non-Federal interests is shown in Table 40. Table 41 shows the total investment costs and annual charges, and provides an apportionment of these costs to Federal and non-Federal interests. From these tabulations, it is seen that the total project cost including land acquisition is $191.5 million (Table 40), the total investment cost, including interest during construction is $211.7 million (Table 41) and the total annual charges are $17.3 million (Table 41).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PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 3
U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 39 - Estimate of Navigation Project Costs for Alternative 3, Option 1 (1,000-foot Vessels) (May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges (4.2, 4.3)*		18.9		41.2	55.3
Breakwaters (2.4)	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.2	12.7	15.5	25.2	56.6
Building Demolition (3.4)		0.0	.1		.1
Conveyors					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 4.2)		.3			.3
Subtotal Direct Costs	6.0	31.9	15.6	66.4	119.9
Contractor's Overhead & Profit @ 15 percent					18.0
Subtotal					137.9
Contingency @ 15 percent					20.7
Subtotal					158.6
Engineering & Design, Supervision & Admin. @ 15 percent					23.8
Subtotal					182.4
Land (3.4, 4.2, 4.3)		3.4	1.7	4.0	9.1
Total Navigation Costs					191.5

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 40 - Apportionment of Total Project Cost for Alternative 3, Option 1 (1,000-Footer)[1/]

Item	Federal	Cost (in Millions) General Features	Single User Features[2/]	Total Non-Federal	Total Project Costs
Bridges	39.5		20.6	20.6	60.1
Breakwaters	2.8				2.8
Bank Cuts & Deepening	36.3		20.3	20.3	56.6
Building Demolition			0.1	0.1	0.1
Conveyors					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		0.3		0.3	0.3
Subtotal	78.6	0.3	41.0	41.3	119.9
Contractor's Overhead & Profit @ 15 percent	11.8	0.0	6.2	6.2	18.0
Subtotal	90.4	0.3	47.2	47.5	137.9
Contingency @ 15 percent	13.5	0.1	7.1	7.2	20.7
Subtotal	103.9	0.4	54.3	54.7	158.6
Engineering & Design, Supervision & Admin. @ 15 percent	15.6	0.1	8.1	8.2	23.8
Subtotal	119.5	0.5	62.4	62.9	182.4
Lands	0.0	3.4	5.7	9.1	9.1
Total	119.5	3.9	68.1	72.0	191.5

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Table 41 - Estimated Investment Cost and Annual Charges
For Alternative 3, Option 1[1/]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	182.4
Interest During Construction	20.2
Lands	9.1
Total Investment, Including Lands	211.7
ANNUAL CHARGES FOR THE PROJECT	
Interest	15.6
Amortization	0.5
Operation and Maintenance	1.2
Future Replacements[2/]	0.0
Total Annual Charge	17.3
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	119.5
Interest During Construction	13.2
Total Investment	132.7
ANNUAL CHARGES	
Interest	9.8
Amortization	0.3
Maintenance	0.5
Total Annual Charges	10.6
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	62.9
Interest During Construction	7.0
Lands	9.1
Total Investment Including Lands	79.0
ANNUAL CHARGES	
Interest	5.8
Amortization	0.2
Maintenance	0.7
Future Replacements[2/]	0.0
Total Annual Charges	6.7

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B-46.

Economic Evaluation of Alternative 3 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 3 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, (2) future vessel launching costs avoided and (3) advance replacements. From Table B47 in Appendix B, the total average annual benefit for Alternative 3 is $17,500,000. The net benefit is $200,000 and the B/C ratio is 1.01. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 42 below.

Table 42 - Summary of Benefits and Costs for Alternative 3, Option 1 (1,000-Footer)

	Average Annual Charges	Average Annual Benefits	Net Average Annual Benefits	Benefit/Cost Ratio
	($ million/yr.)	($ million/yr.)	($ million/yr.)	
Total Project	17.3	17.5	0.2	1.01

Environmental Features/Assessment of Plan 3 - Instead of replacement of the Erie Avenue Bridge with a high level structure, a new movable bridge at Erie Avenue would be constructed. All other construction items in this alternative are identical to Alternative 2.

A lift bridge replacement at Erie Avenue would be more economical than the present bascule type. There would be little or no difference in the traffic service provided by a lift bridge compared to a bascule. The existing bridge could remain operational during construction. There would be brief periods of traffic interference for pavement tie-in near the end of construction. Relatively little property would be required for construction.

When the existing bridge is removed, an approximately equal area of land would be freed for development and use as would be required for the new structure.

The lift bridge towers would be highly visible, but it is anticipated that there would be no major objection. They would be entirely within the industrial river corridor and the N&W Railroad Bridge upstream is the same type structure, establishing a precedent in the area.

In general, a lift bridge replacement for the existing Erie Avenue bascule span would effect no permanent changes from existing conditions. It would be essentially a functional "replacement-in-kind."

Evaluation of Alternative 3 - Alternative 3 fulfills the planning objective of improving Lorain Harbor for navigation by Class X vessels. The average annual benefits exceed the average annual cost. However, under the criteria set forth in the "Digest of Water Resources Policies and

Authorities" EP 1165-2-1, 28 September 1979, paragraph 5-8d states that project optimization occurs when "the level of resource use best satisfies all constraints while maximizing net benefits and assuring efficient project operation." Other alternatives in this study assure an efficient project operation as well as Alternative 3 and also have significantly higher net benefits. This alternative is among the highest cost alternatives and is one of the most to the existing conditions. Therefore, Alternative 3 will not be considered further.

ALTERNATIVE 4 (DIRECT DELIVERY WITH TUNNEL REPLACEMENT OF ERIE AVENUE BRIDGE)

Description of Alternative 4 - The only difference between this alternative and Alternatives 2 and 3 is again the option of replacing the Erie Avenue Bridge which would be replaced in this alternative by a tunnel under the Black River (construction Item E). Alternative 4 is shown on Plate 10 .

The tunnel replacement for the existing Erie Avenue Bridge would have four 13-foot taffic lanes, two 2-1/2-foot emergency sidewalks and a 6-foot pedestrian passageway. The total tunnel length would be approximately 3,000 feet with 1,000 feet constructed under water. Tunnel portals would be aligned with Erie Avenue, with grade intersection at Hamilton Street to the south and near Delaware Street to the north. Some widening of Erie Avenue in these locations would be required. Crosstown traffic would travel substantially the same distance with fewer intersections. Local traffic would be adversed affected in varying degrees depending on the relation of the point of origin and designation to the tunnel entrances. Interruption of traffic for the passage of vessels on the river would be eliminated.

The existing bascule structure would remain in service until the tunnel was opened to traffic. Tunnel construction along Erie Avenue would require considerable long-term rerouting of traffic to other streets and a limited amount of temporary road construction at the approaches to the present bridge.

Cost Estimate for Alternative 4 - The summary cost estimate for Alternative 4 is presented in Table 43. The apportionment of first costs to Federal and non-Federal interests is shown in Table 44. Table 45 shows the total investment costs and annual charges, and provides an apportionment of these costs to Federal and non-Federal interests. From these tabulations, it is seen that the total project cost including land acquisition is $255.0 million (Table 44), the total investment cost, including interest during construction is $282.0 million (Table 45) and the total annual charges are $23.1 million (Table 45).

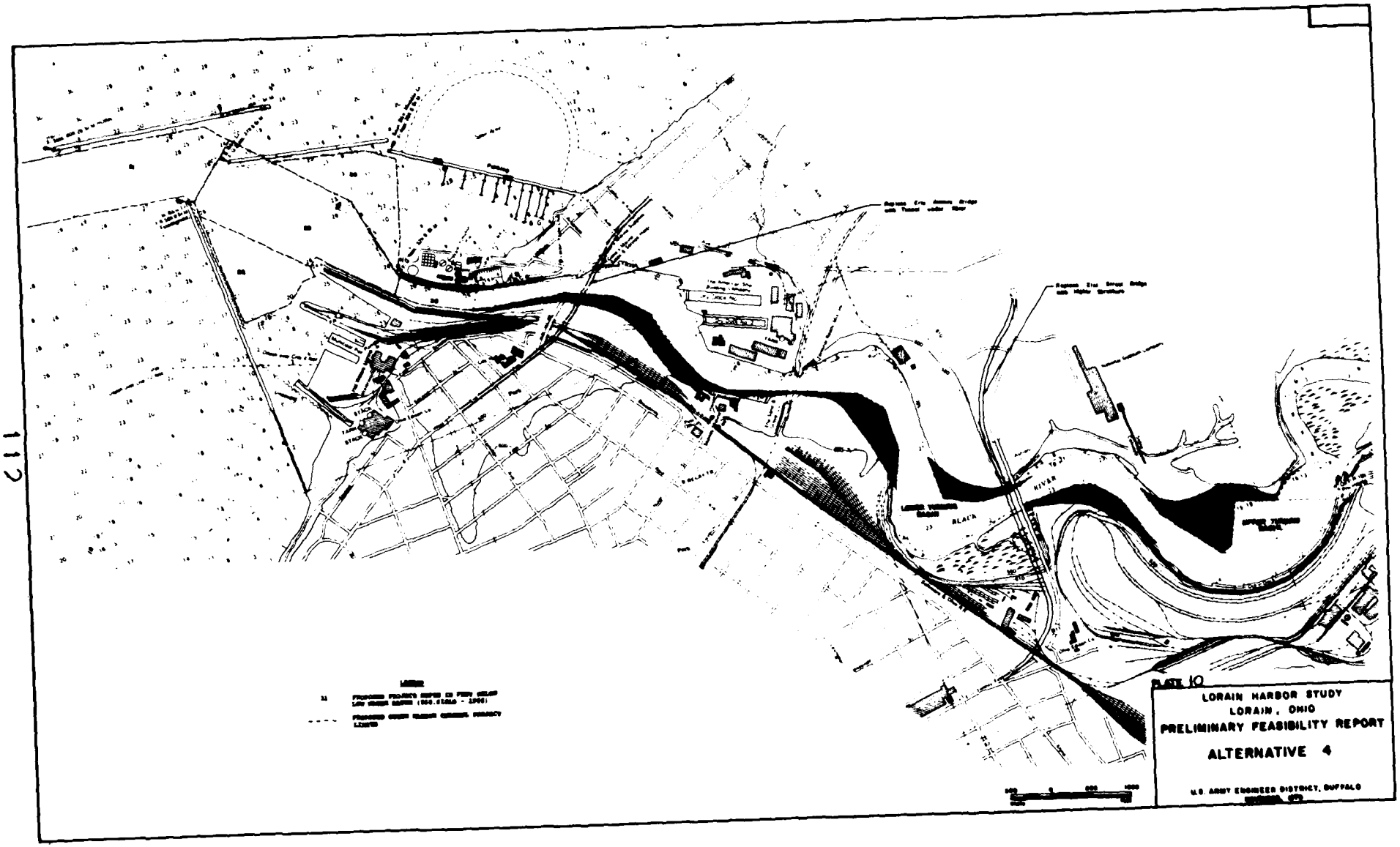
PLATE 10
LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 4
U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 43 - Estimate of Navigation Project Costs for
Alternative 4, Option 1 (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges (4.3)*				41.2	41.2
akwaters (2.4)	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.2	12.7	15.5	25.2	56.6
Building Demolition (3.4)		0.0	.1		0.1
Conveyors					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel (5.1)		58.8			58.8
Utilities (3.4, 5.1)		1.3			1.3
Subtotal Direct Costs	6.0	72.8	15.6	66.4	160.8
Contractor's Overhead & Profit @ 15 percent					24.1
Subtotal					184.9
Contingency @ 15 percent					27.7
Subtotal					212.6
Engineering & Design, Supervision & Admin. @ 15 percent					31.9
Subtotal					244.5
Land (3.4, 4.3, 5.1)		3.4	1.7	4.0	10.5
Total Navigation Costs					255.0

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 44 - Apportionment of Total Project Cost for Alternative 4, Option 1 (1,000-Footer)[1/]

Item	Federal	Cost (in Millions) General Features	Single User Features[2/]	Total Non-Federal	Total Project Costs
Bridges	20.6		20.6	20.6	41.2
Breakwaters	2.8				2.8
Bank Cuts & Deepening	36.3		20.3	20.3	56.6
Building Demolition			0.1	0.1	0.1
Conveyors					
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel	58.8				58.8
Utilities		1.3		1.3	1.3
Subtotal	118.5	1.3	41.0	42.3	160.8
Contractor's Overhead & Profit @ 15 percent	17.8	0.2	6.1	6.3	24.1
Subtotal	136.3	1.5	47.1	48.6	184.9
Contingency @ 15 percent	20.4	0.2	7.1	7.3	27.7
Subtotal	156.7	1.7	54.2	55.9	212.6
Engineering & Design, Supervision & Admin. @ 15 percent	23.5	0.3	8.1	8.4	31.9
Subtotal	180.2	2.0	62.3	64.3	244.5
Lands	0.0	4.8	5.7	10.5	10.5
Total	180.2	6.8	68.0	74.8	255.0

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Table 45 - Estimated Investment Cost and Annual Charges
For Alternative 4, Option 1[1/]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	244.5
Interest During Construction	27.0
Lands	10.5
Total Investment, Including Lands	282.0
ANNUAL CHARGES FOR THE PROJECT	
Interest	20.8
Amortization	0.6
Operation and Maintenance	1.7
Future Replacements[2/]	0.0
Total Annual Charge	23.1
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	180.2
Interest During Construction	19.9
Total Investment	200.1
ANNUAL CHARGES	
Interest	14.8
Amortization	0.4
Maintenance	0.5
Total Annual Charges	15.7
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	64.3
Interest During Construction	7.1
Lands	10.5
Total Investment Including Lands	81.9
ANNUAL CHARGES	
Interest	6.0
Amortization	0.2
Maintenance	1.2
Future Replacements[2/]	0.0
Total Annual Charges	7.4

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B-46.

Economic Evaluation of Alternative 4 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 4 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, (2) future vessel launching costs avoided and (3) advance replacements. From Table 47 in Appendix B, the total average annual benefit for Alternative 4 is $17,600,000. The net benefit is -$5,500,000 and the B/C ratio is 0.76. A summary of annual charges, annual beenfits, net benefits and benefit-to-cost ratio is shown in Table 46 below.

Table 46 - Summary of Benefits and Costs for Alternative 4, Option 1 (1,000-Footer)

	Average Annual Charges	Average Annual Benefits	Net Average Annual Benefits	Benefit/Cost Ratio
	($ million/yr.)	($ million/yr.)	($ million yr.)	
Total Project	23.1	17.6	-5.5	0.76

Environmental Features/Assessment of Plan 4 - The only difference in this alternative from Alternatives 2 and 3 is again the option of replacing the Erie Avenue Bridge, which would be replaced in this alternative by a tunnel under the river.

With a tunnel, crosstown traffic would travel substantially the same distance with fewer intersections. Local traffic would be adversely affected in varying degrees depending on the relation of the point of origin and destination to the tunnel entrances. Interruption of traffic for the passage of vessels on the river would be eliminated.

The existing bascule structure would remain in service until the tunnel was opened to traffic. Tunnel construction along Erie Avenue would require considerable long-term rerouting of traffic to other streets and a limited amount of temporary road construction at the approaches to the present bridge. Upon completion, the tunnel would be mostly invisible with minimal permanent impact on surface activities and facilities.

Evaluation of Alternative 4 - Alternative 4 fulfills the planning objective of improving Lorain Harbor for navigation by Class X vessels. However, the annual benefits do not exceed the average annual costs. It is the policy of the Corps of Engineers not to recommend projects for implementation where costs for the project exceed the benefits that would be realized unless there are overriding considerations of environmental quality or social impacts warranting a departure from economic justification. Alternative 4 does not exhibit any such overriding considerations. Therefore, since Alternative 4 does not exhibit economic efficiency it cannot be recommended for implementation, and will not be considered further.

ALTERNATIVE 5 (PARTIAL TRANSSHIPMENT WITH RIVERSIDE PARK CUT)

Description of Alternative 5 - This alternative would include improvements which allow navigation of 1,000-foot vessels to the Lower Turning Basin and construction of a transshipment conveyor facility below 21st Street. Alternative 5 is shown on Plate 11.

Outer Harbor navigation improvements and a new channel cut through Riverside Park would be the same as in Alternative 1. Channel enlargement upriver from the Riverside Park cut would be required, but only to below the 21st Street Bridge. The east bank at the Lower Turning Basin would be enlarged (construction Item G) to provide easier turning maneuverability for the larger vessels. Excavation and dredging requirements for the improved channel would amount to 1,850,000 cubic yards, excluding the Riverside Park cut which would require an additional 270,000 cubic yards of excavation.

The outstanding feature of this alternative would be the construction of a transshipment facility located on the east bank of the Black River just below the 21st Street Bridge (construction Item J). The facility would employ a belt-conveyor system (construction Item K) to complete the transfer of material upriver. A bridge spanning the Black River would be required to convey material to the U.S. Steel Lorain-Cuyahoga Works located on the west bank of the river. The total length of the belt-conveyor required would be approximately 4,000 feet.

Cost Estimate for Alternative 5 - The summary cost estimate for Alternative 5 is presented in Table 47. The apportionment to Federal and non-Federal interests is shown in Table 48. Table 49 shows the total investment costs and annual charges, and provides an apportionment of these costs to Federal and non-Federal interests. From these tabulations, it is seen that the total project cost including land acquisition is $99.1 million (Table 48), the total investment cost, including interest during construction is $106.1 million (Table 49) and the total annual charges are $8.8 million (Table 49).

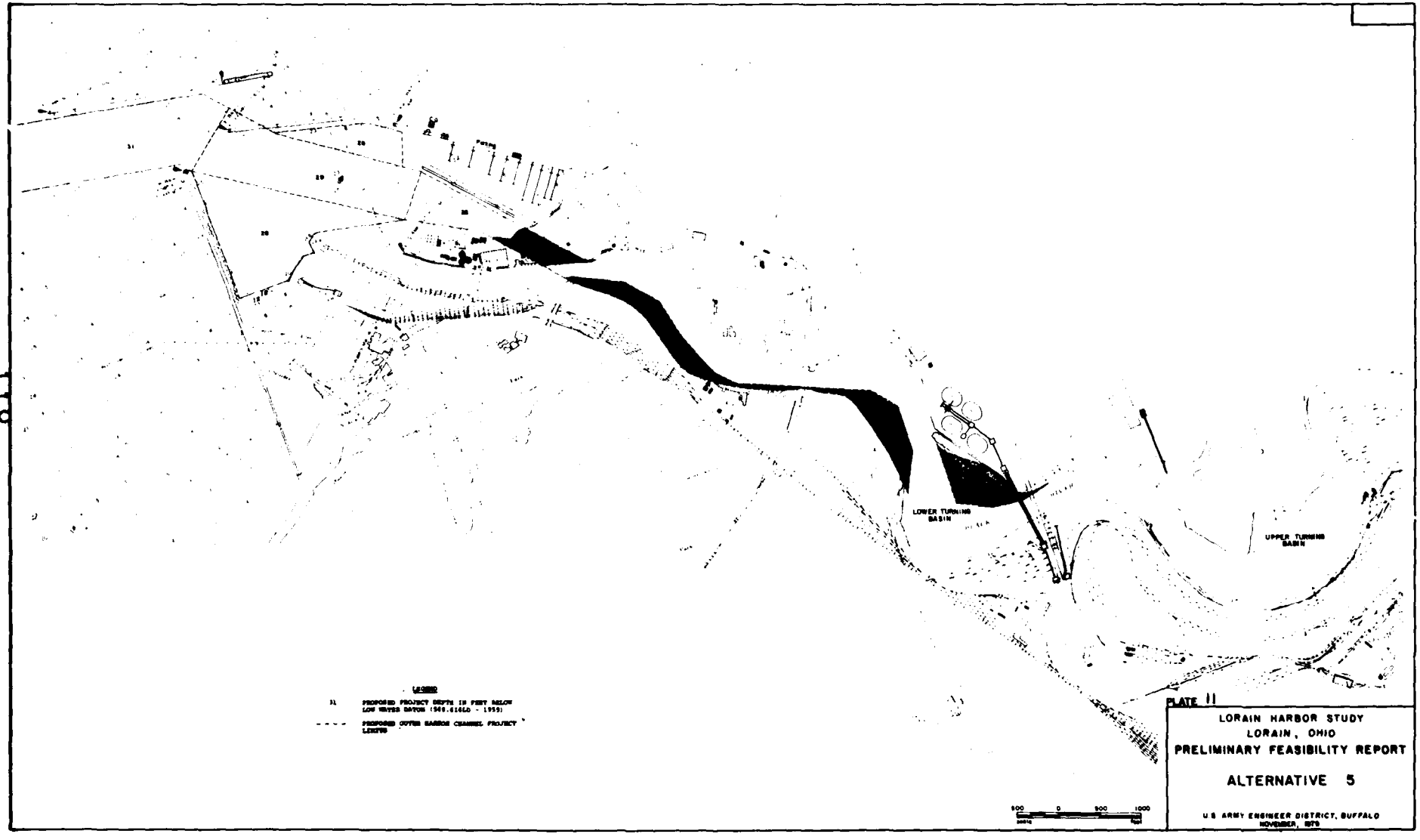

PLATE 11

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 5

U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER, 1975

Table 47 - Estimate of Navigation Project Costs for Alternative 5, Option 1 (1,000-foot Vessels) (May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.5)*	4.3				4.3
Bank Cuts & Deepening (2.5, 3.4)	3.2	15.7	19.4		38.3
Building Demolition (3.4)		1.1	.1		1.2
Conveyors (6.1)			17.3		17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 5.1)		1.1	.3		1.4
Subtotal Direct Costs	7.5	17.9	37.1		62.5
& Overhead & Profit ent					9.4
Subtotal					71.9
Contingency @ 15 percent					10.8
Subtotal					82.7
Engineering & Design, Supervision & Admin. @ 15 percent					12.4
Subtotal					95.1
Land (3.4, 4.3, 5.1)		3.4	1.7	4.0	4.0
Total Navigation Costs					99.1

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 48 - Apportionment of Total Project Cost for Alternative 5, Option 1 (1,000-Footer)[1/]

Item	Federal	Cost (in Millions)			Total Project Costs
		General Features	Single User Features[2/]	Total Non-Federal	
Bridges					
Breakwaters	4.3				4.3
Bank Cuts & Deepening	28.6		9.7	9.7	38.3
Building Demolition		1.1	0.1	1.2	1.2
Conveyors			17.3	17.3	17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		1.1	0.3	1.4	1.4
Subtotal	32.9	2.2	27.4	29.6	62.5
Contractor's Overhead & Profit @ 15 percent	5.0	0.3	4.1	4.4	9.4
Subtotal	37.9	2.5	31.5	34.0	71.9
Contingency @ 15 percent	5.7	0.4	4.7	5.1	10.8
Subtotal	43.6	2.9	36.2	39.1	82.7
Engineering & Design, Supervision & Admin. @ 15 percent	6.5	0.5	5.4	5.9	12.4
Subtotal	50.1	3.4	41.6	45.0	95.1
Lands	0.0	1.9	2.1	4.0	4.0
Total	50.1	5.3	43.7	49.0	99.1

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Table 49 - Estimated Investment Cost and Annual Charges For Alternative 5, Option 1[1/]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	95.1
Interest During Construction	7.0
Lands	4.0
Total Investment, Including Lands	106.1
ANNUAL CHARGES FOR THE PROJECT	
Interest	7.8
Amortization	0.2
Operation and Maintenance	0.5
Future Replacements[2/]	0.3
Total Annual Charge	8.8
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	50.1
Interest During Construction	3.7
Total Investment	53.8
ANNUAL CHARGES	
Interest	4.0
Amortization	0.1
Maintenance	0.5
Total Annual Charges	4.6
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	45.0
Interest During Construction	3.3
Lands	4.0
Total Investment Including Lands	52.3
ANNUAL CHARGES	
Interest	3.8
Amortization	0.1
Maintenance	0.0
Future Replacements[2/]	0.3
Total Annual Charges	4.2

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B-46.

Economic Evaluation of Alternative 5 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 5 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, and (2) future vessel launching costs avoided. From Table 47 in Appendix B, the total average annual benefit for Alternative 5 is $15,900,000. The net benefit is $7,100,000 and the B/C ratio is 1.80. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 50 below.

Table 50 - Summary of Benefits and Costs for Alternative 5, Option 1 (1,000-Footer)

	Average Annual Charges	Average Annual Benefits	Net Average Annual Benefits	Benefit/Cost Ratio
	($ million/yr.)	($ million/yr.)	($ million/yr.)	
Total Project	8.8	15.9	7.1	1.80

Environmental Features/Assessment of Plan 5 - This alternative, the first of the "navigation to the Lower Turning Basin" concepts, features a new channel through Riverside Park, Outer Harbor navigation improvements including the Inner Harbor Breakwater to protect the small-boat marina, and channel enlargement all as discussed in Alternatives 1-4. Channel enlargement, however, would only be to below the 21st Street bridge.

Enlarging the east bank at the Lower Turning Basin would provide easier turning maneuverability for the larger vessels negotiating a 180° turn to head downriver.

The amount of land in acres that would be converted to aquatic habitat via bank cuts under this alternative is as follows.

Bank Cut	Option 1	Option 2
(Riverside Park) A	5.40	6.88
C-2	15.27	15.84
C-1	5.20	5.20
D	12.51	12.51
E-1	6.54	16.39
E-2	10.79	16.39

A transshipment facility would provide adequate berthing for the vessel sizes under study, temporary onshore storage of material in open stockpiles and a transportation system for moving the material upriver. This alternative would provide for direct shipment to 21st Street and transshipment by conveyor to the steel plant.

The site chosen for the transshipment facility is presently owned by the N&W Railroad. Since this is commercial/industrial land, no major impact is expected. There would be noise and dust associated with construction and operation of the facility as well as the unsightliness of the cargo stockpiles; however, in an industrial area such as this, these impacts should be negligible.

The impacts of the conveyor system should also be minimal due to its short length (4,000 feet) and its location in an industrial section of the city. The conveyor would begin on N&W Railroad property, cross the river and terminate on U.S. Steel property. Impacts would probably be limited to noise and dust, however, the land would be used more intensively. Direct shipment to 21st Street in Class X vessels and transshipping to U.S. Steel would conserve vessel fuel oil. Since the conveyor would be above ground, it may have a negative aesthetic impact, especially where it crosses the river.

Evaluation of Alternative 5 - Alternative 5 fulfills the planning objective of improving Lorain Harbor for navigation by Class X vessels and the annual benefits exceed the average annual cost (B/C > 1). However, under the criteria set forth in the "Digest of Water Resources Policies and Authorities" EP 1165-2-1, 28 September 1979, paragraph 5-8d states that project optimization occurs when "the level of resource use best satisfies all constraints while maximizing net benefits and assuring efficient project operation." Other alternatives in this study assure an efficient project operation as well as Alternative 5 and also have higher net benefits. This alternative is a higher cost alternative than other alternatives studied. It also disrupts existing conditions to a greater extent. Therefore it is concluded that Alternative 5 should not be considered further.

ALTERNATIVE 6 (PARTIAL TRANSSHIPMENT WITH NEW HIGH-LEVEL ERIE AVENUE BRIDGE)

Description of Alternative 6 - This alternative would be the same as Alternative 2 except for constructing a transshipment facility (construction Item J) and conveyor (Item K) at the 21st Street Bridge instead of enlarging the Upper Turning Basin (Item H) and replacing the 21st Street Bridge (Item I). Also included in this alternative are the same channel enlargement cuts, excluding the Riverside Park cut; improvements to the Lower Turning Basin and transshipment conveyor facility as in Alternative 5. Construction items included in this alternative are shown on Plate 12.

Cost Estimate for Alternative 6 - The detailed cost estimate for Alternative 6 is presented in Table 51. The apportionment of costs to Federal and non-Federal interests is shown in Table 52. Table 53 shows the estimated annual project costs and annual charges and provides a breakdown of the Federal and non-Federal share of the costs for Alternative 6. From these tabulations, it is seen that the total project cost including land acquisition is $149.0 million (Table 52); the total investment cost, including interest during construction is $164.5 million (Table 53); and the total annual charges are $13.6 million (Table 53).

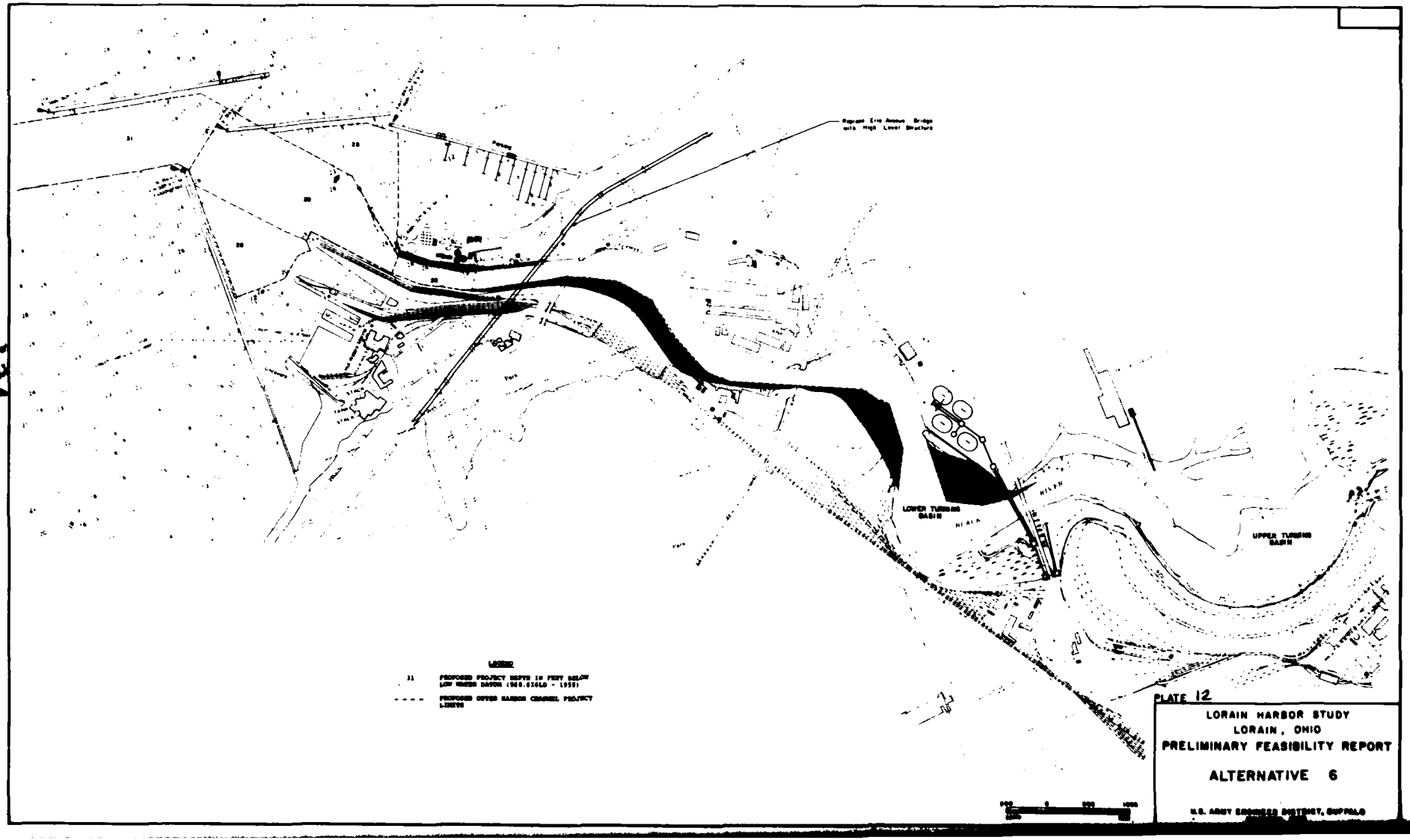

PLATE 12

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 6

U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 51 - Estimate of Navigation Project Costs for
Alternative 6, Option 1 (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges (4.1)*		35.6			35.6
Breakwaters (2.4)	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.1	12.9	19.5		35.5
Building Demolition (3.4)		0.0	.1		0.1
Conveyors (6.1)			17.3		17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 4.1, 6.1)		.8	.2		1.0
Subtotal Direct Costs	5.9	49.3	37.1		92.3
Contractor's Overhead & Profit @ 15 percent					13.8
Subtotal					106.1
Contingency @ 15 percent					15.9
Subtotal					122.0
Engineering & Design, Supervision & Admin. @ 15 percent					18.3
Subtotal					140.3
Land (3.4, 4.3, 5.1)		6.6	2.1		8.7
Total Navigation Costs					149.0

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 52 - Apportionment of Total Project Cost for Alternative 6, Option 1 (1,000-Footer)1/

Item	Federal	Cost (in Millions) General Features	Single User Features2/	Total Non-Federal	Total Project Costs
Bridges	35.6				35.6
Breakwaters	2.8				2.8
Bank Cuts & Deepening	25.8		9.7	9.7	35.5
Building Demolition			0.1	0.1	0.1
Conveyors			17.3	17.3	17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		0.7	0.3	1.0	1.0
Subtotal	64.2	0.7	27.4	28.1	92.3
Contractor's Overhead & Profit @ 15 percent	9.6	0.1	4.1	4.2	13.8
Subtotal	73.8	0.8	31.5	32.3	106.1
Contingency @ 15 percent	11.1	0.1	4.7	4.8	15.9
Subtotal	84.9	0.9	36.2	37.1	122.0
Engineering & Design, Supervision & Admin. @ 15 percent	12.8	0.1	5.4	5.5	18.3
Subtotal	97.7	1.0	41.6	42.6	140.3
Lands	0.0	6.6	2.1	8.7	8.7
Total	97.7	7.6	43.7	51.3	149.0

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Table 53 - Estimated Investment Cost and Annual Charges
For Alternative 6, Option 1[1]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	140.3
Interest During Construction	15.5
Lands	8.7
Total Investment, Including Lands	164.5
ANNUAL CHARGES FOR THE PROJECT	
Interest	12.1
Amortization	0.3
Operation and Maintenance	0.9
Future Replacements[2]	0.3
Total Annual Charge	13.6
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	97.7
Interest During Construction	10.8
Total Investment	108.5
ANNUAL CHARGES	
Interest	8.0
Amortization	0.2
Maintenance	0.5
Total Annual Charges	8.7
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	42.6
Interest During Construction	4.7
Lands	8.7
Total Investment Including Lands	56.0
ANNUAL CHARGES	
Interest	4.1
Amortization	0.1
Maintenance	0.4
Future Replacements[2]	0.3
Total Annual Charges	4.9

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B46.

Economic Evaluation of Alternative 6 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 6 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, (2) future vessel launching costs avoided, and (3) advance replacements. From Table B47 in Appendix B, the total average annual benefit for Alternative 6 is $16,000,000. The net benefit is $2,400,000 and the B/C ratio is 1.18. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 54 below.

Table 54 - Summary of Benefits and Costs for Alternative 6, Option 1 (1,000-Footer)

	Average Annual Charges	Average Annual Benefits	Net Average Annual Benefits	Benefit/Cost Ratio
	($ million/yr.)	($ million/yr.)	($ million/yr.)	
Total Project	13.6	16.0	2.4	1.18

Environmental Features/Assessment of Plan 6 - The features of this alternative have been previously discussed as follows:

Enlarge or Reorient Outer Harbor Entrance	- Alternative 1
Replace Erie Avenue Bridge with a Higher Structure	- Alternative 2
Enlarge Channel	- Alternative 1
Enlarge Lower Turning Basin	- Alternative 5
Construct Conveyor Transfer Facility Below 21st Street	- Alternative 5
Construct Conveyor System Upriver from 21st Street	- Alternative 5

Evaluation of Alternative 6 - Alternative 6 fulfills the planning objective of improving Lorain Harbor for navigation by Class X vessels and the annual benefits exceed the average annual cost (B/C > 1); however, under the criteria set forth in the "Digest of Water Resources Policies and Authorities" EP 1165-2-1, 28 September 1979, paragraph 5-8d states that project optimization occurs when "the level of resource use best satisfies all constraints while maximizing net benefits and assuring efficient project operation." Other alternatives studied also provide an efficient project operation and have significantly higher net benefits. Alternative 6 is also a higher cost alternative than other alternatives studied, and it also disrupts existing conditions to a greater extent than others. Therefore it is concluded that Alternative 6 should be considered further.

ALTERNATIVE 7 (PARTIAL TRANSSHIPMENT WITH NEW MOVABLE ERIE AVENUE BRIDGE)

Description of Alternative 7 - This alternative would be identical to Alternative 6 in all ways except that the Erie Avenue Bridge would be

replaced with a movable bridge. This bridge would have the same features as the new Erie Avenue Bridge described in Alternative 3. Construction items included in this alternative are shown in Plate 13.

Cost Estimate for Alternative 7 - The detailed cost estimate for Alternative 7 is presented in Table 55. The apportionment of costs to Federal and non-Federal interests is shown in Table 56. Table 57 shows the estimated annual project costs and annual charges and provides a breakdown of the Federal and non-Federal share of the costs for Alternative 7. From these tabulations, it is seen that the total project cost including land acquisition is $120.0 million (Table 56); the total investment cost, including interest during construction is $132.7 million (Table 57); and the total annual charges are $11.1 million (Table 57).

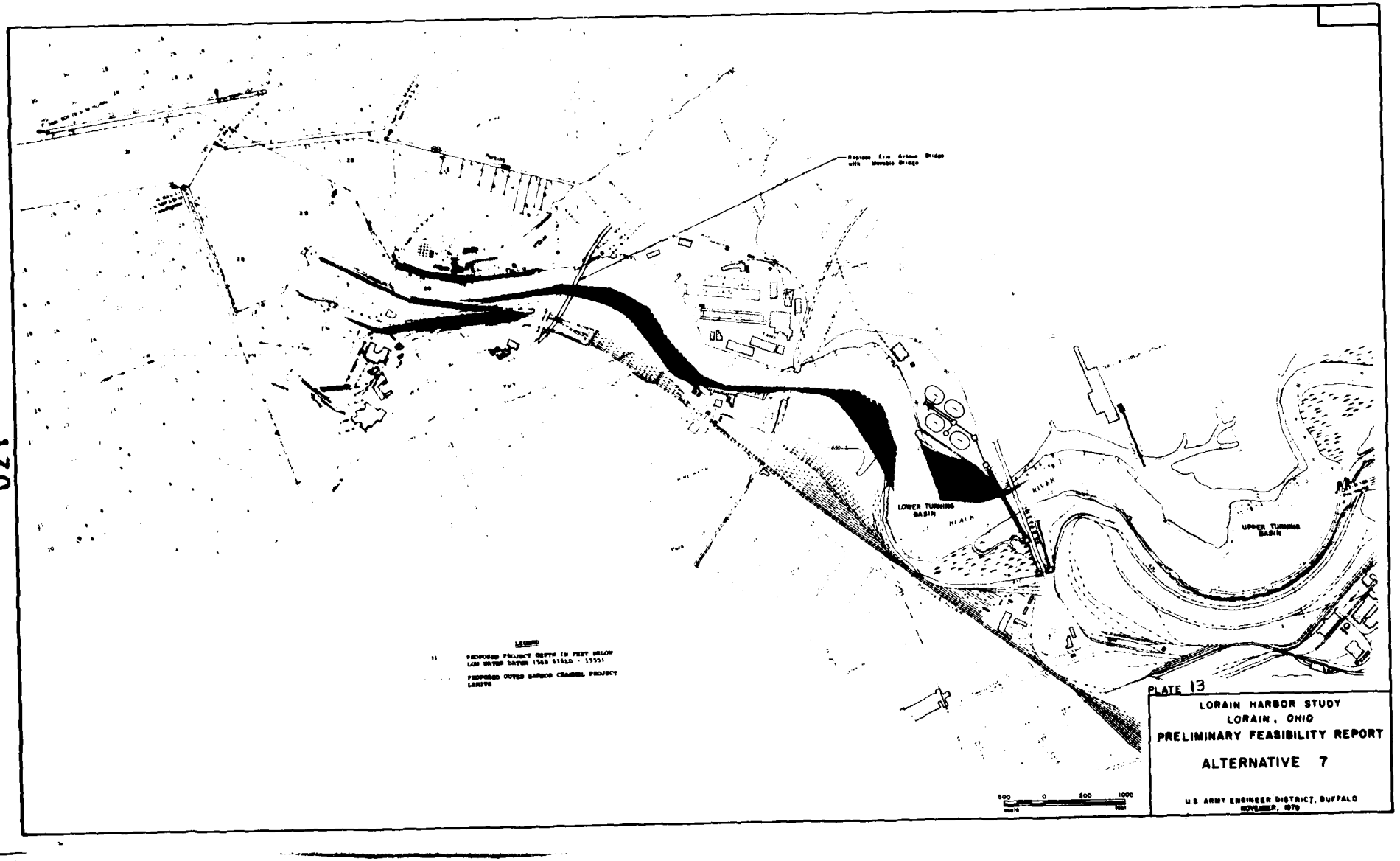
Replace Erie Avenue Bridge with Movable Bridge
LOWER TURNING BASIN
UPPER TURNING BASIN
RIVER
LEGEND
PROPOSED PROJECT DEPTH IN FEET BELOW LOW WATER DATUM (560.61MLD - 1955)
PROPOSED OUTER HARBOR CHANNEL PROJECT LIMITS
500 0 500 1000
PLATE 13
LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 7
U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER, 1979

Table 55 - Estimate of Navigation Project Costs for
Alternative 7, Option 1 (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges (4.2)*		18.9			18.9
Breakwaters (2.4)	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.1	12.9	19.5		35.5
Building Demolition (3.4)		0.0	.1		0.1
Conveyors (6.1)			17.3		17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 4.2, 6.1)		.4	.3		0.7
Subtotal Direct Costs	5.9	32.2	37.2		75.3
Contractor's Overhead & Profit @ 15 percent					11.3
Subtotal					86.6
Contingency @ 15 percent					13.0
Subtotal					99.6
Engineering & Design, Supervision & Admin. @ 15 percent					14.9
Subtotal					114.5
Land (3.4, 4.2, 6.1)		6.6	2.1		5.5
Total Navigation Costs					120.0

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 56 - Apportionment of Total Project Cost for Alternative 7, Option 1 (1,000-Footer)[1/]

Item	Federal	Cost (in Millions) General Features	Single User Features[2/]	Total Non-Federal	Total Project Costs
Bridges	18.9				18.9
Breakwaters	2.8				2.8
Bank Cuts & Deepening	25.8		9.7	9.7	35.5
Building Demolition			0.1	0.1	0.1
Conveyors			17.3	17.3	17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		0.4	0.3	0.7	0.7
Subtotal	47.5	0.4	27.4	27.8	75.3
Contractor's Overhead & Profit @ 15 percent	7.1	0.1	4.1	4.2	11.3
Subtotal	54.6	0.5	31.5	32.0	86.6
Contingency @ 15 percent	8.2	0.1	4.7	4.8	13.0
Subtotal	62.8	0.6	36.2	36.8	99.6
Engineering & Design, Supervision & Admin. @ 15 percent	9.4	0.1	5.4	5.5	14.9
Subtotal	72.2	0.7	41.6	42.3	114.5
Lands	0.0	3.4	2.1	5.5	5.5
Total	72.7	4.1	43.7	47.8	120.0

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Table 57 - Estimated Investment Cost and Annual Charges
For Alternative 7, Option 1[1/]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	114.5
Interest During Construction	12.7
Lands	5.5
Total Investment, Including Lands	132.7
ANNUAL CHARGES FOR THE PROJECT	
Interest	9.8
Amortization	0.3
Operation and Maintenance	0.7
Future Replacements[2/]	0.3
Total Annual Charge	11.1
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	72.2
Interest During Construction	8.0
Total Investment	80.2
ANNUAL CHARGES	
Interest	5.9
Amortization	0.2
Maintenance	0.5
Total Annual Charges	6.6
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	42.3
Interest During Construction	4.7
Lands	5.5
Total Investment Including Lands	52.5
ANNUAL CHARGES	
Interest	3.9
Amortization	0.1
Maintenance	0.2
Future Replacements[2/]	0.3
Total Annual Charges	4.5

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B46.

Economic Evaluation of Alternative 7 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 7 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, (2) future vessel launching costs avoided, and (3) advance replacements. From Table B47 in Appendix B, the total average annual benefit for Alternative 7 is $16,000,000. The net benefit is $4,900,000 and the B/C ratio is 1.44. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 58 below.

Table 58 - Summary of Benefits and Costs for Alternative 7

	Average Annual Charges	Average Annual Benefits	Net Average Annual Benefits	Benefit/Cost Ratio
	($ million/yr.)	($ million/yr.)	($ million/yr.)	
Total Project	11.1	16.0	4.9	1.44

Environmental Features/Assessment of Plan 7 - The environmental effects of Alternative 7 would be identical to Alternative 6, except the Erie Avenue Bridge (construction Item C for Alternative 6) would be replaced with a new movable bridge (construction Item D). The impacts for the movable bridge were previously discussed for Alternative 3.

Evaluation of Alternative 7 - Alternative 7 fulfills the planning objective of improving Lorain Harbor for navigation by Class X vessels and the average annual benefits exceed the average annual costs (B/C > 1); however, under the criteria set forth in the "Digest of Water Resources Policies and Authorities" EP 1165-2-1, 28 September 1979, paragraph 5-8d states that project optimization occurs when "the level of resource use best satisfies all constraints while maximizing net benefits and assuring efficient project operation." Since other alternatives studied meet the navigation objective, assure an efficient project operation, are less costly to construct than Alternative 7, have significantly higher net benefits, and are less disruptive to the community, Alternative 7 will not be considered further.

ALTERNATIVE 8 (PARTIAL TRANSSHIPMENT WITH TUNNEL REPLACEMENT OF ERIE AVENUE BRIDGE)

Description of Alternative 8 - This alternative is identical to Alternatives 6 and 7 except that the Erie Avenue Bridge would be replaced with a tunnel under the Black River (construction Item E). The tunnel would have the same features as the tunnel described in Alternative 4. Construction items included in this alternative are shown in Plate 14.

Cost Estimate for Alternative 8 - The detailed cost estimate for Alternative 8 is presented in Table 59. The apportionment of costs to Federal and non-Federal interests is shown in Table 60. Table 61 summarizes the estimated annual project costs and annual charges and provides a breakdown of the Federal and non-Federal share of the costs for Alternative 8. From these tabulations, it is seen that the total project cost including land acquisition is $183.5 million (Table 60); the total investment cost, including interest during construction is $196.5 million (Table 61); and the total annual charges are $16.4 million (Table 61).

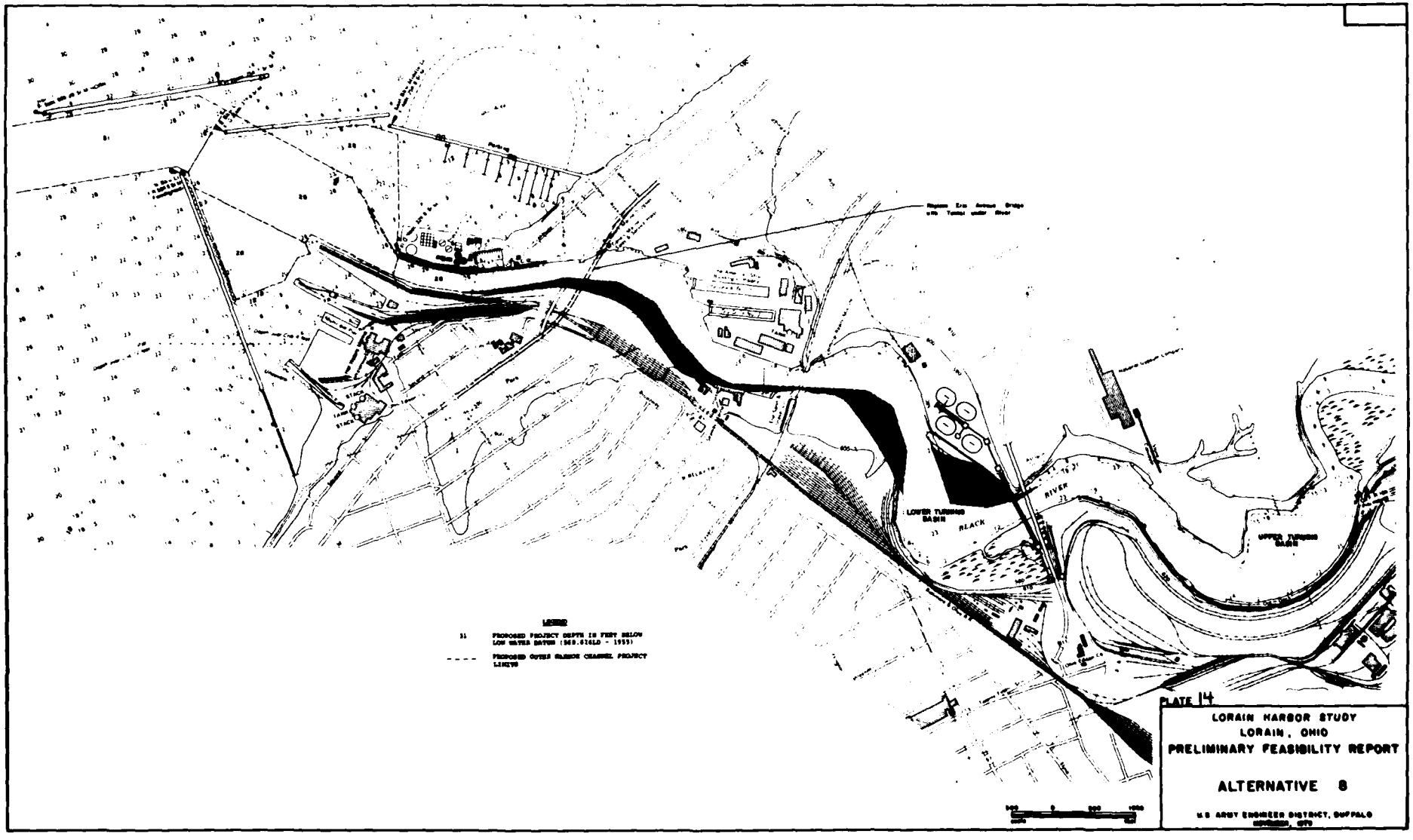

PLATE 14

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 8

U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 59 - Estimate of Navigation Project Costs for
Alternative 8, Option 1 (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amahip	Amahip to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.4)*	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.1	12.9	19.5		35.5
Building Demolition (3.4)		0.0	.1		0.1
Conveyors (6.1)			17.3		17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel (5.1)		58.8			58.8
Utilities (3.4, 4.2, 6.1)		1.4	0.3		1.7
Subtotal Direct Costs	5.9	73.1	37.2		116.2
Contractor's Overhead & Profit @ 15 percent					17.4
Subtotal					133.6
Contingency @ 15 percent					20.0
Subtotal					153.6
Engineering & Design, Supervision & Admin. @ 15 percent					23.0
Subtotal					176.6
Land (3.4, 4.2, 6.1)		6.6	2.1		6.9
Total Navigation Costs					183.5

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 61 - Estimated Investment Cost and Annual Charges
For Alternative 8, Option 1[1/]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	176.6
Interest During Construction	13.0
Lands	6.9
Total Investment, Including Lands	196.5
ANNUAL CHARGES FOR THE PROJECT	
Interest	14.5
Amortization	0.4
Operation and Maintenance	1.2
Future Replacements[2/]	0.3
Total Annual Charge	16.4
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	132.9
Interest During Construction	9.8
Total Investment	142.7
ANNUAL CHARGES	
Interest	10.5
Amortization	0.3
Maintenance	0.5
Total Annual Charges	11.3
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	43.7
Interest During Construction	3.2
Lands	6.9
Total Investment Including Lands	53.8
ANNUAL CHARGES	
Interest	4.0
Amortization	0.1
Maintenance	0.7
Future Replacements[2/]	0.3
Total Annual Charges	5.1

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B-40.

Table 60 - Apportionment of Total Project Cost for Alternative 8, Option 1 (1,000-Footer)[1/]

Item	Federal	Cost (in Millions) General Features	Single User Features[2/]	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	2.8				2.8
Bank Cuts & Deepening	25.8		9.7	9.7	35.5
Building Demolition			0.1	0.1	0.1
Conveyors			17.3	17.3	17.3
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel	58.8				58.8
Utilities		1.4	0.3	1.7	1.7
Subtotal	87.4	1.4	27.4	27.8	116.2
Contractor's Overhead & Profit @ 15 percent	13.1	0.2	4.1	4.3	17.4
Subtotal	100.5	1.6	31.5	33.1	133.6
Contingency @ 15 percent	15.1	0.2	4.7	4.9	20.0
Subtotal	115.6	1.8	36.2	38.0	153.6
Engineering & Design, Supervision & Admin. @ 15 percent	17.3	0.3	5.4	5.7	23.0
Subtotal	132.9	2.1	41.6	43.7	176.6
Lands	0.0	4.8	2.1	6.9	6.9
Total	132.9	6.9	43.7	50.6	183.5

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1,000-foot vessels. Therefore, costs of all improvements upstream of AmShip would be cost shared 50 percent Federal and 50 percent non-Federal.

Economic Evaluation of Alternative 8 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 8 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, (2) future vessel launching costs avoided, and (3) advance replacements. From Table B47 in Appendix B, the total average annual benefit for Alternative 7 is $16,700,000. The net benefit is $300,000 and the B/C ratio is 1.02. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 62 below.

Table 62 - Summary of Benefits and Costs for Alternative 8, Option 1 (1,000-Footer)

	Average Annual Charges	Average Annual Benefits	Net Average Annual Benefits	Benefit/Cost Ratio
	($ million/yr.)	($ million/yr.)	($ million/yr.)	
Total Project	16.4	16.1	.03	0.98

Environmental Features/Assessment of Plan 8 - The features of this alternative have been previously discussed as follows:

Enlarge or Reorient Outer Harbor Entrance	- Alternative 1
Replace Erie Avenue Bridge with Tunnel under River	- Alternative 4
Enlarge Channel	- Alternative 1
Enlarge Lower Turning Basin	- Alternative 5
Construct Conveyor Transfer Facility Below 21st Street	- Alternative 5
Construct Conveyor System Upriver from 21st Street	- Alternative 5

Evaluation of Alternative 8 - Alternative 8 fulfills the planning objective of improving Lorain Harbor for navigation by Class X vessels. However, the annual benefits do not exceed the average annual costs. It is the policy of the Corps of Engineers not to recommend projects for implementation where costs for the project exceed the benefits that would be realized unless there are overriding considerations of environmental quality or social impacts warranting a departure from economic decisions. Alternative 8 does not exhibit any such overriding considerations. Therefore since Alternative 8 does not exhibit economic efficiency, it cannot be recommended for implementation.

INTRODUCTION TO "TRANSSHIPMENT FROM LAKEFRONT" ALTERNATIVES

The preceding eight alternatives would provide for movement of iron ore in 1,000-foot vessels directly to the U.S. Steel plant on the Black River (Alternatives 1 through 4) or upriver to the 21st Street Bridge in 1,000-footers and transshipment therefrom to the U.S. Steel plant

(Alternatives 5 through 8). As was shown during the discussion of these eight alternatives, navigation improvements on the Black River would be very expensive and not highly cost effective.

In an attempt to reduce the project first costs, a range of alternatives that would provide direct shipment to the lakefront harbor in 1,000-foot vessels and transshipment upriver by various modes were also evaluated as part of this Stage 2 study. Four of these alternatives (Alternatives 9 through 12) would provide improvement to the harbor entrance and delivery of iron ore from a lakefront transshipment facility to the U.S. Steel plant by conveyor, special service vessel, train, or truck for Alternatives 9 through 12, respectively. Alternatives 13 through 16 would incorporate the same features as Alternatives 9 through 12, and would also include improvements at the mouth of the Black River to Erie Avenue Bridge for 1,000-footers at the AmShip facility. Alternatives 9 through 16 are discussed below.

ALTERNATIVE 9 (LAKEFRONT TRANSSHIPMENT - CONVEYOR UPRIVER)

Description of Alternative 9 - This is the first of several alternatives that would provide for movement of iron ore upriver to the U.S. Steel plant from a transshipment facility capable of accommodating 1,000-foot vessels, located immediately westerly of the mouth of the Black River. This alternative would improve harbor entrance conditions to permit safe and efficient operation of 1,000-foot vessels to the lakefront, and provide a transshipment facility for delivery of iron ore to U.S. Steel by conveyor. Construction items included in this alternative are shown on Plate 14a earlier in this section.

Lakefront navigation improvements would include maintaining the existing river channel entrance, removing a 600-foot section of the East Breakwater and lengthening by 600 feet the Outer Breakwater (construction Item A). The Outer Harbor area would be deepened by approximately 3 feet.

This alternative would use an existing but inactive coal slip for the berthing area for the transshipment facility. This area of the Outer Harbor is sufficient to accommodate the transshipment facility for Alternative 9 and the Lakefront transshipment facility recently constructed by Republic Steel Corporation that serves its Cleveland and hinterland plants. The east pier of the coal slip, selected as the wharf for the proposed transshipment facility (construction Item L) would require renovation and structural modifications to render it suitable for a docking facility. The coal slip area would also require dredging to enable berthing of 1,000-foot vessels. For this alternative, a conveyor system would be used to transport the off-loaded iron ore upriver to the U.S. Steel Plant (construction Item M). The system would be fed by a dock hopper constructed on the east pier which would receive the shipments and direct the material flow to a transfer station for subsequent routing to a storage area or direct movement upriver. Approximately 1,500 lineal feet of tunnel construction would be required to bypass Republic's pellet storage piles and an additional 30 lineal feet of tunnel would be necessary to pass a below-grade rail crossing. The conveyor system would meander upriver, pass beneath the approach ramp to the 21st Street Bridge and terminate at U.S. Steel. Elevated structures would be

required to bridge East Ninth Street and the N&W Railroad tracks. The conveyor would be enclosed for safety and to diminish noise and air pollution. Dust collection systems would be provided at transfer points.

Cost Estimate for Alternative 9 - The summary cost estimate of principal project features for Alternative 9 is presented in Table 63. Table 64 shows the apportionment of costs to Federal and non-Federal interests and Table 65 presents a summary of the annual charges for Alternative 9. From these tabulations, it is seen that the total project cost including land acquisition is $60.2 million (Table 64); the total investment cost, including interest during construction is $64.5 million (Table 65); and the total annual charges are $5.7 million (Table 65).

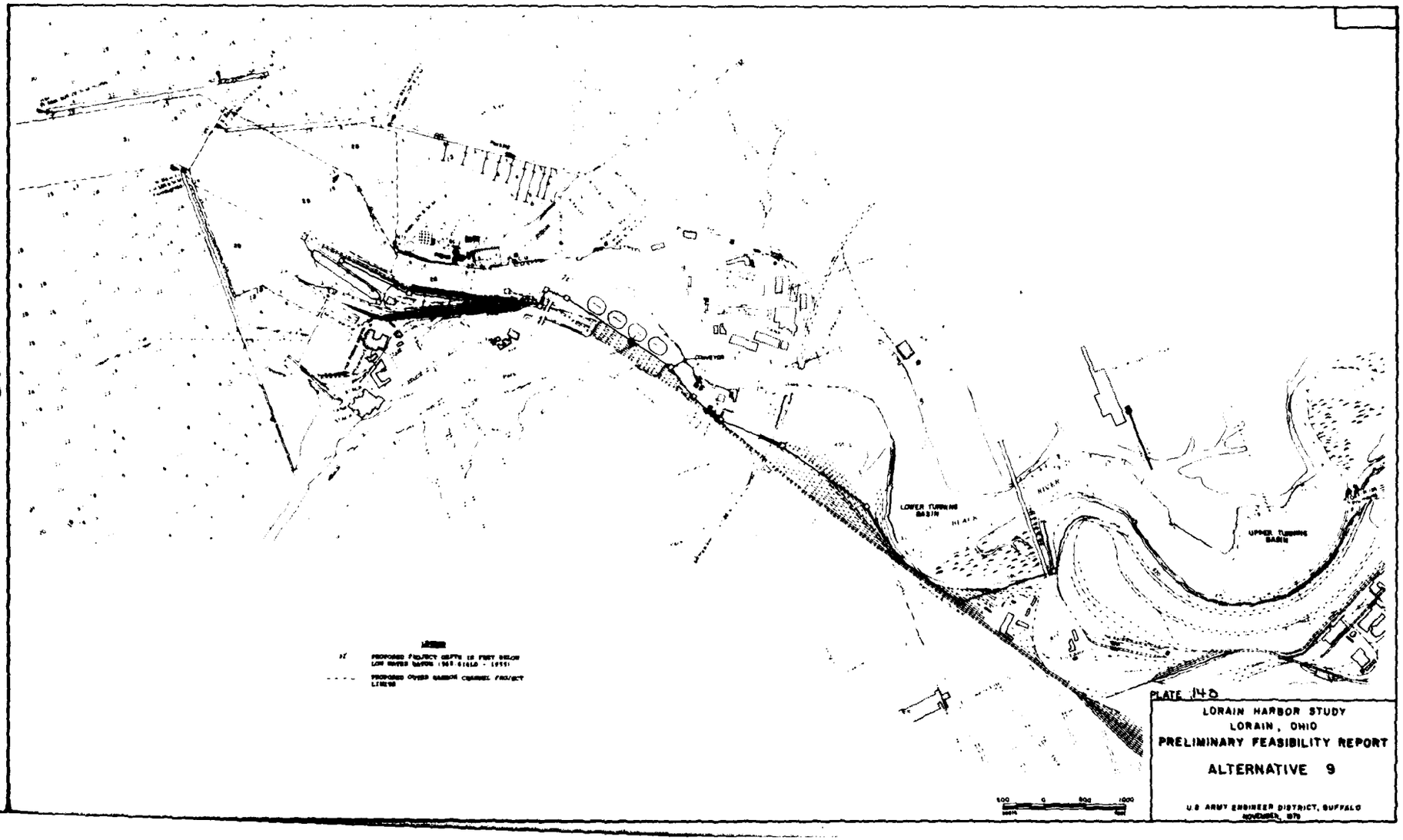

PLATE 140

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 9

U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER, 1979

Table 63 - Estimate of Navigation Project Costs for Alternative 9, Option 1 (1,000-foot Vessels) (May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.4)*	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.1	.5			3.6
Building Demolition					
Conveyors (6.2)		7.7	24.4		32.1
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (6.2)			0.3		0.3
Subtotal Direct Costs	5.9	8.2	24.7		38.8
Contractor's Overhead & Profit @ 15 percent					5.8
Subtotal					44.6
Contingency @ 15 percent					6.7
Subtotal					51.3
Engineering & Design, Supervision & Admin. @ 15 percent					7.7
Subtotal					59.0
Land (3.4, 4.2, 6.1)		6.6	2.1		1.2
Total Navigation Costs					60.2

*( ) Indicates Table in Appendix A detailing these costs at February 1979 price levels.

Table 64 - Apportionment of Total Project Cost for Alternative 9, Option 1 (1,000-Footer)[1/]

Item	Costs in Millions		Total Project Costs
	Federal	Non-Federal[2/]	
Bridges			
Breakwaters	2.8		2.8
Bank Cuts & Deepening	3.6		3.6
Building Demolition			
Conveyors		32.1	32.1
Rail Facility & Improvements			
Special Purpose Vessel & Facility			
Truck Transfer Facility & Roadway			
Tunnel			
Utilities		0.3	0.3
Subtotal	6.4	32.4	38.8
Contractor's Overhead & Profit @ 15 percent	1.0	4.8	5.8
Subtotal	7.4	37.2	44.6
Contingency @ 15 percent	1.1	5.6	6.7
Subtotal	8.5	42.8	51.3
Engineering & Design, Supervision & Admin. @ 15 percent	1.3	6.4	7.7
Subtotal	9.8	49.2	59.0
Lands	0.0	1.2	1.2
Total Project Cost	9.8	50.4	60.2

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.
2/ Costs for transshipment facility.

Table 65 - Estimated Investment Cost and Annual Charges
For Alternative 9, Option 1[1/]

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	59.0
Interest During Construction	4.3
Lands	1.2
Total Investment, Including Lands	64.5
ANNUAL CHARGES FOR THE PROJECT	
Interest	4.8
Amortization	0.1
Operation and Maintenance	0.3
Future Replacements[2/]	0.5
Total Annual Charge	5.7
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	9.8
Interest During Construction	0.7
Total Investment	10.5
ANNUAL CHARGES	
Interest	0.8
Amortization	0.0
Maintenance	0.3
Total Annual Charges	1.1
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	49.2
Interest During Construction	3.6
Lands	1.2
Total Investment Including Lands	54.0
ANNUAL CHARGES	
Interest	4.0
Amortization	0.1
Maintenance	0.0
Future Replacements[2/]	0.5
Total Annual Charges	4.6

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table 846.

Economic Evaluation of Alternative 9 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 9 is presented in Appendix B - Economic Evaluation. The only benefit category applicable to this alternative is iron ore transportation savings. From Table B47 in Appendix B, the total average annual benefit for Alternative 9 is $15,800,000. The net benefit is $10,100,000 and the B/C ratio is 2.78. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 66 below.

Table 66 - Summary of Benefits and Costs for Alternative 9, Option 1 (1,000-Footer)

	Average Annual Charges ($ million/yr.)	Average Annual Benefits ($ million/yr.)	Net Average Annual Benefits ($ million/yr.)	Benefit/Cost Ratio
Total Project	5.7	15.8	10.1	2.78

Environmental Features/Assessment of Plan 9 - With this alternative, the Outer Harbor would be improved as discussed in Alternative 1.

This is the first of the alternatives which would provide for navigation to the lakefront and transshipment upriver to U.S. Steel. These alternatives would result in a minimal saving of fuel oil, since vessels would not have to make their way up the 3-mile river channel to U.S. Steel.

A lakefront transshipment facility has been built by Republic Steel Corporation and serves as a Taconite terminal in Lorain Harbor at the mouth of the Black River. The conveyor system meandering upriver to U.S. Steel from the coal dock immediately west of the mouth of the Black River would pass through primarily commercial and industrial land; therefore, environmental impacts would be minimal. The conveyor would require elevated structures to bridge across East 9th Street and to bridge over the N&W Railroad tracks. This could create a negative aesthetic impact, since the conveyor would be in plain view. At ground level, the conveyor would be enclosed by a prefabricated metal building for safety and to diminish noise and air pollution. Dust collection systems would be provided at each transfer point.

Evaluation of Alternative 9 - Alternative 9 is the first of the lakefront transshipment alternatives. It involves the construction of a lakefront transshipment facility and an upriver conveyor system. This alternative has the second highest net benefits ($10,100,000) and the second best benefit-to-cost ratio (2.78) of any of the alternatives.

Construction of a transshipment facility and any means of upriver transshipment would be the responsibility of local interests. Therefore, this report does not attempt to determine what upriver transshipment mode should be utilized. The analysis performed does show lakefront transshipment to be the

most economically efficient concept (maximum net benefits and greatest B/C ratios), and the four transshipment alternatives investigated (Alternatives 9-12) all appear to be environmentally, financially, and institutionally feasible. Which of those four alternatives that should be considered in greater detail in Stage 3 will be discussed with local officials and industry representatives at a workshop to be held at the start of Stage 3.

This alternative would require the acquisition of land or rights-of-way for the conveyor for the 3-mile length of the Black River. It would also require modifications to U.S. Steel's present method of receipt of iron ore.

It is concluded that Alternative 9 warrants further consideration as the selected plan for commercial navigation improvements, contingent upon the expressed desire of local interests. Therefore, Alternative 9 will be presented, along with Alternatives 10, 11, and 12, to workshop participants as one of the possible alternatives to be investigated in greater detail in Stage 3. If local interests desire further consideration of Alternative 9, it will be carried into Stage 3.

ALTERNATIVE 10 (LAKEFRONT TRANSSHIPMENT - VESSEL UPRIVER)

Description of Alternative 10 - This alternative would be identical to Alternative 9 in all ways but one. In lieu of the conveyor system (construction Item M), an upriver special purpose vessel facility would be constructed (construction Item N). The special purpose vessel would be a highly maneuverable craft suitable for river navigation as well as open-lake navigation. This self-unloading vessel would have a cargo capacity of approximately 20,000 tons. The berthing facility for this vessel would be constructed on the west bank of the Black River just upstream from Erie Avenue. A turning basin would also be constructed at this point to enable the vessel to turn around. The facility would include a ship loader which would be capable of loading the special purpose vessel at a rate of 2,500 tons per hour. Conveyors between the Lakefront transshipment area and the special purpose vessel facility would be constructed to move material. To meet the annual anticipated through-put of 8,000,000 tons of iron ore by U.S. Steel, the special purpose vessel would need to operate 16 hours per day, 6 days a week for the duration of the shipping season. Construction items included in this alternative are shown in Plate 15.

Cost Estimate for Alternative 10 - The summary cost estimate for Alternative 10 is presented in Table 67. Table 68 provides the apportionment of the project costs to Federal and non-Federal interests. The annual charges, including apportionment, are shown in Table 69. From these tabulations, it is seen that the total project cost, including land acquisition, is $51.4 million (Table 68); the total investment cost, including interest during construction is $55.0 million (Table 69); and the total annual charges are $4.9 million (Table 69).

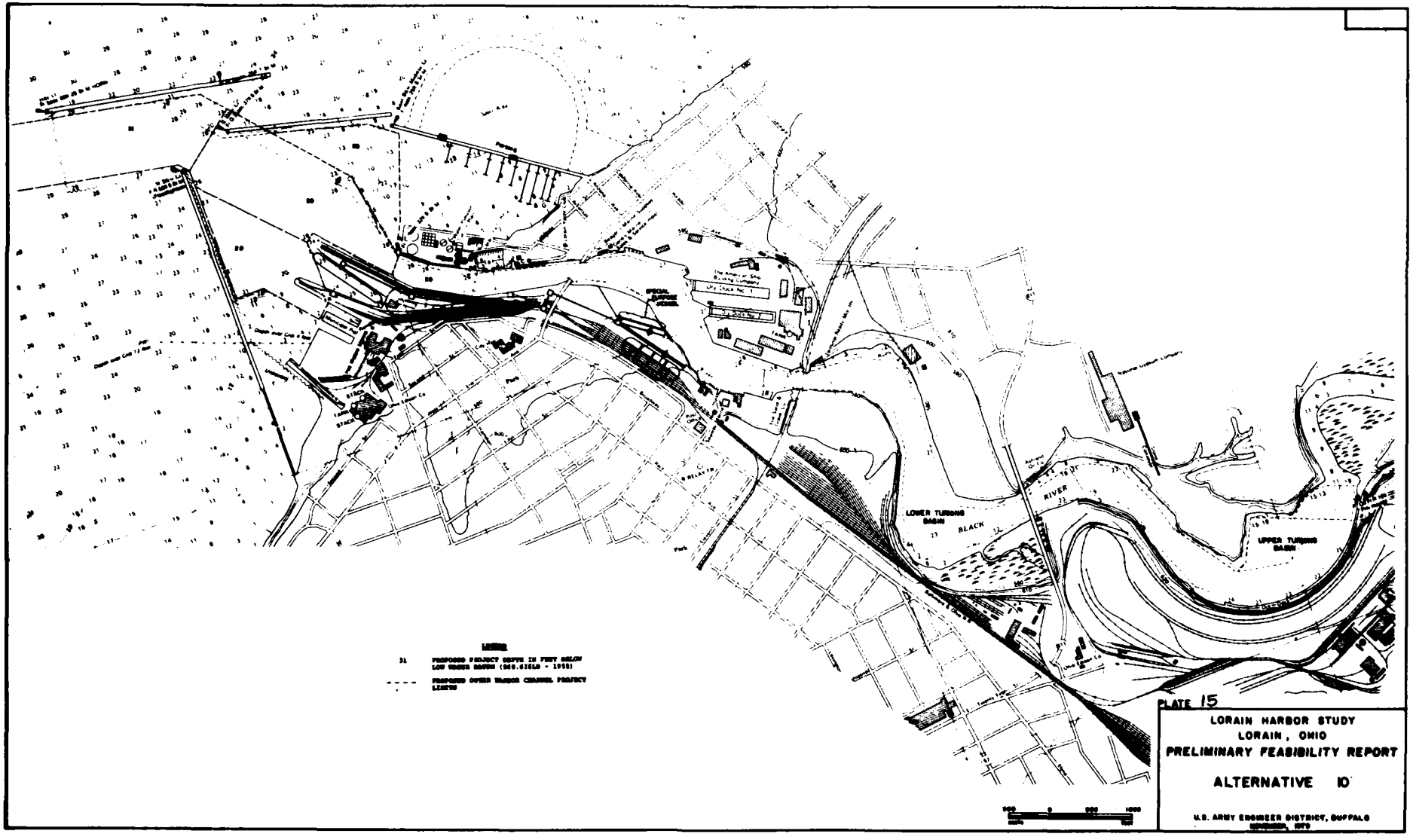

PLATE 15

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 10

U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER, 1970

Table 67 - Estimate of Navigation Project Costs
Alternative 10 Option 1/ (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.4)*	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.1	.5			3.6
Building Demolition					
Conveyors (6.3)		7.2	8.7		15.9
Rail Facility & Improvements					
Special Purpose Vessel & Facility			9.6		9.6
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 4.2, 6.1)			0.3		0.3
Subtotal Direct Costs	5.9	7.7	18.6		32.2
Contractor's Overhead & Profit @ 15 percent					4.8
Subtotal					37.0
Contingency @ 15 percent					5.6
Subtotal					42.6
Engineering & Design, Supervision & Admin. @ 15 percent					6.4
Subtotal					49.0
Land (6.3)			2.4		2.4
Total Navigation Costs					51.4

*( ) Indicates Table in previous section(s) detailing these costs.

Table 68 - Apportionment of Total Project Cost for Alternative 10, Option 1 (1,500-foot) 1/

Item	Cost (in millions				
		Non-Federal			
	Federal	General Features	Single User Features 2/	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	2.8				2.8
Bank Cuts & Deepening	3.6				3.6
Building Demolition					
Conveyors					15.9
Rail Facility & Improvements					
Special Purpose Vessel & Facility					9.6
Truck Transfer Facility & Roadway					
Tunnel					
Utilities					0.3
Subtotal	6.4				32.2
Contractor's Overhead & Profit @ 15 percent	1.0				4.8
Subtotal	7.4				37.0
Contingency @ 15 percent	1.1				5.6
Subtotal	8.5				42.6
Engineering & Design, Supervision & Admin. @ 15 percent	1.3				6.4
Subtotal	9.8				49.0
Lands	0.0				2.4
Total	9.8	0.0			51.4

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1000-foot vessels. Therefore costs of all improvements upstream of Amship would be cost-shared 50 percent Federal and 50 percent Non-Federal.

Table 69 - Estimated Investment Cost and Annual Charges
For Alternative 10 1/, Option 1 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	49.0
Interest During Construction	3.6
Lands	2.4
Total Investment, Including Lands	55.0
ANNUAL CHARGES FOR THE PROJECT	
Interest	4.1
Amortization	0.1
Operation and Maintenance	0.3
Future Replacements 2/	0.4
Total Annual Charge	4.9
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	9.8
Interest During Construction	0.7
Total Investment	10.5
ANNUAL CHARGES	
Interest	0.8
Amortization	0.0
Operation and Maintenance	0.3
Total Annual Charges	1.1
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	39.2
Interest During Construction	2.9
Lands	2.4
Total Investment Including Lands	44.5
ANNUAL CHARGES	
Interest	3.3
Amortization	0.1
Operation and Maintenance	0.0
Future Replacements 2/	0.4
Total Annual Charges	3.8

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B4a

Economic Evaluation of Alternative 10 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 10 is presented in Appendix B - Economic Evaluation. The benefit category included in this alternative is iron ore transportation savings. From Table B47 in Appendix B, the total average annual benefit for Alternative 10 is $12,300,000. The net benefit is $7,400,000 and the benefit/cost ratio is 2.51. A summary of annual charges, annual benefits, net benefits, and benefit-to-cost ratio is shown in Table 70 below.

Table 70 - Summary of Benefits and Costs for Alternative 10

	Average Annual Charges ($ million per year)	Average Annual Benefits ($ million per year)	Net Average Annual Benefits ($ million per year)	Benefit/Cost Ratio
Total Project	4.9	12.3	7.4	2.51

Environmental Features/Assessment of Plan 10 - This alternative would be identical to Alternative 9 in all ways but one. In lieu of the conveyor system, an upriver special purpose vessel facility would be constructed.

A berthing facility would be constructed for the special purpose vessel on the west bank of the Black River, just upstream from Erie Avenue. The channel would be widened in this area to permit the vessel to turn around without having to enter the Outer Harbor. This would result in land being converted to aquatic habitat. This land is presently owned by the B&O Railroad.

Placing the stockpiles upstream from Erie Avenue and west of the special purpose berthing facility would require the removal of 6,500 linear feet of railroad trackage.

Using a special purpose vessel to transport cargo to U.S. Steel would not significantly affect the natural environment since commercial craft already navigate the maintained river.

Evaluation of Alternative 10 - Alternative 10 is the second of the lakefront transshipment alternatives. It involves the construction of the lakefront transshipment facility and utilization of a "special purpose vessel" for upriver delivery. This alternative is economically justified, and has net benefits of $7,400,000 and benefit/cost ratio of 2.51 which are among the highest of any of the alternatives.

Construction of a transshipment facility and any means of upriver transshipment would be the responsibility of local interests. Therefore, this report does not attempt to determine what upriver transshipment mode should be utilized. The analysis performed does show lakefront transshipment to be the most economically efficient concept (maximum net benefits and greatest benefit/cost ratios) and the four transshipment schemes investigated (Alternatives 9-12) all appear to be environmentally, socially, financially,

and institutionally feasible. Which of these four alternatives that should be considered in greater detail in Stage 3 will be discussed with local officials and industry representatives at a workshop to be held at the start of Stage 3.

This alternative would not require nearly the amount of land acquisition as the three other lakefront transshipment alternatives due to utilization of the existing waterway. It also would not require U.S. Steel to modify its present method of iron ore receipt.

It is concluded that Alternative 10 warrants further consideration as the selected plan for commercial navigation improvements, contingent upon the expressed desires of local interests. Therefore, Alternative 10 will be presented, along with Alternatives 9, 11, and 12, to workshop participants as one of the possible alternatives to be investigated in greater detail in Stage 3. If local interests desire further consideration of Alternative 10, it will be carried into Stage 3.

ALTERNATIVE 11 (LAKEFRONT TRANSSHIPMENT - RAIL UPRIVER)

Description of Alternative 11 - This alternative is identical to Alternative 10 except that in lieu of a special purpose vessel (Construction Item N), material would be shipped upriver from the conveyor system hopper via the existing rail system (Construction Item O). Construction items in this alternative are shown on Plate 16.

The rail car loading facility would be located upstream of the Erie Avenue Bridge and fed by a conveyor system from the lakefront transshipment facility. The rail car loader would be a surge-bin type hopper capable of flood-loading the rail cars. The hopper cars would have a cargo capacity of 100 tons each. The material could be moved upriver by 50 car unit trains. To move the amount of material anticipated would require two unit trains operating simultaneously 24 hours per day, 5 days a week for the duration of the shipping season. Cycle time for loading and delivery upriver is estimated to be 4 hours. While there is existing trackage, the rail would require upgrading in order to carry the anticipated loads.

Cost Estimate for Alternative 11 - The summary cost estimate for Alternative 11 is presented in Table 71. Table 72 shows the apportionment of these costs to Federal and non-Federal interests. Table 73 shows the annual charges including apportionment. From these tabulations, it is seen that the total project cost including land acquisition is $38.4 million (Table 72); the total investment cost, including interest during construction is $41.0 million (Table 73); and the total annual charges are $3.8 million (Table 73).

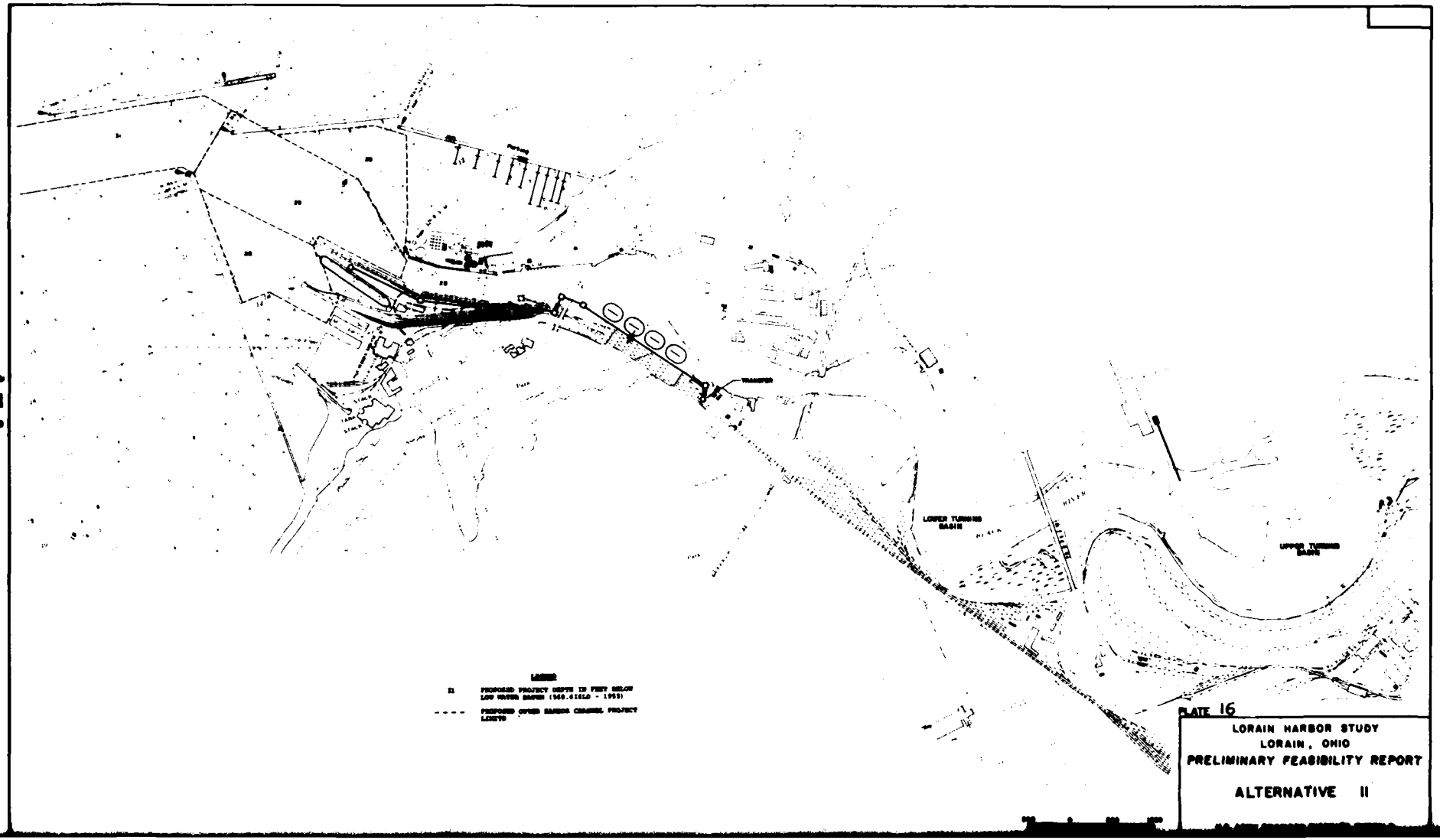

PLATE 16

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE II

Table 71 - Estimate of Navigation Project Costs
Alternative 11 Option 1/ (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.4)*	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.1	.5			3.6
Building Demolition					
Conveyors (6.4)		7.2	5.0		12.2
Rail Facility & Improvements (6.4)					
Special Purpose Vessel & Facility			9.6		9.6
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (6.4)			0.3		0.3
Subtotal Direct Costs	5.9	8.2	9.5		23.6
Contractor's Overhead & Profit @ 15 percent					3.6
Subtotal					27.2
Contingency @ 15 percent					4.1
Subtotal					31.3
Engineering & Design, Supervision & Admin. @ 15 percent					4.7
Subtotal					36.0
Land (6.4)			2.4		2.4
Total Navigation Costs					38.4

*( ) Indicates Table in previous section(s) detailing these costs.

Table 72 - Apportionment of Total Project Cost for Alternative 10, Option 1 (1,500-foot) 1/

Item	Cost (in millions)				
		Non-Federal			
	Federal	General Features	Single User Features 2/	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	2.8				2.8
Bank Cuts & Deepening	3.6				3.6
Building Demolition					
Conveyors			12.2	12.2	12.2
Rail Facility & Improvements			4.7	4.7	4.7
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities			0.3	0.3	0.3
Subtotal	6.4		17.2	17.2	23.6
Contractor's Overhead & Profit @ 15 percent	1.0		2.6	2.6	3.6
Subtotal	7.4		19.8	19.8	27.2
Contingency @ 15 percent	1.1		3.0	3.0	4.1
Subtotal	8.5		22.8	22.8	31.3
Engineering & Design, Supervision & Admin. @ 15 percent	1.3		3.4	3.4	4.7
Subtotal	9.8		26.2	26.2	36.0
Lands	0.0		2.4	2.4	2.4
Total	9.8	0.0	28.6	28.6	38.4

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1000-foot vessels. Therefore costs of all improvements upstream of Amship would be cost-shared 50 percent Federal and 50 percent Non-Federal.

Table 73 - Estimated Investment Cost and Annual Charges
For Alternative 11 1/, Option 1 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	36.0
Interest During Construction	2.6
Lands	2.4
Total Investment, Including Lands	41.0
ANNUAL CHARGES FOR THE PROJECT	
Interest	3.0
Amortization	0.1
Operation and Maintenance	0.3
Future Replacements 2/	0.4
Total Annual Charge	3.8
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	9.8
Interest During Construction	0.7
Total Investment	10.5
ANNUAL CHARGES	
Interest	0.8
Amortization	0.0
Operation and Maintenance	0.3
Total Annual Charges	1.1
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	26.2
Interest During Construction	1.9
Lands	2.4
Total Investment Including Lands	30.5
ANNUAL CHARGES	
Interest	2.2
Amortization	0.1
Operation and Maintenance	0.0
Future Replacements 2/	0.4
Total Annual Charges	2.7

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B46.

Economic Evaluation of Alternative 11 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 11 is presented in Appendix B - Economic Evaluation. The only benefit category applicable to this alternative is iron ore transportation savings. From Table B47 in Appendix B, the total average annual benefit for Alternative 11 is $14,900,000. The net benefit is $11,100,000 and the benefit/cost ratio is 3.91. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 74 below.

Table 74 - Summary of Benefits and Costs for Alternative 11, Option 1 (1,000-foot)

	Average Annual Charges ($ million per year)	Average Annual Benefits ($ million per year)	Net Average Annual Benefits ($ million per year)	Benefit/Cost Ratio
Total Project	3.8	14.9	11.1	3.91

Environmental Features/Assessment of Plan 11 - This alternative is identical to Alternatives 9 and 10, featuring enlarging or reorienting the Outer Harbor entrance and construction of a transshipment facility at lakefront, except that in lieu of a conveyor system (Alternative 9) or the special purpose vessel (Alternative 10), material could be shipped upriver via the existing rail system.

Upgrading of existing trackage would be required to facilitate rail shipments to U.S. Steel. Sufficient land area is not available to provide loop rail trackage at each end of the rail system. Train movements would have to move in reverse from U.S. Steel to return to the rail loading facility.

Since this area is already developed for railroad use, impacts are expected to be minimal. Some vessel fuel oil would be conserved since vessels would not have to travel all the way upriver to U.S. Steel.

Evaluation of Alternative 11 - Alternative 11 is the third of the lakefront transshipment alternatives. It involves the construction of the lakefront transshipment facility and an upriver railroad system. This alternative has the highest net annual benefits ($11,100,000) and the best benefit-to-cost ratio (3.91) of any of the alternatives.

Construction of a transshipment facility and any means of upriver transshipment would be the responsibility of local interests. Therefore, this report does not attempt to determine what upriver transshipment mode should be utilized. The analysis performed does show lakefront transshipment to be the most economically efficient concept (maximum net benefits and greatest benefit/cost ratios), and the four transshipment schemes investigated (Alternatives 9-12) all appear to be environmentally, socially, financially, and institutionally feasible. Which of these four alternatives that should be considered in greater detail in Stage 3 will be discussed with local

officials and industry representatives at a workshop to be held at the start of Stage 3.

This alternative would require utilization of existing trackage owned by the Chessie Railroad Company. It would also require U.S. Steel to modify its present method of receipt of iron ore. This method would be reasonably energy efficient.

It is concluded that Alternative 11 warrants further consideration as the selected plan for commercial navigation improvements, contingent upon the expressed desires of local interests. Therefore, Alternative 11 will be presented along with Alternatives 9, 10, and 12 to workshop participants as one of the possible alternatives to be investigated in greater detail in Stage 3. If local interests desire further consideration of Alternative 11 it will be carried into Stage 3.

ALTERNATIVE 12 (LAKEFRONT TRANSSHIPMENT - TRUCK UPRIVER)

Description of Alternative 12 - This alternative would be similar to Alternative 10 except instead of a special purpose vessel there would be construction of an upriver truck system to carry material as far as the U.S. Steel property. Construction items for this alternative are shown on PlatE 17.

From the transshipment facility, a conveyor system would direct the material flow to the truck-loading facility along the Black River (Construction Item P). The truck-loading facility would be a surge-bin type hopper capable of quick-loading 55-ton trucks. A roadway which parallels the river would be constructed from the truck-loading facility upriver to U.S. Steel. A truck turnaround would be provided at each end. The exclusive roadway would require two 15-foot lanes, 14-foot shoulders, a reinforced concrete median barrier and an overall right-of-way width on the order of 70 feet. Fencing would also be required along the length of the private roadway. A fleet of 16 trucks operating 24 hours per day, 7 days a week for the duration of the shipping season would be required. Cycle time for loading, traveling, unloading and returning is estimated at 32 minutes.

Cost Estimate for Alternative 12 - The summary cost estimate for Alternative 12 is presented in Table 75. Table 76 summarizes the estimated project costs and provides a breakdown of the Federal and non-Federal share of these costs for Alternative 12. The annual charges including apportionment, are shown in Table 77. From these tabulations, it is seen that the total project cost, including land acquisition is $43.0 million (Table 76); the total investment cost, including interest during construction is $45.9 million (Table 77); and the total annual charges are $4.9 million (Table 77).

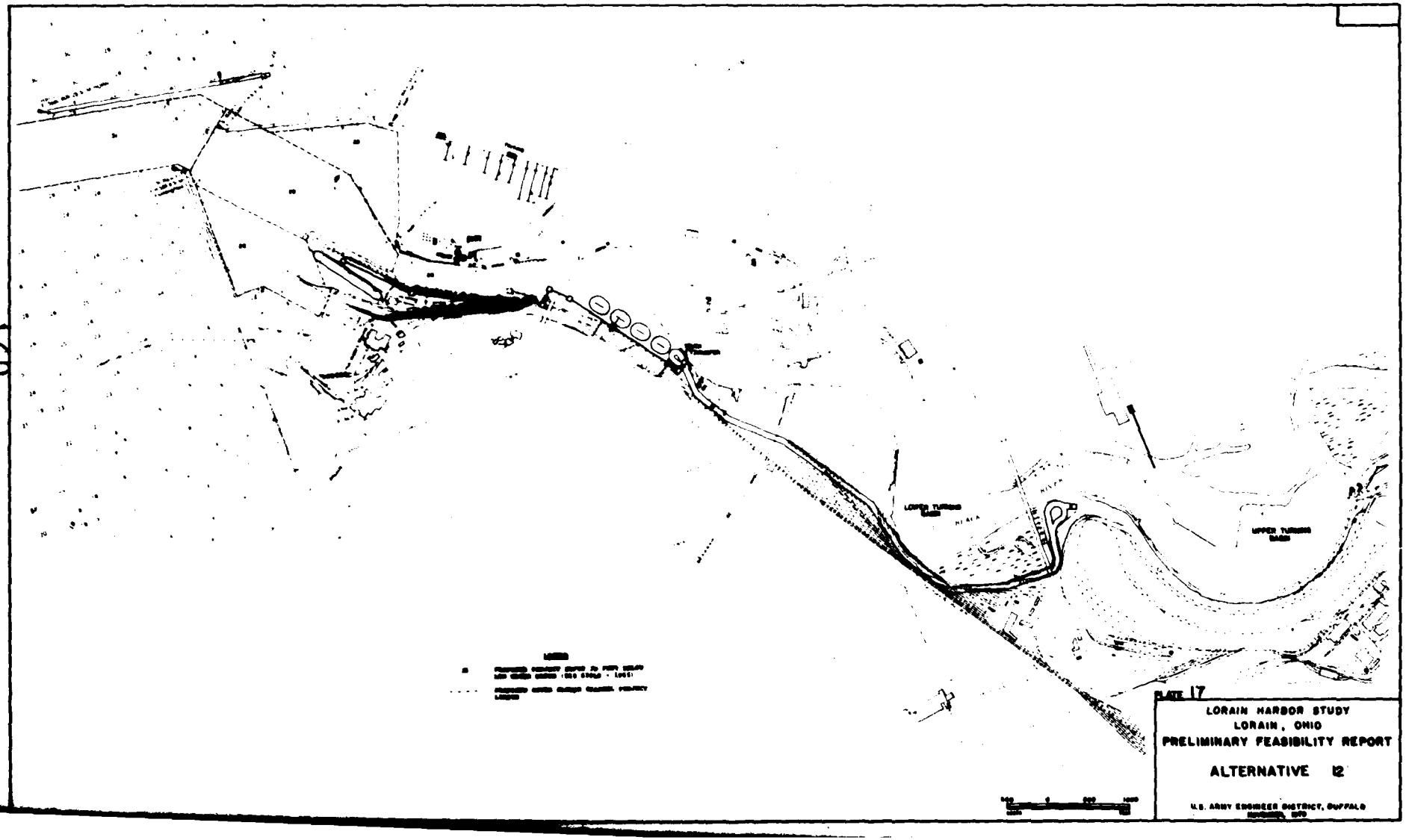
LOWER TURNING BASIN
UPPER TURNING BASIN
PLATE 17
LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 12
U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 75 - Estimate of Navigation Project Costs
Alternative 12 Option 1/ (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.4)*	2.8				2.8
Bank Cuts & Deepening (2.4, 3.4)	3.1	.5			3.6
Building Demolition					
Conveyors (6.5)		7.2	5.0		12.2
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway (6.5)		.5	6.8		7.3
Tunnel					
Utilities (6.5)			0.3		0.3
Subtotal Direct Costs	5.9	8.2	12.1		26.2
Contractor's Overhead & Profit @ 15 percent					4.0
Subtotal					30.2
Contingency @ 15 percent					4.5
Subtotal					34.7
Engineering & Design, Supervision & Admin. @ 15 percent					5.2
Subtotal					39.9
Land (6.5)			3.1		3.1
Total Navigation Costs					43.0

*( ) Indicates Table in previous section(s) detailing these costs.

Table 76 - Apportionment of Total Project Cost for Alternative 12, Opt. n 1 (1,500-foot) 1/

Item	Cost (in millions				
		Non-Federal			
	Federal	General Features	Single User Features 2/	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	2.8				2.8
Bank Cuts & Deepening	3.6				3.6
Building Demolition					
Conveyors			12.2	12.2	12.2
Rail Facility & Improvements			7.3	7.3	7.3
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities			0.3	0.3	0.3
Subtotal	6.4		19.8	19.8	26.2
Contractor's Overhead & Profit @ 15 percent	1.0		3.0	3.0	4.0
Subtotal	7.4		22.8	22.8	30.2
Contingency @ 15 percent	1.1		3.4	3.4	4.5
Subtotal	8.5		26.2	26.2	34.7
Engineering & Design, Supervision & Admin. @ 15 percent	1.3		3.9	3.9	5.2
Subtotal	9.8		30.1	30.1	39.9
Lands	0.0		3.1	3.1	3.1
Total	9.8	0.0	33.2	33.2	43.0

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1000-foot vessels. Therefore costs of all improvements upstream of Amship would be cost-shared 50 percent Federal and 50 percent Non-Federal.

Table 77 - Estimated Investment Cost and Annual Charges
For Alternative 12 1/, Option 1 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	39.9
Interest During Construction	2.9
Lands	3.1
Total Investment, Including Lands	45.9
ANNUAL CHARGES FOR THE PROJECT	
Interest	3.4
Amortization	0.1
Operation and Maintenance	0.3
Future Replacements 2/	1.1
Total Annual Charge	4.9
FEDERAL SHARE TOTAL INVESTMENT COST	
Total Project Cost	9.8
Interest During Construction	0.7
Total Investment	10.5
Annual Charges	
Interest	0.8
Amortization	0.0
Operation and Maintenance	0.3
Total Annual Charges	1.1
NON-FEDERAL SHARE TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	30.1
Interest During Construction	2.2
Lands	3.1
Total Investment Including Lands	35.4
ANNUAL CHARGES	
Interest	2.6
Amortization	0.1
Operation and Maintenance	0.0
Future Replacements 2/	1.1
Total Annual Charges	3.8

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table 8Ha

Economic Evaluation of Alternative 11 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 11 is presented in Appendix B - Economic Evaluation. The only benefit category applicable in this alternative is iron ore transportation savings. From Table B47 in Appendix B, the total average annual benefits for Alternative 12 is $11,600,000. The net benefit is $6,700,000 and the benefit/cost ratio is 2.36. A summary of annual charges, annual benefits, net benefits, and benefit-to-cost ratio is shown in Table 78 below.

Table 78 - Summary of Benefits and Costs for Alternative 11

	Average Annual Charges ($ million per year)	Average Annual Benefits ($ million per year)	Net Average Annual Benefits ($ million per year)	Benefit/Cost Ratio
Total Project	4.9	11.6	6.7	2.36

Environmental Features/Assessment of Plan 12 - The transshipment facility at the lakefront and all other associated construction items - i.e. enlarging or reorienting the Outer Harbor - would be identical to Alternatives 9, 10, and 11. The outstanding feature of Alternative 12 would be the construction of an upriver truck system to carry material as far as the U.S. Steel property.

Temporary noise, dust, and odors would be experienced during construction of the roadway for the truck transport system. Some noise and dust would also be experienced during operation. Some existing railroad trackage would be converted to road, since the roadway would pass through existing railroad yards. Since the roadway would be in an industrial area, aesthetic impacts would be negligible. Fuel used by trucks would probably be considerable as truck transshipment methods are usually not as energy efficient as conveyors, special purpose vessels, or railroads.

Evaluation of Alternative 12 - Alternative 12 is the fourth of the lakefront transshipment alternatives. It involves the construction of the lakefront transshipment facility and upriver movement of the bulk cargo by truck. This alternative is economically justified, but has the lowest net benefits of the four lakefront transshipment alternatives.

Construction of a transshipment facility and any means of upriver transshipment would be the responsibility of local interests. Therefore, this report does not attempt to determine what upriver transshipment mode should be utilized. The analysis performed does show lakefront transshipment to be the economically efficient concept (maximum net benefits and greatest benefit/cost ratios), and the four transshipment schemes investigated (Alternatives 9-12) all appear to be environmentally, socially, financially, and institutionally feasible. Which of these four alternatives that should be considered in greater detail in Stage 3 will be discussed with local officials and industry representatives at a workshop to be held at the start of Stage 3.

This alternative would require acquisition of lands for the entire length of the river. It would also require U.S. Steel to modify their existing method of receipt of iron ore. This method of upriver transshipment is the least energy efficient of the four methods.

It is concluded that Alternative 11 warrants further consideration as the selected plan for commercial navigation improvements, contingent upon the expressed desires of local interests. Therefore, Alternative 12 will be presented along with Alternatives 9, 10, and 11 to workshop participants as one of the possible alternatives to be investigated in greater detail in Stage 3. If local interests desire further consideration of Alternative 12, it will be carried into Stage 3.

ALTERNATIVE 13 - (LAKEFRONT TRANSSHIPMENT WITH RIVERSIDE PARK CUT - CONVEYOR UPRIVER)

Desciption of Alternative 13 - This alternative is identical to Alternative 9 in all ways except for an added construction item. This additional item is the construction of a new channel through Riverside Park (Construction Item B), as described in Alternative 1. The construction of the Riverside Park Cut would enable easy access to the American Shipbuilding facility by the larger vessel. The components of this alternative are shown on Plate 18.

Cost Estimate for Alternative 13 - The summary cost estimate for Alternative 13 is presented in Table 79, and Table 80 shows the apportionment of project costs to Federal and non-Federal interests. Annual charges, including apportionment, are shown in Table 81. From these tabulations, it is seen that the total project cost including land acquisition is $79.6 million (Table 80); the total investment cost, including interest during construction is $85.3 million (Table 81); and the total annual charges are $7.4 million (Table 81).

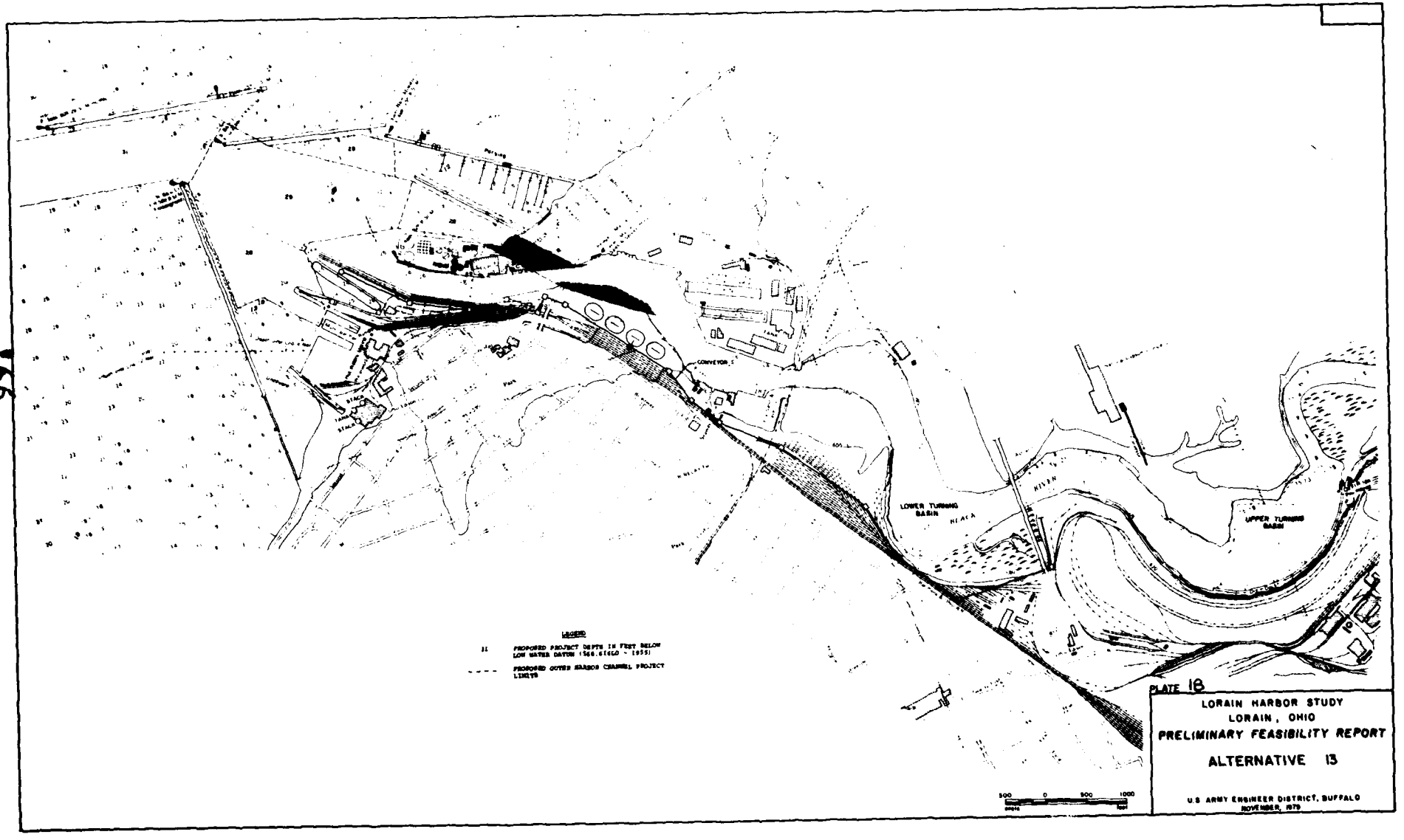

PLATE 18

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 13

U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER, 1979

Table 79 - Estimate of Navigation Project Costs
Alternative 13 Option 1/ (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.6)*	4.3				4.3
Bank Cuts & Deepening (2.6, 3.4)	3.2	8.8			12.0
Building Demolition (3.4)		1.1			1.1
Conveyors (6.2)		7.7	24.4		32.1
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 6.2)		1.1	0.3		1.4
Subtotal Direct Costs	7.5	18.7	24.7		50.9
Contractor's Overhead & Profit @ 15 percent					7.6
Subtotal					58.5
Contingency @ 15 percent					[illegible].8
Subtotal					67.3
Engineering & Design, Supervision & Admin. @ 15 percent					10.1
Subtotal					77.4
Land (6.5)		1.0	1.2		2.2
Total Navigation Costs					79.6

*( ) Indicates Table in previous section(s) detailing these costs.

Table 80 - Apportionment of Total Project Cost for Alternative 13, Option 1 (1,500-foot) 1/

Item	Cost (in millions)				
		Non-Federal			
	Federal	General Features	Single User Features 2/	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	4.3				4.3
Bank Cuts & Deepening	12.0				12.0
Building Demolition		1.1		1.1	1.1
Conveyors			32.1	32.1	32.1
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		1.1	0.3	1.4	1.4
Subtotal	16.3	2.2	32.4	34.6	50.9
Contractor's Overhead & Profit @ 15 percent	2.4	0.3	4.9	5.2	7.6
Subtotal	18.7	2.5	37.3	39.8	58.5
Contingency @ 15 percent	2.8	0.4	5.6	6.0	8.8
Subtotal	21.5	2.9	42.9	45.8	67.3
Engineering & Design, Supervision & Admin. @ 15 percent	3.2	0.4	6.5	6.9	10.1
Subtotal	24.7	3.3	49.4	52.7	77.4
Lands	0.0	1.0	1.2	2.2	2.2
Total	24.7	4.3	50.6	54.9	79.6

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1000-foot vessels. Therefore costs of all improvements upstream of Amship would be cost-shared 50 percent Federal and 50 percent Non-Federal.

Table 81 - Estimated Investment Cost and Annual Charges
For Alternative 10 1/, Option 1 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	77.4
Interest During Construction	5.7
Lands	2.2
Total Investment, Including Lands	85.3
ANNUAL CHARGES FOR THE PROJECT	
Interest	6.3
Amortization	0.2
Operation and Maintenance	0.4
Future Replacements 2/	0.5
Total Annual Charge	7.4
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	24.7
Interest During Construction	1.8
Total Investment	26.5
ANNUAL CHARGES	
Interest	2.0
Amortization	0.1
Operation and Maintenance	0.4
Total Annual Charges	2.5
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	52.7
Interest During Construction	3.9
Lands	2.2
Total Investment Including Lands	58.8
ANNUAL CHARGES	
Interest	4.3
Amortization	0.1
Operation and Maintenance	0.0
Future Replacements 2/	0.5
Total Annual Charges	4.9

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B46.

Economic Evaluation of Alternative 13 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 13 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, and (2) future vessels launching costs avoided. From Table B47 in Appendix B, the total average annual benefit for Alternative 13 is $16,000,000. The net benefit is $8,600,000 and the benefit/cost ratio is 2.16. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 82 below.

Table 82 - Summary of Benefits and Costs for Alternative 13

	Average Annual Charges ($ million per year)	Average Annual Benefits ($ million per year)	Net Average Annual Benefits ($ million per year)	Benefit/Cost Ratio
Total Project	7.4	16.0	8.6	2.16

Environmental Features/Assessment of Plan 13 - This alternative would be identical to Alternative 9 which calls for enlarging or reorienting the Outer Harbor entrance, constructing a transshipment facility at lakefront, and constructing an upriver conveyor system. It would also include the additional item of a new channel that would be constructed through Riverside Park, as discussed under Alternative 1.

The Riverside Park Cut would enable easy access to American Shipbuilding facility by larger vessels as well as allow conveyor transshipment upriver to the U.S. Steel plant.

Evaluation of Alternative 13 - Alternative 13 is essentially the same as Alternative 9 with the addition of a Riverside Park Cut. The additional benefits to be realized by making the Riverside Park Cut ($200,000), do not outweigh the additional costs. Therefore, Alternative 9 will be retained instead of Alternative 13 ($1.7 million), and the cost for providing the Riverside Park Cut exclusively for Amship is not incrementally justified. Therefore, it is concluded that Alternative 13 should not be considered further based on the benefit categories identified in Stage 2. However, as part of the Stage 3 study, a congestion study will be performed to determine if vessel delays due to 1,000-foot vessels docked at the new Republic Transshipment facility at the mouth of the Black River produce enough new benefits to require a structural improvement to be made to alleviate this problem. The Riverside Park Cut would be one such alternative but not necessarily the only one. If it is found that congestion at the mouth of the Black River is a serious (and costly) problem, the Riverside Park Cut may be added to the alternatives chosen to be taken into Stage 3. This possible congestion problem did not surface until late in the summer of 1980, which did not permit time to consider it in Stage 2.

ALTERNATIVE 14 - (LAKEFRONT TRANSSHIPMENT WITH RIVERSIDE PARK CUT VESSEL UPRIVER)

Description of Alternative 14 - This alternative would be identical to Alternative 10 with the addition of the cut through Riverside Park (Construction Item B) to service the American Shipbuilding facility (see Plate 19).

Cost Estimate for Alternative 14 - The summary cost estimate for Alternative 14 is presented in Table 83, and Table 84 shows the apportionment of these costs to Federal and non-Federal interests. Table 85 provides the estimate of annual charges, including apportionment for Alternative 14. From these tabulations, it is seen that the total project cost including land acquisition is $70.3 million (Table 84); the total investment cost, including interest during construction is $75.3 million (Table 85); and the total annual charges are $6.6 million (Table 85).

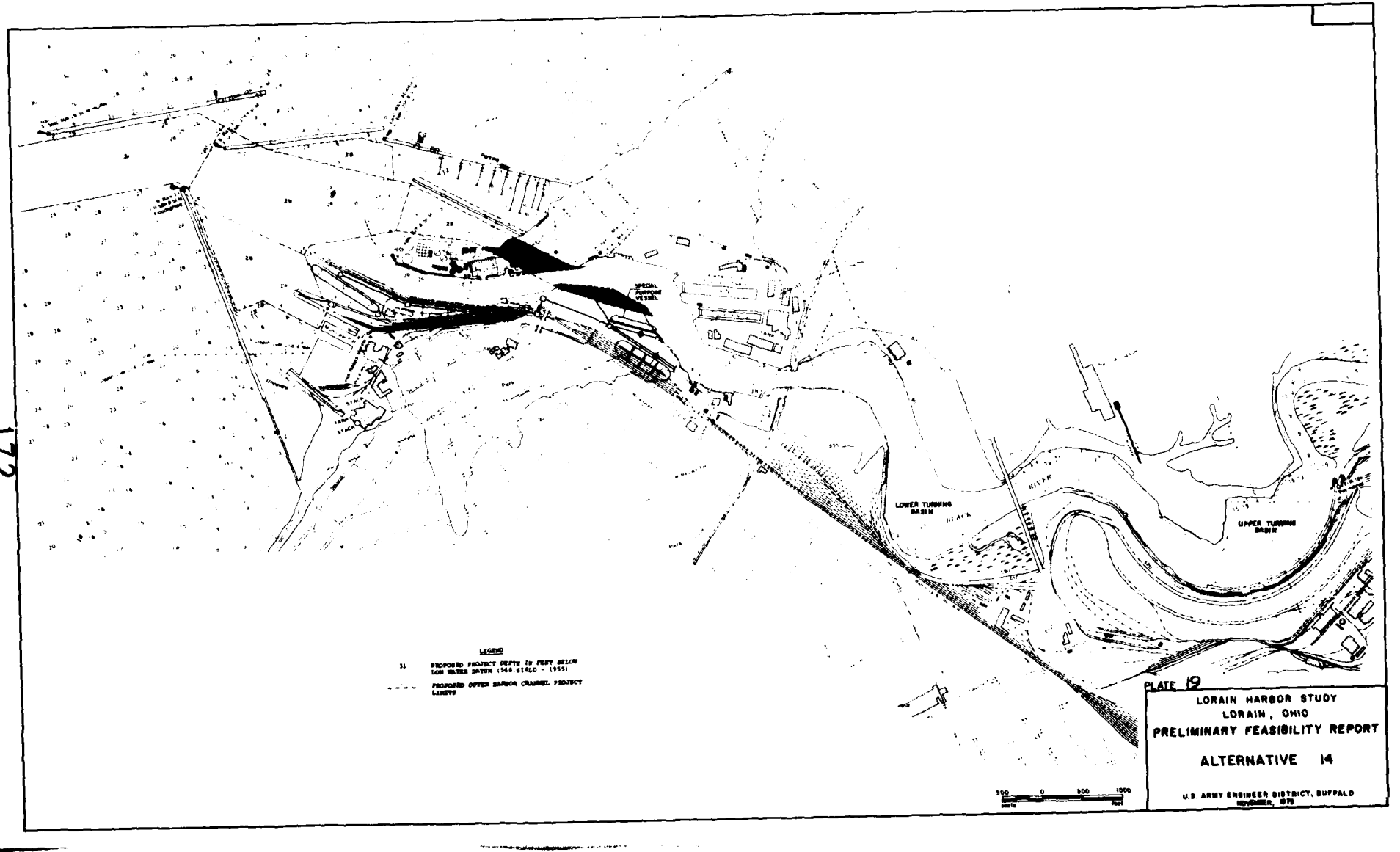

PLATE 19

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 14

U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER, 1970

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LORAIN HARBOR, OHIO. PRELIMINARY FEASIBILITY STUDY (STAGE 2). R--ETC(U)
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Table 83 - Estimate of Navigation Project Costs
Alternative 14 Option 1/ (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.6)*	4.3				4.3
Bank Cuts & Deepening (2.6, 3.4)	3.2	8.8			12.0
Building Demolition (3.4)		1.1			1.1
Conveyors (6.3)		7.2	8.7		15.9
Rail Facility & Improvements					
Special Purpose Vessel & Facility (6.3)			9.6		9.6
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 6.3)		1.1	0.3		1.40
Subtotal Direct Costs	7.5	18.2	18.6		44.3
Contractor's Overhead & Profit @ 15 percent					6.6
Subtotal					50.9
Contingency @ 15 percent					7.6
Subtotal					58.5
Engineering & Design, Supervision & Admin. @ 15 percent					8.8
Subtotal					67.3
Land (3.4, 6.3)		1.0	2.0		3.0
Total Navigation Costs					70.3

*( ) Indicates Table in previous section(s) detailing these costs.

Table 84 - Apportionment of Total Project Cost for Alternative 10, Option 1 (1,500-foot) 1/

Item	Cost (in millions)				
		Non-Federal			
	Federal	General Features	Single User Features 2/	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	4.3				4.3
Bank Cuts & Deepening	12.0				12.0
Building Demolition		1.1		1.1	1.1
Conveyors			15.9	15.9	15.9
Rail Facility & Improvements					
Special Purpose Vessel & Facility			9.6		
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		1.1	0.3	1.4	1.4
Subtotal	16.3	2.2	25.8	28.0	44.3
Contractor's Overhead & Profit @ 15 percent	2.4	0.3	3.9	4.2	6.6
Subtotal	18.7	2.5	29.7	32.2	50.9
Contingency @ 15 percent	2.8	0.4	4.4	4.8	7.6
Subtotal	21.5	2.9	34.1	37.0	58.5
Engineering & Design, Supervision & Admin. @ 15 percent	3.2	0.4	5.2	5.6	8.8
Subtotal	24.7	3.3	39.3	42.6	67.3
Lands	0.0	1.0	2.0	3.0	3.0
Total	24.7	4.3	41.3	45.6	70.3

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1000-foot vessels. Therefore costs of all improvements upstream of Amship would be cost-shared 50 percent Federal and 50 percent Non-Federal.

Table 85 - Estimated Investment Cost and Annual Charges
For Alternative 14 1/, Option 1 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	67.3
Interest During Construction	5.0
Lands	3.0
Total Investment, Including Lands	75.3
ANNUAL CHARGES FOR THE PROJECT	
Interest	5.6
Amortization	0.2
Operation and Maintenance	0.4
Future Replacements 2/	0.4
Total Annual Charge	6.6
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	24.7
Interest During Construction	1.8
Total Investment	26.5
ANNUAL CHARGES	
Interest	2.0
Amortization	0.1
Operation and Maintenance	0.4
Total Annual Charges	2.5
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	42.6
Interest During Construction	3.2
Lands	3.0
Total Investment Including Lands	48.8
ANNUAL CHARGES	
Interest	3.6
Amortization	0.1
Operation and Maintenance	0.0
Future Replacements 2/	0.4
Total Annual Charges	4.1

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table 84.

Economic Evaluation of Alternative 14 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 14 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, and (2) future vessels launching costs avoided. From Table B47 in Appendix B, the total average annual benefit for Alternative 14 is $12,500,000. The net benefit is $5,900,000 and the benefit/cost ratio is 1.89. A summary of annual charges, annual benefits, net benefits, and benefit-to-cost ratio is shown in Table 86 below.

Table 86 - Summary of Benefits and Costs for Alternative 14

	Average Annual Charges ($ million per year)	Average Annual Benefits ($ million per year)	Net Average Annual Benefits ($ million per year)	Benefit/Cost Ratio
Total Project	6.6	12.5	5.9	1.89

Environmental Features/Assessment of Plan 14 - This alternative would have features identical to Alternative 10, which includes enlarging or reorienting the Outer Harbor entrance, constructing a transshipment facility at lakefront, and constructing an upriver special purpose vessel facility, with the addition of the channel cut through Riverside Park (Construction Item B), as discussed under Alternative 13.

Evaluation of Alternative 14 - Alternative 14 is essentially the same as Alternative 10 with the addition of a Riverside Park Cut. The additional annual benefits to be realized by making the Riverside Park Cut ($500,000) do not outweigh the additional costs ($1.7 million), and is not incrementally justified. Therefore, it is concluded that Alternative 14 should not be considered further based on the benefit categories identfied in Stage 2.

However, as part of the Stage 3 study, a congestion study will be performed to determine if vessel delays due to 1000-foot docked at the new Republic Transshipment facility, at the mouth of the Black River, produce enough new benefits to require a structural improvement to be made to alleviate this problem. The Riverside Park Cut would be one such alternative but not necessarily the only one. If it is found that congestion at the mouth of the Black River is a serious (and costly) problem, the Riverside Park Cut may be added to the alternatives chosen to be taken into Stage 3. This possible congestion problem did not surface until late in the summer of 1980, which did not permit time to consider it in Stage 2.

ALTERNATIVE 15 (LAKEFRONT TRANSSHIPMENT WITH RAIL UPRIVER AND RIVERSIDE PARK CUT)

Description of Alternative 15 - This alternative is identical to Alternative 11 but has the addition of the Riverside Park Cut (Construction Item B) to provide access by large vessels to the American Shipbuilding facility (see Plate 20).

Cost Estimate for Alternative 15 - The summary cost estimate for Alternative 15 is presented in Table 87. Table 88 summarizes the apportionment of the project costs to Federal and non-Federal interests, Table 89 shows the annual changes for Alternative 15. From these tabulations, it is seen that the total project cost including land acquisition is $57.2 million (Table 88); the total investment cost, including interest during construction is $61.2 million (Table 89); and the total annual charges are $5.5 million (Table 89).

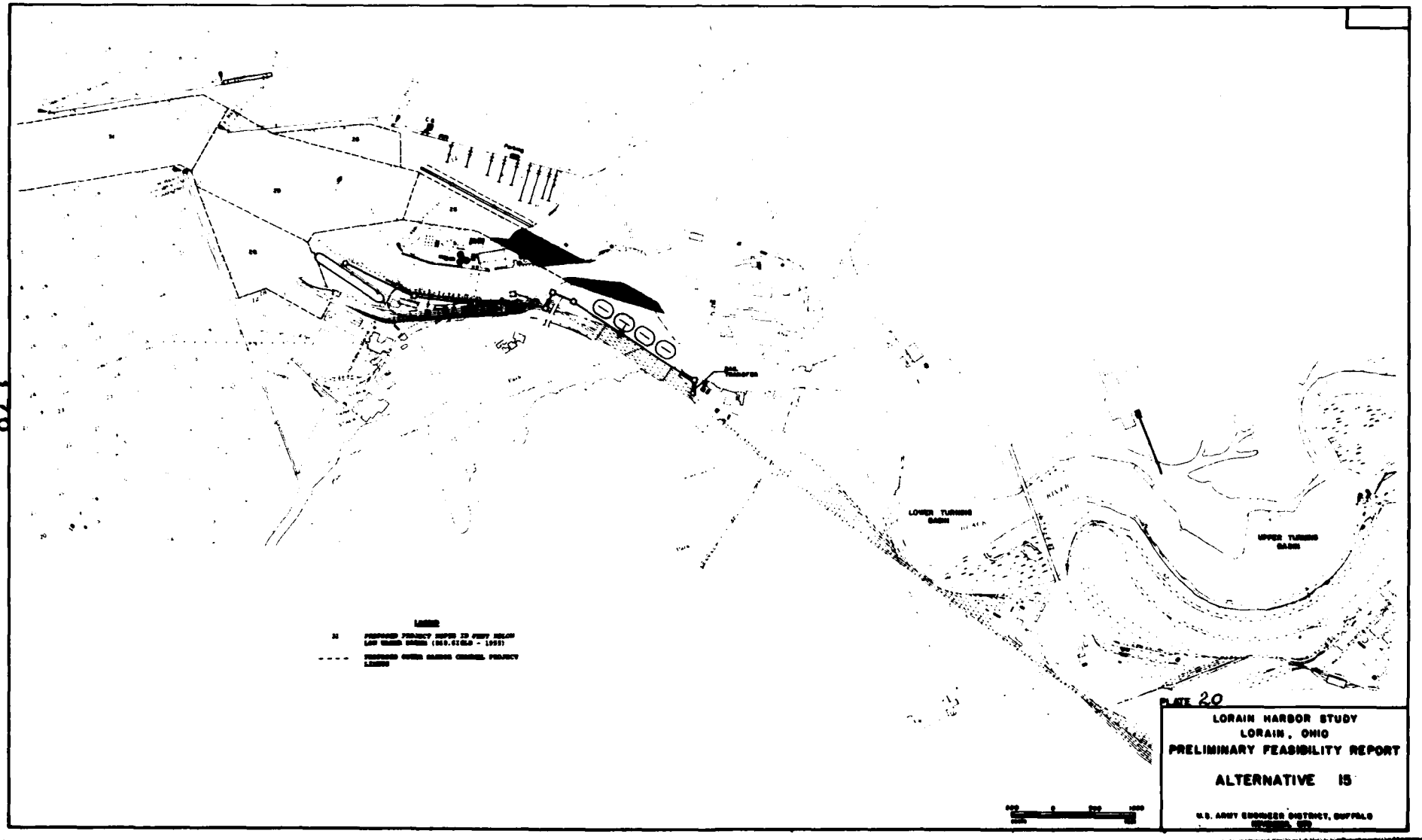
LOWER TURNING BASIN
UPPER TURNING BASIN
PLATE 20
LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 15
U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 87 - Estimate of Navigation Project Costs
Alternative 15 Option 1/ (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.6)*	4.3				4.3
Bank Cuts & Deepening (2.6, 3.4)	3.2	8.8			12.0
Building Demolition (3.4)		1.1			1.1
Conveyors (6.4)		7.2	5.0		12.2
Rail Facility & Improvements (6.4)		.5	4.2		4.7
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities (3.4, 6.4)		1.1	0.3		1.4
Subtotal Direct Costs	7.5	18.7	9.5		35.7
Contractor's Overhead & Profit @ 15 percent					5.3
Subtotal					41.0
Contingency @ 15 percent					6.2
Subtotal					47.2
Engineering & Design, Supervision & Admin. @ 15 percent					7.0
Subtotal					54.2
Land (3.4, 6.3)		1.0	2.0		3.0
Total Navigation Costs					57.2

*( ) Indicates Table in previous section(s) detailing these costs.

Table 88 - Apportionment of Total Project Cost for Alternative 15, Option 1 (1,500-foot) 1/

Item	Cost (in millions)				
		Non-Federal			
	Federal	General Features	Single User Features 2/	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	4.3				4.3
Bank Cuts & Deepening	12.0				12.0
Building Demolition		1.1		1.1	1.1
Conveyors			12.2	12.2	12.2
Rail Facility & Improvements			4.7	4.7	4.7
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway					
Tunnel					
Utilities		1.1	0.3	1.4	1.4
Subtotal	16.3	2.2	17.2	19.4	35.7
Contractor's Overhead & Profit @ 15 percent	2.4	0.3	2.6	2.9	5.3
Subtotal	18.7	2.5	19.8	22.3	41.0
Contingency @ 15 percent	2.8	0.4	3.0	3.4	6.2
Subtotal	21.5	2.9	22.8	25.7	47.2
Engineering & Design, Supervision & Admin. @ 15 percent	3.2	0.4	3.4	3.7	7.0
Subtotal	24.7	3.3	26.2	29.5	54.2
Lands	0.0	1.0	2.0	3.0	3.0
Total	24.7	4.3	28.2	32.5	57.2

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1000-foot vessels. Therefore costs of all improvements upstream of Amship would be cost-shared 50 percent Federal and 50 percent Non-Federal.

Table 89 - Estimated Investment Cost and Annual Charges
For Alternative 15 1/, Option 1 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	54.2
Interest During Construction	4.0
Lands	3.0
Total Investment, Including Lands	61.2
ANNUAL CHARGES FOR THE PROJECT	
Interest	4.5
Amortization	0.2
Operation and Maintenance	0.4
Future Replacements 2/	0.4
Total Annual Charge	5.5
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	24.7
Interest During Construction	1.8
Total Investment	26.5
ANNUAL CHARGES	
Interest	2.0
Amortization	0.1
Operation and Maintenance	0.4
Total Annual Charges	2.5
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	29.5
Interest During Construction	2.2
Lands	3.0
Total Investment Including Lands	34.7
ANNUAL CHARGES	
Interest	2.5
Amortization	0.1
Operation and Maintenance	0.0
Future Replacements 2/	0.4
Total Annual Charges	3.0

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B-46.

Economic Evaluation of Alternative 15 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 15 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, and (2) future vessels launching costs avoided. From Table B47 in Appendix B, the total average annual benefit for Alternative 15 is $15,000,000. The net benefit is $9.500,000 and the benefit/cost ratio is 2.73. A summary of annual charges, annual benefits, net benefits and benefit-to-cost ratio is shown in Table 90 below.

Table 90 - Summary of Benefits and Costs for Alternative 14

	Average Annual Charges ($ million per year)	Average Annual Benefits ($ million per year)	Net Average Annual Benefits ($ million per year)	Benefit/Cost Ratio
Total Project	5.5	15.0	9.5	2.73

Environmental Features/Assessment of Plan 15 - This alternative would have features identical to Alternative 11; enlarge or reorient Outer Harbor entrance, construct transshipment facility at lakefront, and construct upriver rail facility, with the addition of the channel cut through Riverside Park, as discussed under Alternative 14.

Evaluation of Alternative 15 - Alternative 15 is essentially the same as Alternative 11 with the addition of a Riverside Park Cut. The additional annual benefits to be realized by making the Riverside Park Cut ($250,000) do not outweigh the additional costs ($1.7 million), and is not incrementally justified. Therefore, it is concluded that Alternative 15 should not be considered further based on the benefit categories identified in Stage 2.

However, as part of the Stage 3 study, a congestion study will be performed to determine if vessel delays due to 1,000-foot vessels, docked at the new Republic Transshipment Facility, to pass at the mouth of the Black River produce enough new benefits to require a structural improvement to be made to alleviate this problem. The Riverside Park Cut would be one such alternative but not necessarily the only one. If it is found that congestion at the mouth of the Black River is a serious (and costly) problem, the Riverside Park Cut may be added to the alternatives chosen to be taken into Stage 3. This possible congestion problem did not surface until late in the summer of 1980, which did not permit time to consider it in Stage 2.

ALTERNATIVE 16 (LAKEFRONT TRANSSHIPMENT WITH RIVERSIDE PARK CUT - RAIL UPRIVER)

Description of Alternative 16 - This alternative would have the features identical to Alternative 12 with the addition of the cut through Riverside Park to provide better access by 1,000-foot vessels to the American Shipbuilding facility (see Plate 21).

Cost Estimate for Alternative 16 - The summary cost estimate for Alternative 16 is presented in Table 91. Table 92 shows the apportionment of costs to Federal and non-Federal interests. Annual charges for Alternative 16 are shown in Table 93. From these tabulations, it is seen that the total project cost including land acquisition is $61.8 million (Table 92); the total investment cost, including interest during construction is $66.1 million (Table 93); and the total annual charges are $6.6 million (Table 93).

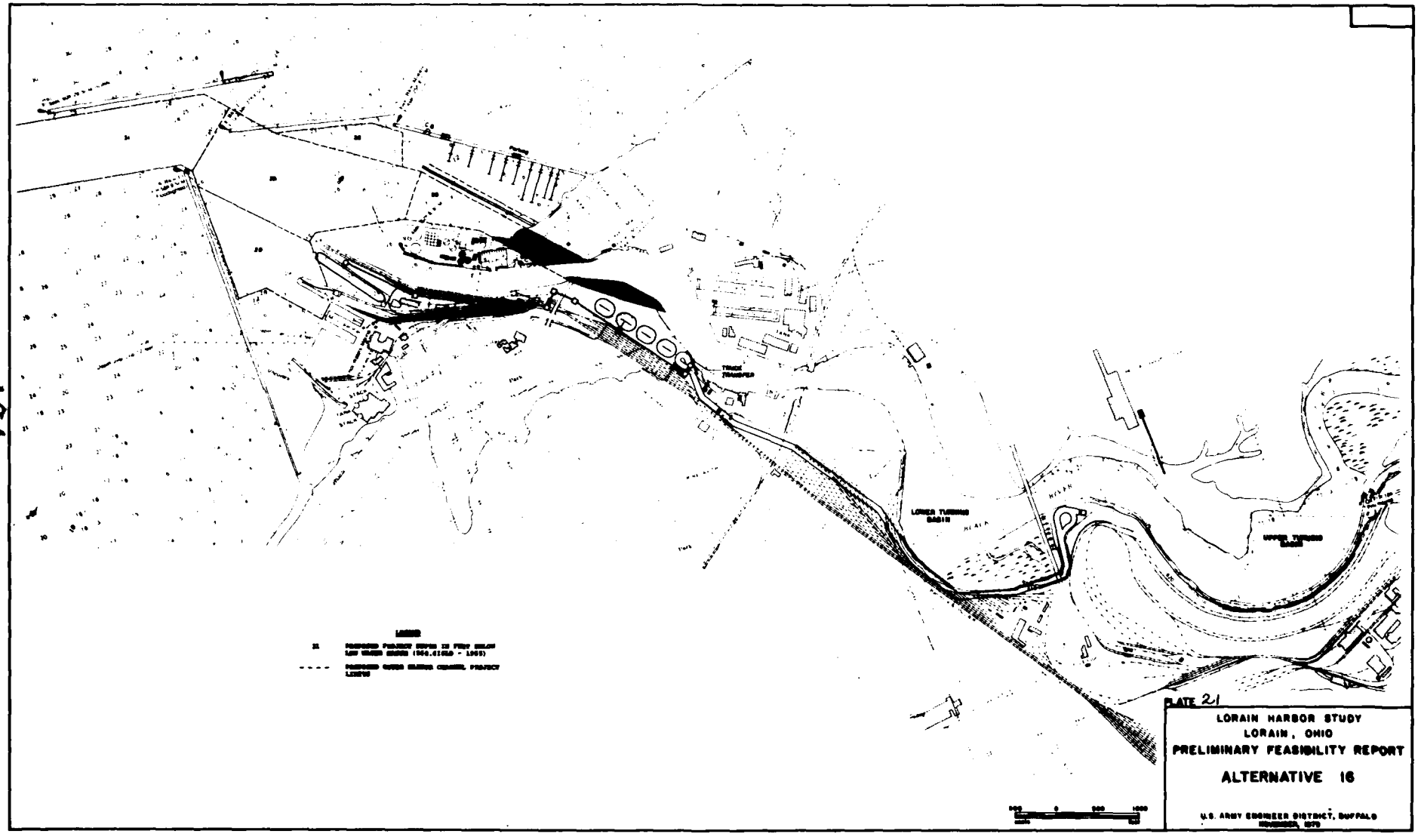
LOWER TURNING BASIN
UPPER TURNING BASIN
TRUCK TRANSFER
RIVER
LEGEND
PLATE 21
LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 16
U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 91 - Estimate of Navigation Project Costs
Alternative 16 Option 1/ (1,000-foot Vessels)
(May 1980 Dollars)

Item	Costs (in millions)				
	Outer Harbor	Mouth of Black River to Amship	Amship to Lower Turning Basin	Lower Turning Basin to Upper Turning Basin	Total Costs
Bridges					
Breakwaters (2.6)*	4.3				4.3
Bank Cuts & Deepening (2.6, 3.4)	3.2	8.8			12.0
Building Demolition (3.4)		1.1			1.1
Conveyors (6.5)		7.2	5.0		12.2
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway (6.5)		0.5	6.8		7.3
Tunnel					
Utilities (3.4, 6.5)		1.1	0.3		1.4
Subtotal Direct Costs	7.5	17.2	11.1		38.3
Contractor's Overhead & Profit @ 15 percent					5.7
Subtotal					44.0
Contingency @ 15 percent					6.6
Subtotal					50.6
Engineering & Design, Supervision & Admin. @ 15 percent					7.5
Subtotal					58.1
Land (3.4, 6.5)		1.0	2.7		3.7
Total Navigation Costs					61.8

*( ) Indicates Table in previous section(s) detailing these costs.

Table 92 - Apportionment of Total Project Cost for Alternative 16, Option 1 (1,500-foot) 1/

Item	Cost (in millions)				
		Non-Federal			
	Federal	General Features	Single User Features 2/	Total Non-Federal	Total Project Costs
Bridges					
Breakwaters	4.3				4.3
Bank Cuts & Deepening	12.0				12.0
Building Demolition		1.1		1.1	1.1
Conveyors			12.2	12.2	12.2
Rail Facility & Improvements					
Special Purpose Vessel & Facility					
Truck Transfer Facility & Roadway				7.3	7.3
Tunnel					
Utilities		1.1	0.3	1.4	1.4
Subtotal	16.3	2.2	19.8	22.0	38.3
Contractor's Overhead & Profit @ 15 percent	2.4	0.3	3.0	3.3	5.7
Subtotal	18.7	2.5	22.8	25.3	44.0
Contingency @ 15 percent	2.8	0.4	3.4	3.8	6.6
Subtotal	21.5	2.9	26.2	29.1	50.6
Engineering & Design, Supervision & Admin. @ 15 percent	3.2	0.4	3.9	4.3	7.5
Subtotal	24.7	3.3	30.1	33.4	58.1
Lands	0.0	1.0	2.7	3.7	3.7
Total	24.7	4.3	32.8	37.1	61.8

1/ Cost estimates based on design work done by Michael Baker Jr. Inc., and updated to May 1980 price levels.

2/ Upstream of American Shipbuilding, U.S. Steel would be the only user of 1000-foot vessels. Therefore costs of all improvements upstream of Amship would be cost-shared 50 percent Federal and 50 percent Non-Federal.

Table 93 - Estimated Investment Cost and Annual Charges
For Alternative 16 1/, Option 1 1/

Item	Total $ (million)
TOTAL INVESTMENT FOR THE PROJECT	
Total Project Cost, Excluding Lands	58.1
Interest During Construction	4.3
Lands	3.7
Total Investment, Including Lands	66.1
ANNUAL CHARGES FOR THE PROJECT	
Interest	4.9
Amortization	0.2
Operation and Maintenance	0.4
Future Replacements 2/	1.1
Total Annual Charge	6.6
FEDERAL SHARE	
TOTAL INVESTMENT COST	
Total Project Cost	24.7
Interest During Construction	1.8
Total Investment	26.5
ANNUAL CHARGES	
Interest	2.0
Amortization	0.1
Operation and Maintenance	0.4
Total Annual Charges	2.5
NON-FEDERAL SHARE	
TOTAL INVESTMENT COST INCLUDING LANDS	
Total Project Cost Excluding Lands	33.4
Interest During Construction	2.5
Lands	3.7
Total Investment Including Lands	39.6
ANNUAL CHARGES	
Interest	2.9
Amortization	0.1
Operation and Maintenance	0.0
Future Replacements 2/	0.1
Total Annual Charges	4.1

1/ 7-3/8 percent interest rate, 50-year life (i=.07375; amount = .00216)
2/ Description of Future Replacements is included in Appendix B, Table B46

Economic Evaluation of Alternative 16 - The detailed discussion on the projected benefits that would be realized from implementation of Alternative 16 is presented in Appendix B - Economic Evaluation. Benefit categories included in this alternative are: (1) iron ore transportation savings, and (2) future vessels launching costs avoided. From Table B47 in Appendix B, the total average annual benefit for Alternative 16 is $11,700,000. The net benefit is $5,100,000 and the benefit/cost ratio is 1.77. A summary of annual charges, annual benefits, net benefits, and benefit-to-cost ratio is shown in Table 94 below.

Table 94 - Summary of Benefits and Costs for Alternative 16

	Average Annual Charges ($ million per year)	Average Annual Benefits ($ million per year)	Net Average Annual Benefits ($ million per year)	Benefit/Cost Ratio
Total Project	6.6	11.7	5.1	1.77

Environmental Features/Assessment of Plan 16 - This alternative would have features identical to Alternative 12; enlarge or reorient Outer Harbor entrance, construct transshipment facility at lakefront, and construct upriver truck system, with the addition of the channel cut through Riverside Park, as discussed under Alternative 13.

Evaluation of Alternative 16 - Alternative 16 is essentially the same as Alternative 12 with the addition of a Riverside Park Cut. The additional annual benefits to be realized by making the Riverside Park Cut ($200,000), do not outweigh the additional costs (($1.7 million), and is not incrementally justified. Therefore, it is concluded that Alternative 16 should not be considered further, based on the benefit categories identified in Stage 2.

However, as part of the Stage 3 study, a congestion study will be performed to determine if vessel delays due to 1,000-foot vessel, docked at the new Republic Transshipment Facility, to pass at the mouth of the Black River produce enough new benefits to require a structural improvement to be made to alleviate this problem. The Riverside Park Cut would be one such alternative but not necessarily the only one. If it is found that congestion at the mouth of the Black River is a serious (and costly) problem, the Riverside Park Cut may be added to the alternatives chosen to be taken into Stage 3. This possible congestion problem did not surface until late in the summer of 1980, which did not permit time to consider it in Stage 2.

ALTERNATIVE 17 (NO-ACTION (DO NOTHING))

Description of Alternative 17 - The No-Action (Do Nothing) Alternative for Lorain Harbor continues cargo movements within the current harbor configuration. It provides for the existing program of harbor maintenance, but does not provides for further harbor modifications needed for safe and efficient operation of 1,000-foot vessels. This means bulk cargo will

continue to be transported in vessels limited in size by the current harbor and channel alignments for depth. For the Outer Harbor Entrance, the "Base Case" vessel is a lightloaded Class X vessel, and for the Black River Channel, a Class VIII vessel. As vessel traffic increases to handle projected increases in tonnage required, existing problems related to safe and efficient navigation would intensify. This alternative, referred to as the "Base Case", provides a basis for calculating the transportation savings that would result if alternative improvements were implemented.

This alternative, is not favored by local interests, because it does not meet the planning objective of improving conditions for commercial navigation by Class X vessels. Problems and needs stated earlier in this report would remain unchanged.

Alternative 17 will be carried into Stage 3 as the basis of comparison for other alternatives. Since other alternative plans of improvement for modifying Lorain Harbor to accomodate Class X vessels are economically justified, and appear to be environmentally, socially, financially, and institutionally viable, it is not expected the the "No-Action" plan will emerge as the selected plan.

SECTION E
COMPARISON OF PLANS

Initially there were nine concepts considered as possible solutions for meeting the planning objective of improvements to Lorain Harbor for commerical navigation. Of these, six were eliminated during the initial iteration due to overriding economic, environmental or operational problems. The three remaining concepts were then further developed into 16 alternatives and studied in depth. The 17th alternative, the No Action (Do Nothing) Plan, was included as the "basis of comparison" to the 16 structural plans and as a candidate for the "selected plan" in the event none of the action (or structural) plans are implementable. Engineering, economic, and environmental aspects of the alternatives were discussed in Section D.

COMPARISON OF PLANS

A summary matrix of the comparative costs, benefits, and economic efficiency for all the plans considered is presented in Tables 95 and 96. This is followed by Tables 97 and 98 that provide an abbreviated "summary of effects" for the alternatives based on available information.

Table 95 - Economic Comparisons of Alternative Plans 1-8 for Option 1 1/ (1000-foot vessels)
(May 1980 Price Levels)

Item	Direct Delivery Alternatives				Transshipment From 21st Street Bridge Alternatives			
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8
	$	$	$	$	$	$	$	$
Total Project Investment Cost:								
Federal	108,400,000	161,200,000	132,700,000	200,100,000	53,800,000	108,500,000	80,200,000	142,700,000
Non-Federal	80,600,000	82,900,000	79,000,000	81,900,000	52,300,000	56,000,000	52,500,000	53,800,000
Total	189,000,000	244,100,000	211,700,000	282,000,000	106,100,000	164,500,000	132,700,000	196,500,000
Annual Charges								
Federal	8,700,000	12,800,000	10,600,000	15,700,000	4,600,000	8,700,000	6,600,000	11,300,000
Non-Federal	6,600,000	7,100,000	6,700,000	7,400,000	4,200,000	4,900,000	4,500,000	5,100,000
Total	15,300,000	19,900,000	17,300,000	23,100,000	8,800,000	13,600,000	11,100,000	16,400,000
Annual Benefits	17,400,000	17,600,000	17,600,000	17,600,000	15,900,000	16,000,000	16,000,000	16,000,000
Net Benefits	2,100,000	-2,300,000	230,000	-5,470,000	7,100,000	2,400,000	4,800,000	-350,000
Benefit/Cost	1.14	0.88	1.01	0.76	1.80	1.18	1.44	0.98

1/ Dollar amounts shown for Federal and non-Federal shares are based on traditional cost-sharing policies found in EP 1165-2-1 pages 5-23 (25 September 1979).

Table 96 - Economic Comparisons of Alternative Plans for Option 1 (1,000-foot vessels) 9-17 1/
(May 1980 Price Levels)

Item	Transshipment from Lakefront Alternatives				Transshipment from Lakefront With Riverside Park Cut				Do-Nothing
	Alternative 9	Alternative 10	Alternative 11	Alternative 12	Alternative 13	Alternative 14	Alternative 15	Alternative 16	Alternative 17
	$	$	$	$	$	$	$	$	$
Total Project Investment Cost:									
Federal	10,500,000	10,500,000	10,500,000	10,500,000	26,500,000	26,500,000	26,500,000	26,500,000	0
Non-Federal	54,000,000	44,500,000	30,500,000	35,400,000	58,800,000	48,800,000	34,700,000	39,600,000	0
Total	64,500,000	55,000,000	41,000,000	45,900,000	85,300,000	75,300,000	61,200,000	66,100,000	0
Annual Charges									
Federal	1,100,000	1,100,000	1,100,000	1,100,000	2,500,000	2,500,000	2,500,000	2,500,000	0
Non-Federal	4,600,000	3,800,000	2,700,000	3,800,000	4,900,000	4,100,000	3,000,000	4,100,000	0
Total	5,700,000	4,900,000	3,800,000	4,900,000	7,400,000	6,600,000	5,500,000	6,600,000	0
Annual Benefits	15,800,000	12,300,000	14,900,000	11,600,000	16,000,000	12,500,000	15,000,000	11,700,000	0
Net Benefits	10,100,000	7,400,000	11,100,000	6,700,000	8,600,000	5,900,000	9,500,000	5,100,000	0
Benefit/Cost	2.78	2.51	3.91	2.36	2.16	1.89	2.73	1.77	0

1/ Dollar amounts shown for Federal and non-Federal shares are based on traditional cost-sharing policies found in EP 1165-2-1 pages 5-23 (28 September 1979).

Table 97 - Summary of Effects for Alternative Plans 1 Through 8 and 17

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Alternative 17
A. Plan Description	Direct Delivery with: a. Outer Harbor Mode. b. Riverside Park Cut c. Enlarged Channel d. Enlarged Upper Turning Basin e. Replace 21st Street Bridge	Direct Delivery with: same as Alt 1, except instead of Riverside Park Cut, replace Erie Ave. Bridge with high level bridge.	Direct Delivery with: same as Alt 2, except replace Erie Ave. Bridge with movable bridge	Direct Delivery with: same as Alt 2, except replace Erie Ave. Bridge with a tunnel	Partial transshipment: a. Outer Harbor Mode b. Riverside Park Cuteside Park c. Enlarged Channel d. Enlarged Lower Turning Basin e. Transshipment Facility f. Upriver Conveyor	Partial Transshipment: same as Alt 5, except instead of Riverside Park Cut, replace Erie Ave. Bridge with high level bridge	Partial Transshipment: same as Alt 6, except replace Erie Ave. Bridge with movable bridge	Partial Transshipment: same as Alt 6, except replace Erie Ave. Bridge with a tunnel	No Action No Nothing Plan
B. Significant Impacts									
1. National Economic Development									
a. Beneficial Impacts									
(1) Total Annual Benefits	$17,400,000	$17,600,000	$17,500,000	$17,600,000	$15,900,000	$16,000,000	$16,000,000	$16,000,000	0
b. Adverse Impacts									
(1) Total Investment Cost 1/									
(a) Federal	108,400,000	161,200,000	132,700,000	200,100,000	53,800,000	108,500,000	80,200,000	142,700,000	0
(b) Non-Federal	80,600,000	82,900,000	79,000,000	81,900,000	52,300,000	56,000,000	52,500,000	53,800,000	0
(c) Total	189,000,000	244,100,000	211,700,000	282,000,000	106,100,000	164,500,000	132,700,000	196,500,000	0
(2) Annual Charges									
(a) Federal	8,700,000	12,000,000	10,600,000	15,700,000	4,600,000	8,700,000	6,600,000	11,300,000	0
(b) Non-Federal	6,600,000	7,100,000	6,700,000	7,400,000	4,200,000	4,900,000	4,500,000	5,100,000	0
(c) Total	15,300,000	19,900,000	17,300,000	23,100,000	8,800,000	13,600,000	11,100,000	16,400,000	0
c. Economic Efficiency									
(1) Net Annual Benefits	$2,100,000	-$2,300,000	$250,000	-$5,500,000	$7,100,000	$2,400,000	$4,900,000	-$350,000	0
(2) B/C Ratio	1.14	0.88	1.01	0.76	1.80	1.18	1.44	0.98	0
2. Environmental Quality									
a. Beneficial Impacts									
(1) Biological Impact									
(a) Brookwater	Aquatic habitat provided 2.24 acres	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	None
(b) River	Aquatic habitat provided 82.68 acres	Aquatic habitat provided 82.16 acres	Same as Alt 2	Same as Alt 2	Aquatic habitat provided 55.71 acres	Aquatic habitat provided 52.19 acres	Same as Alt 6	Same as Alt 6	
(2) Air Quality	None	None	None	None	None	None	None	None	None
(3) Water Quality	None	None	None	None	None	None	None	None	None
(4) Erosion	New areas of sheet pile will reduce erosion in areas not sheet piled previously	Same as Alt 1	Same as Alt 1	Same as Alt 1	Similar to Alt 1 but to less extent since less distance of river will be sheet piled	Same as Alt 4	Same as Alt 6	Same as Alt 4	Continue at present rate
b. Adverse Impacts									
(1) Biological Impacts									
(a) Brookwater	Aquatic habitat destroyed 3.22 acres	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	None
(b) River	None	None	None	None	None	None	None	None	

1/ Includes cost of lands required for the project

Table 97 - Summary of Effects for Alternative Plans 1 Through 8 and 17 (Cont'd)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Alternative 17
(2) Air Quality	Temporary decrease during construction. Possible significant decrease if steel plant expands and/or new industry locates in Lorain.	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1	None
(3) Water Quality	Temporary decrease during construction. Natural flow of river altered to new Riverside Park Cut.	Temporary turbidity during construction.	Same as Alt 2	Same as Alt 2	Same as Alt 1	Same as Alt 2	Same as Alt 2	Same as Alt 2	None
(4) Erosion	None	None	None	None	None	None	None	None	None
3. Social Well-Being									
a. Beneficial Impacts									
(1) Noise	Decrease as fewer ships utilize channel since one Class X vessel replaces three Class VI vessels presently utilized.	Same as Alt 1 and also vessels and bridge operator will no longer need to sound horns to open and close moveable bridge.	Same as Alt 1	Same as Alt 2	Same as Alt 1	Same as Alt 2	Same as Alt 1	Same as Alt 2	None
(2) Aesthetic Values	None	None	None	None	None	None	None	None	None
(3) Community Cohesion	None	None	None	None	None	None	None	None	None
(4) Desirable Community Growth	Possibly enhanced due to increase in output of goods as local industries expand and/or new industry locates at Lorian due to ease of shipment of raw materials and goods. Some short-term growth during construction.	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1 plus some new jobs at new transshipment facility.	Same as Alt 5	Same as Alt 5	Same as Alt 5	None
(5) Cultural Resources	None	None	None	None	None	None	None	None	None
(6) Traffic Flow	No impact since Erie Ave. Bridge still would open for vessels to pass.	High level bridge at Erie Avenue would eliminate necessity for delays as vessels pass.	Same as Alt 1, since new bridge would be essentially replacement in kind.	Tunnel would serve the same function as the high level bridge in Alt 2.	Same as Alt 1	Same as Alt 2	Same as Alt 3	Same as Alt 4	None
b. Adverse Impacts									
(1) Noise	Temporary increase during construction.	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1, and increase in area of transshipment facility due to machinery operation.	Same as Alt 5	Same as Alt 5	Same as Alt 5	None
(2) Aesthetic Values	Elimination of Riverside Park	High level bridge would block view of the harbor.	Towers for moveable bridge would partially block view of the harbor.	None	Same as Alt 1	Same as Alt 2	Same as Alt 3	Same as Alt 4	None
(3) Community Cohesion	None	Large areas of residential land would be taken. Pedestrian use of bridge would be reduced due to length and location of access points.	No affect, replacement in kind.	Pedestrian use of tunnel would be reduced due to length and location of access points.	Same as Alt 1	Same as Alt 2	Same as Alt 3	Same as Alt 4	None
(4) Desirable Community Growth	None	None	None	None	None	None	None	None	None
(5) Cultural Resources	None	None	None	None	None	None	None	None	None
(6) Traffic Flow	None	Temporary delays during construction.	Same as Alt 2	Same as Alt 2	None	Same as Alt 2	Same as Alt 2	Same as Alt 2	None

Table 97 - Summary of Effects for Alternative Plans 1 Through 8 and 17 (Cont'd)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Alternative 17
4. Regional Development									
(a) Beneficial Impacts									
(1) Value of Increased Income	Possible increase due to easier access to full length of river may entice increase in industry on or near the river bank. U.S. Steel may expand existing facility.	Same as Alt 1	Same as Alt 1	Same as Alt 1	Slightly less increase than Alt 1 due to less distance of riverbank able to be accessed by Class X vessels. U.S. Steel may expand existing facility.	Same as Alt 5	Same as Alt 5	Same as Alt 5	None
(2) Quality of Increased Employment	Possible increase due to location of new industry along full length of river.	Same as Alt 1	Same as Alt 1	Same as Alt 1	Similar to Alt 1 except a) less due to less length of river opened up, b) increase due to increase at transhipment facility.	Same as Alt 5	Same as Alt 5	Same as Alt 5	None
(3) Tax Base	Increase due to possible increase in industrial activity.	Same as Alt 1	Same as Alt 1	Same as Alt 1	Similar to Alt 1 except less due to less length of river opened up. Increase due to transshipment facility.	Same as Alt 5	Same as Alt 4	Same as Alt 5	None

Table 98 - Summary of Effects of Alternatives 9 Through 17

	Alternative 9	Alternative 10	Alternative 11	Alternative 12	Alternative 13	Alternative 14	Alternative 15	Alternative 16	Alternative 17
A. Plan Description	Lakefront Transshipment a. Outer Harbor Mods. b. Lakefront Transshipment Facility c. Upriver Conveyor System	Lakefront Transshipment a. Outer Harbor Mods. b. Lakefront Transshipment Facility c. Special Purpose Vessel	Lakefront Transshipment a. Outer Harbor Mods. b. Lakefront Transshipment Facility c. Upriver Rail System	Lakefront Transshipment a. Outer Harbor Mods. b. Lakefront Transshipment Facility c. Upriver Truck System	Same as Alt. 9 with the addition of Riverside Park Cut	Same as Alt. 10 with the addition of Riverside Park Cut	Same as Alt. 11 with the addition of Riverside Park Cut	Same as Alt. 12 with the addition of Riverside Park Cut	No Action No Nothing Plan
B. Significant Impacts									
1. National Economic Development									
a. Beneficial Impacts									
(1) Total Annual Benefits	$13,800,000	$12,300,000	$14,900,000	$11,600,000	$16,000,000	$12,500,000	$15,000,000	$11,700,000	0
b. Adverse Impacts									
(1) Total Investment Cost 1/									
(a) Federal	10,500,000	10,500,000	10,500,000	10,500,000	26,500,000	26,500,000	26,500,000	26,500,000	0
(b) Non-Federal	54,000,000	44,500,000	30,500,000	35,400,000	58,800,000	48,800,000	34,700,000	39,600,000	0
(c) Total	64,500,000	55,000,000	41,000,000	45,900,000	85,300,000	75,300,000	61,200,000	66,100,000	0
(2) Annual Charges									
(a) Federal	1,100,000	1,100,000	1,100,000	1,100,000	2,500,000	2,500,000	2,500,000	2,500,000	0
(b) Non-Federal	4,600,000	3,800,000	2,700,000	3,800,000	4,900,000	4,100,000	3,000,000	4,100,000	0
(c) Total	5,700,000	4,900,000	3,800,000	4,900,000	7,400,000	6,600,000	5,500,000	6,600,000	0
c. Economic Efficiency									
(1) Net Annual Benefits	10,100,000	7,400,000	11,100,000	6,700,000	8,600,000	5,900,000	9,500,000	5,100,000	0
(2) B/C Ratio	2.78	2.51	3.91	2.36	2.16	1.89	2.73	1.77	0
2. Environmental Quality									
a. Beneficial Impacts									
(1) Biological Impact									
(a) Freshwater	Aquatic habitat provided 2.24 acres	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None
(b) River	None	None	None	None	Aquatic habitat provided 5.40 acres	Same as Alt 13	Same as Alt 13	Same as Alt 13	None
(2) Air Quality	None	None	None	None	None	None	None	None	None
(3) Water Quality	None	None	None	None	None	None	None	None	None
(4) Erosion	None	None	None	None	None	None	None	None	Continue at present rate
b. Adverse Impacts									
(1) Biological Impacts									
(a) Freshwater	Aquatic habitat destroyed: 3.33 acres	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None
(b) River	None	None	None	None	None	None	None	None	
(2) Air Quality	Temporary decrease during construction. Possible significant decrease if steel plant expands. Minor decrease from dust from conveyors.	Temporary decrease during construction. Possible significant decrease if steel plant expands.	Same as Alt 10	Temporary decrease during construction. Possible significant decrease if steel plant expands. Decrease due to exhaust from fleet of trucks.	Same as Alt 9	Same as Alt 10	Same as Alt 10	Same as Alt 12	None
(3) Water Quality	Temporary decrease during construction less than Alt. 1-8. Possible decrease if steel plant expands.	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None

1/ Includes cost of lands required for the project

Table 98 - Summary of Effects of Alternatives 9 Through 17 (Cont'd)

	Alternative 9	Alternative 10	Alternative 11	Alternative 12	Alternative 13	Alternative 14	Alternative 15	Alternative 16	Alternative 17
(4) Erosion	None	None	None	None	None	None	None	None	None
3. Social Well-Being									
a. Beneficial Impacts									
(1) Noise	Increase as fewer ships utilize channel reducing vessel noise and horn soundings to pass Erie Avenue Bridge.	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None
(2) Aesthetic Values	None	None	None	None	None	None	None	None	None
(3) Community Cohesion	None	None	None	None	None	None	None	None	None
(4) Desirable Community Growth	Smaller than for Alternatives 1-8. No channel work would limit commerce to existing conditions. New transshipment facility and possible expansion for U.S. Steel.	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9 and possible increase at Ansship.	Same as Alt 13	Same as Alt 13	None	
(5) Cultural Resources	None	None	None	None	None	None	None	None	None
(6) Traffic Flow	Improvement due to fewer openings of Erie Avenue Bridge	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None
b. Adverse Impacts									
(1) Noise	Temporary increase during construction. Increase in area of transshipment facility due to machinery operation. Increase due to conveyor operation.	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None
(2) Aesthetic Values	Increase due to uprivor conveyor	None	None	Increase due to segregated haul road	Same as Alt 9	None	None	Same as Alt 12	None
(3) Community Cohesion	None	None	None	None	None	None	None	None	None
(4) Desirable Community Growth	None	None	None	None	None	None	None	None	None
(5) Cultural Resources	None	None	None	None	None	None	None	None	None
(6) Traffic Flow	None	None	None	None	None	None	None	None	None
4. Regional Development									
(a) Beneficial Impacts									
(1) Value of Increased Income	Small increase due to transshipment facility U.S. Steel may expand existing facility.	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None
(2) Quality of Increased Employment	Increase in employment at transshipment facility. Possible increase at U.S. Steel.	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None
(3) Tax Base	Increase due to transshipment facility. Possible increase due to expansion at U.S. Steel.	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	Same as Alt 9	None

TRADE OFF ANALYSIS

All of the alternatives developed, except the No-Action plan, contain modifications to the harbor area to allow Class X vessels to more safely and efficiently enter Lorain Harbor and also allow the vessel to be loaded to a system-wide draft of 25.5 feet. Alternatives 1 through 4 deal with further improvements to allow Class X vessels to navigate the entire length of the Federal project. Alternatives 5 through 8 would limit the length of river the Class X vessel could transit to that portion north of the 21st Street Bridge with transshipment from the bridge to the U.S. Steel Plant, a short distance further upstream (south). Alternatives 9-16 call for improvements to the harbor area only with iron ore for U.S. Steel being transshipped from the lakefront by either conveyor, special purpose vessel, rail or truck. Alternative 17, is used as the basis of comparison.

In devising the alternatives, primary consideration was given to economic considerations, potential adverse environmental impacts, and effects on existing and proposed facilities. From investigations performed as part of this study, there appear to be no serious environmental impacts from any of the alternatives. The alternatives were developed such that the impact on existing facilities would be minimal. Where the alternatives impacted upon the proposed small-boat harbor (the only proposed facility identified), additional breakwaters were added to the alternatives to reduce or eliminate the impact. Therefore, the overriding consideration used to determine which alternatives would be carried into the Final Feasibility portion of this study is economics.

RATIONALE FOR PLANS ELIMINATED FROM FURTHER DETAILED STUDY

As stated in the Trade Off Analysis section above, the overriding consideration in choosing which alternatives deserve further study and which will be eliminated is the economic efficiency and associated project costs of the alternatives.

Direct Delivery (Alternatives 1-4) - The Direct Delivery Alternatives range in cost from $189,000,000 to $282,000,000. Annual Charges range from $15,300,000 to $23,100,000. Alternatives 2 and 4 are not economically justified (B/C less than 1). Plans 1 and 3 are only marginally justified (B/C of 1.14 and 1.01 respectively.) These alternatives also require the largest outlay of both Federal and non-Federal funds. These alternatives require the most land acquisition and also would cause the most disruption to existing conditions. Any improvements upriver of the Amship facility would be in the single user category requiring a 50 percent Federal - 50 percent non-Federal cost sharing. For these reasons Alternatives 1-4 are eliminated from further consideration.

Transshipment from North of 21st Street Bridge (Alternatives 5-8) - The cost for Alternatives 5 through 8 range from $106,100,000 to $196,500,000. Annual charges range from $8,800,000 to $16,400,000. Alternatives 5, 6, and 7 are economically justified with Alternative 5 being the best with a benefit-cost ratio of 1.89. Alternative 8 is not economically justified (benefit/cost ratio less than 1). The three alternatives, economically

justified, are significantly more expensive, require significantly more land acquisition and cause much greater disruption to existing conditions than do Alternatives 9-16 .

As with Alternatives 1-4, any improvements upriver of the Amship facility would be in the single-user category and therefore would require a 50 percent Federal - 50 percent non-Federal cost sharing.

Therefore, Alternatives 5-8 were also eliminated from further consideration.

Lakefront Transshipment, No Riverside Park Cut (Alternatives 9-12) - These alternatives all involve construction of a lakefront transshipment facility and transshipment of the iron ore upriver by either conveyor (Alt 9), special purpose vessel (Alt 10), train (Alt 11), or truck (Alt 12). Alternatives 11 and 9 have the maximum net benefits of $11,100,000 and $10,100,000 and benefit-to-cost ratios of 3.91 and 2.78 respectively. However, since any transshipment mode would be entirely the responsibility of local interests, it is concluded that the preferred transshipment alternative(s) to be investigated in Stage 3 should be decided by local interests. Workshops will be held at the beginning of Stage 3 for the purpose of obtaining local views on the preferred transshipment alternatives. It is suggested that one land and one water mode be investigated, as the maximum, in Stage 3.

Lakefront Transshipment With Riverside Park Cut (Alternatives 13-16) - Alternatives 13-16 are similar to Alternatives 9-12 except that a Riverside Park Cut has been added. The additional benefits attributable to the Riverside Park Cut are less than the additional costs incurred. Since Alternatives 9-12 fulfill the planning objectives and have greater net benefits, Alternatives 13-16 appear to warrent elimination from further consideration. However, late in Stage 2, a congestion problem at the Republic Steel Transshipment Facility surfaced. If vessel delays because of this area of congestion are significant, the Riverside Park Cut in Alternatives 13-16 could be cost effective. Therefore, the District proposes to conduct a congestion study early in Stage 3 and based on their analysis, include or eliminate the Riverside Park Cut, as appropriate.

ADDITIONAL MODIFICATIONS NECESSARY FOR OPERATION BY 1,200-FOOT VESSEL

The authorizing resolution for this study states in part "Resolved ... that the Board of Engineers for Rivers and Harbors ... review the report on Lorain Harbor ... with a view of determining whether any modifications to the recommendations ... is advisable ... including consideration of the passage and safe navigation of new and larger ships operating on the Great Lakes."

The maximum Ship Size Study performed by North Central Division, Corps of Engineers, identified the maximum ship size to be used on the Great Lakes as 1,200 feet X 130 feet. Therefore, during preliminary designs for this study, modifications to accommodate this size vessel were made. Appendix A includes the designs arrived at as well as costs for these modifications.

There are presently no 1,200-foot vessels operating on the Great Lakes, nor does the Corps have any information that any are being planned. Before operation of a 1,200-foot vessel would be possible, system changes would also be necessary, such as a new lock near the Poe Lock to allow the 1,200-foot vessel to pass between Lake Superior and Lake Huron.

There are presently no benefits that can be credited to the Lorain project for use of 1,200-foot vessels without discounting for this scenerio that appears to be at least 25 to 50 years in the future. Therefore, any improvements at this time to accommodate such a vessel would not appear to be justified.

However, since the Project is evaluated with a 50-year life, 1,200-foot vessels may be a reality by the end of that period. Therefore, any modifications made to accommodate 1,000-foot ships should be investigated to determine if they would preclude operation by 1,200-foot vessels.. If they do, and the modification could be changed to not preclude 1,200-foot vessel operation at a minimal extra cost, the change to the modification should be investigated.

The lakefront transshipment Alternatives 9-12 recommended for presentation to the local interests require modifications to the existing East Breakwater and dredging of the Outer Harbor. The preliminary designs of modifications necessary for safe and efficient operation of 1,000-foot vessels into and out of Lorain Harbor are sufficient for operation of 1,200-foot vessels also. Therefore, no changes are necessary to Alternatives 9-12 to include possible 1,200-foot vessel operation.

RATIONALE FOR CANDIDATE NED PLAN AND EQ PLAN

In selecting the National Economic Development Plan (NED), candidate plans must not only satisfy the planning objectives and evaluation criteria; they must also maximize net benefits. The plan that best fulfills these criteria is Alternative 11, lakefront delivery with upriver transsshipment by rail, with annual net benefits of $11,900,000.

Recognizing that environmental quality has both natural and human manifestations, the EQ Plan addresses the planning objectives in a way which emphasizes aesthetic, ecological,and cultural contributions. Beneficial EQ contributions are made by preserving, maintaining, restoring or enhancing the significant cultural and natural environmental attributes of the study area. Developing an EQ Plan involves measuring the environmental changes related to different plans and selecting the plan which, based on public input, contributes to or is most harmonious with environmental objectives. This means that candidate EQ Plans must make net positive contributions to the components of the EQ account.

In some studies, it may be impossible to develop a plan that meets the minimum requirements for designating an EQ Plan; i.e., a plan that makes net positive contributions to the EQ account. In those cases, the plan which is least damaging to the environment will be identified. The Lorain Harbor Commercial Navigation Study is such a case.

Due to the commercial and industrial nature of the study area, there is little opportunity to develop EQ objectives which would lead to an EQ Plan. Therefore, the least environmentally damaging plan has been identified for this study. Alternatives 1-8 all include some type of bridge replacement, channel enlargement, and Outer Harbor reorientation. Alternatives 13-16 all include reorientation of the Outer Harbor and construction of a new channel through Riverside Park, as well as construction of a transshipment facility at lakefront. Alternatives 9-12 all include enlarging and reorienting the Outer Harbor entrance and construction of a transshipment facility at lakefront. Alternative 9 proposes an upriver conveyor system from the transshipment facility. Alternative 10 proposes construction of an upriver special purpose vessel facility, Alternative 11 an upriver rail facility and Alternative 12 an upriver truck facility. These four alternatives (Alternatives 9-12) would produce the least amount of disturbance of the Black River channel, banks and surrounding land, by not including as construction items the construction of a new channel through Riverside Park, bridge replacements, channel enlargement, or turning basin enlargements. Of these four lakefront transshipment alternatives, Alternative 11, construction of a Transshipment Facility at Lakefront and Upriver Rail Facility has been chosen as the plan that is least environmentally damaging. Rail trackage to the U.S. Steel Plant is already in existence, although in need of upgrading, thus not necessitating new construction, as in the case of a conveyor, berthing facility for a special purpose vessel or channel widening in the berthing area to permit the vessel to turn around without having to enter the Outer Harbor, or roadway for the truck system. The rail alternative is also believed to be the most energy-efficient of the four methods of transporting material upriver. Therefore, Alternative 11 has been identified as the plan that is least damaging to the environment.

SECTION F
STUDY MANAGEMENT

The purposes of this section are: (1) to provide an outline of the principal activities needed to complete the Feasibility Study; (2) to describe the methodologies to be used; (3) to describe the contemplated public involvement and coordination activities; and (4) to provide information on the study schedule for the remainder of the Feasibility Study.

INTRODUCTION OF STUDIES TO BE PERFORMED IN STAGE 3

As previously stated, the emphasis of this Stage 2 study was placed on modifications to Lorain Harbor to serve its commercial navigation needs. However, in conformance with the goals of multi-objective planning for related water resource problems and needs in the study area, investigations of the harbor sedimentation problem and recreational navigation (small-boat harbor) needs have been identified as additional study objectives to be undertaken as part of the Lorain Harbor study. It was determined that development of intermediate plans (Stage 2) and development of detailed plans (Stage 3) for the sedimentation and recreational navigation portions of this study will be performed during the Stage 3 portion of the overall study.

Figure F1, following, shows the schedule of major activities that will be performed for Commercial Navigation, Recreational Navigation, and Erosion and Sedimentation prior to submitting the Final Feasibility Report for Lorain Harbor. From the schedule, note that Stage 2 studies for Recreational Navigation and Erosion are performed concurrently with the Stage 3 study of Commercial Navigation. The Stage 2 findings for these two needs will be submitted to higher authority for review and approval as intermediate report. During the detailed design stage, the results of the three interdependent studies will be incorporated into a Draft Final Feasibility Report on Lorain Harbor. The Draft FFR/DEIS and FFR/EIS will be prepared during Fiscal Year 1983.

The activities involved in completing the study of each of these three water resources needs are described below.

COMMERCIAL NAVIGATION

Stage 2 Findings

The findings of this Preliminary Feasibility Report are that, of all the alternatives studied, transshipment from the lakefront would be the least costly and most economically efficient alternative(s). After consideration of other factors - i.e., financial feasibility, environmental and social impacts. etc. - it was concluded that the lakefront transshipment should be carried into Stage 3 as the preferred alternative. Since any form of transshipment would be a local responsibility, the decision as to which transshipment modes to be investigated further will be determined by local interests during the public involvement portion of the Stage 3 effort.

PROPOSED SCHEDULE OF MAJOR ACTIVITIES FOR LORAIN HARBOR STUDY

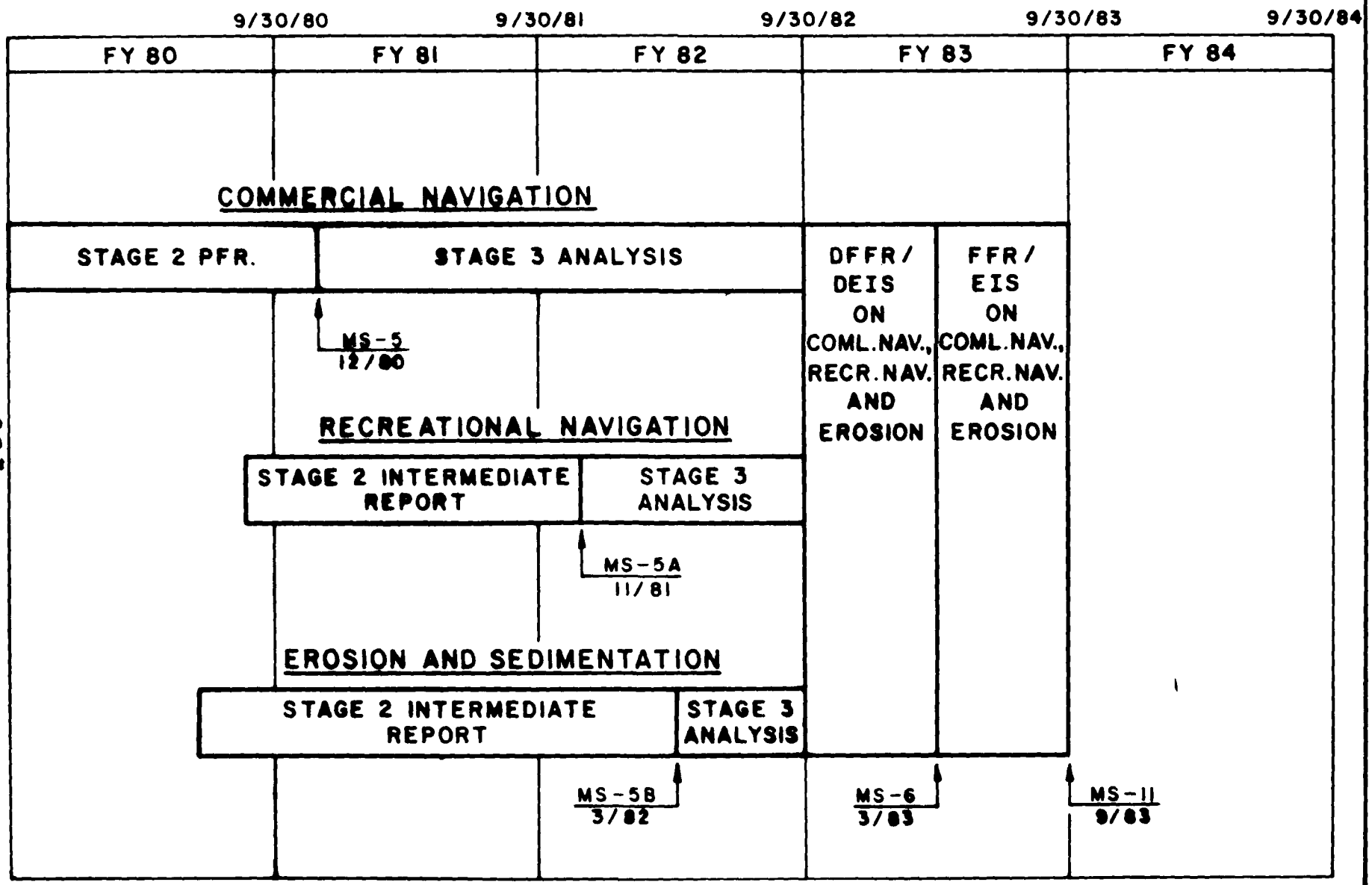

FIGURE F-1

The management plan presented herein assumes that only two of the four transshipment alternatives will be studied in-depth in Stage 3.

Stage 3 Methodology for Commercial Navigation

The emphasis in Stage 3 will be placed on: refining designs, quantities, and cost estimates for the two alternatives chosen by local interests to be investigated in-depth; refining traffic forecasts, fleet forecasts, and regional economic impacts; determining to a greater extent how season extension and connecting channels study impact on the Lorain Study; investigating the recently identified congestion problem to determine what if anything should be done to alleviate this problem; and evaluating the environmental impacts of the Selected Plan.

Before refinement of the designs can begin, more accurate operating characteristics must be determined for 1,000-foot vessels. Assumptions made in Stage 2 will be checked for accuracy and corrected as necessary. This aspect could prove critical since the majority of benefits for all alternatives are accrued due to insufficient draft. If lesser amount of depth is required to allow for vessel roll, pitch, squat and bottom clearance, benefits will be reduced.

A potential congestion problem at the mouth of the Black River has arisen during the 1980 shipping season. Captains of vessels bound for U.S. Steel docks upriver have stated that when a 1,000-foot vessel is unloading at the Republic Steel Pellet Terminal, there is not sufficient room to pass. This problem will be studied in Stage 3 and corrective features incorporated into the Selected Plan if necessary.

Further refinement of other economic factors is also necessary. U.S. Steel owns and operates its own bulk cargo fleet. The majority of these vessels are in the 500-700 foot length and are approaching the end of their design life. U.S. Steel has recently purchased two 1,000-foot vessels. In Stage 3, U.S. Steel's plans for updating their fleet will be investigated in greater detail.

Also to be studied in greater detail in Stage 3 is American Shipbuilding's long-range forecast for construction of 1,000-foot vessels and also for the mandatory 5-year hull inspection for 1,000-foot vessels. This information plus information from other sources will be used to update information used in Stage 2.

The Study Flow Network (CPM) showing the activities involved in the remainder of the feasibility study on commercial navigation is presented on Figure 2 of Appendix F. With reference to the CPM, the future involvement of the District's interdisciplinary team is as follows:

Coastal Engineering - Refine design for breakwater modifications. Provide wave height and frequency for waves from various directions to be used in determining depth required at the entrance to the harbor. This work will take a total of 3 man-months.

Geotechnical Section - This work totals 3 man-months of in-house effort involving: stability analysis of harbor structures, a materials survey, and preparation of a geotechnical appendix.

General Engineering - The work involved is: preparation of final quantity and cost estimates (6-1/2 man-months); and 1 month for preparation of the cost appendix for a total of 7-1/2 man-months.

Economics - The economics work involves: refine traffic forecasts - 1 man-month; investigation of transportation costs per ton vs. Low Water Datum reference plane - 1/2 man-month; refine fleet forecast - 1 man-month; congestion study - 1 man-month; capacity study and season extension studies interface - 1 man-month; refinement of transshipment alternatives - 1 man-month; and refine regional economic impacts - 1 man-month; for a total effort of 7-1/2 man-months.

Environmental - The in-house effort involves 5 man-months to prepare the Draft Environmental Impact Statement and 404 evaluation and 1 man-month to prepare the Final Environmental Impact Statement. Total in-house effort totals 6 man-months. Contract costs consist of $5,000 to the USF&WLS for Coordination Act activities.

Real Estate - The appraisal would be performed by North Central Division at a cost of approximately $2,000.

Drafting - About 3 man-months of in-house effort, involving graphic displays for the Final Feasibility Report and preparation of visual aids for workshops and the public meetings.

Project Management and Planning - The study manager is expected to spend approximately 50 percent of his time accomplishing Stage 3 activities. These activities are primarily involved with coordinating efforts of the interdisciplinary team, preparation of materials for public meetings and workshops, coordination with other agencies, budget and related activities and report preparation.

Public Involvement and Coordination for Commercial Navigation Portion of Stage 3

A workshop is planned for mid-December 1980 to present the results of the Stage 2 study and to determine which two transshipment alternatives will be carried into Stage 3 planning. Close contact will be maintained with the principal local industries (U.S. Steel, Republic Steel, and American Shipbuilding) to solicit input to this study. A final public meeting will be held at the end of Stage 3 to present the findings of the Feasibility Study.

EROSION, SEDIMENTATION, AND HARBOR MAINTENANCE DREDGING

Preliminary Erosion and Sediment Investigation (Stage 2 Effort) - As previously stated, the purpose of this investigation is to identify the sources of sediment contribution to Lorain Harbor with the objecive of reducing harbor maintenance dredging by reducing erosion at the source, if feasible.

The initial study on Erosion and Sedimentation for Lorain Harbor is an interagency effort involving Buffalo District, the U.S. Geological Survey, and the U.S. Soil Conservation Service. There are three major work items to be accomplished in this phase of the study. They are: (1) a stream gaging/sediment sampling network; (2) an upland erosion study; and (3) a streambank/channel erosion study.

Stream Gaging Network - Under this Interagency Agreement, the U.S. Geological Survey will conduct a 1-year sediment-sampling program in the Black River, OH, Watershed for the purposes of providing basic sediment data to be used by Buffalo District in identifying the prolific sources of sediment in this watershed.

The sampling network shall consist of four gages. The type, location, and costs are as follows:

a. The present Elyria gage located approximately 2 miles downstream from the confluence of the East and West Branches of the Black River will be utilized. Some modifications are necessary to increase the capacity of this station to meet Corps needs. At this station, samples will be taken both by an automatic sampler and grab samples. A determination of the daily flow and gradation of the sediment will be made. Sufficient bedload sampling will also be performed at this location to provide an estimate of the total sediment load at Elyria. Total cost, including 1-year sampling, is $20,000.

b. The second station will be on the West Branch, a short distance upstream of the confluence of the East and West Branches. A permanent station will be established at this location. This station will yield the same data for the West Branch as the previously discussed station would for the main stem. However, no bedload sampling will be performed for this station. Total cost, including 1-year sampling, is $30,500.

c. The remaining two stations will be wire-weight gages located approximately at the mid-point of the drainage areas, one on each branch. These stations will yield only event sampling (primarily high-flow events that produce the significant sediment transport) and will include some gradation data. An estimate of the annual suspended sediment load at these two stations will be provided. Cost for each station, including 1-year sampling, is $7,440.

In addition to the network described above, the Geological Survey will perform a single-event sampling tracing the sediment transport from Elyria to Lorain Harbor. The purposes of this investigation are to quantify the sediment contribution between the Elyria gage and Lorain Harbor, and the sediment discharge into Lake Erie.

The data collected will be used as the basis for estimating the annual suspended and total sediment sediment yield at the four stations listed above. The results of the investigation will be provided to the Buffalo District by 1 July 1981, and be accompanied by the necessary text to: describe the subwatersheds sampled; sampling techniques (including frequency) used; methodology used to obtain estimates of annual suspended sediment yield; interpretation of data and results (i.e. - seasonal distributions of sediment yield, any information or judgments on whether the sampling year is wet, normal or average, or dry, etc.) as appropriate; and other related information. Cost for the report is $4,000.

Figure 2 of Appendix E is the Study Flow Network showing the activities and schedule for the U.S.G.S. effort on the Erosion and Sedimentation Study.

Upland Erosion Study - The Upland Erosion portion of this study will be performed by the Water Quality Section of the Buffalo District. Information on such variables as soil type, slope, land uses, etc. will be used to determine the location and quantity of sediments being eroded from upland areas. Areas found to have the most serious erosion problems will be located and land management practices to reduce erosion will be determined. However, the majority of the area that will be under investigation is privately owned and therefore any Government participation would be limited to information on the results of the Upland Erosion Study. Implementation of the findings would be a local responsibility.

Data required for this portion of the study will come from two sources. The first being data previously collected as part of the ongoing Lake Erie Wastewater Management Study presently being accomplished by Buffalo District. This information consists of soil types, slopes, land uses, etc., for rural land areas. Additional data is necessary for urban areas not previously investigated. To obtain these data, the Buffalo District entered into an interagency agreement with the U.S. Soil Conservation Service (SCS) to perform the necessary field sampling program in appropriate subareas of the Black River Watershed. This effort has been accomplished and the data furnished to the Water Quality Section of the Buffalo District.

Involvement of the District's interdisciplinary team in the upland erosion portion of this study is as follows:

a. Water Quality - Using the data previously collected for the Lake Erie Wastewater Management Study and data collected by the U.S. Soil Conservation Service (SCS) as part of their ongoing Natural Resources and Erosion Inventory, areas of critical erosion and appropriate management practices to prevent this erosion will be determined. This work totals approximately 6 man-months.

b. Economics - Derive benefits from reduction in maintenance dredging attributable to upland erosion, approximately 1 man-month.

c. Project Management and Planning - The study manager is expected to spend approximately 10 percent of his time in Stage 3 on this portion of

the study. The effort is primarily coordination of the effort within Buffalo District and between Buffalo District and other agencies.

Preliminary Study of Streambank/Channel Erosion - A preliminary study on streambank/channel erosion in the Black River will be performed to determine if sufficient erosion is occurring to warrant detailed study. This effort is presently scheduled to be accomplished by the U.S. Soil Conservation Service under an interagency agreement with the Buffalo District. This preliminary study will involve the following areas (See Figure 2 of Appendix E for CPM showing the schedule for these activities):

a. Literature Search - The SCS will conduct a literature search in order to familiarize themselves with previous studies that have been performed within the study area. A listing of reference materials pertaining to the study will be provided. Upon request, the District will furnish to the SCS copies of any Corps of Engineers reports relevant to this study.

b. Aerial Photography Interpretation - The SCS will obtain historical aerial photography of the Black River and its East and West Branches for use in the study. Aerial photography from the 1938 and 1979 flights of the basin will be used as the basis of comparison to estimate the amount of annual streambank recession along the Black River. A photo mosaic and prints of these historical photos will be made as well as overlay maps to determine historical areas and amounts of critical streambank erosion.

c. Field Reconnaissance - After review of historical aerial photography, the SCS shall perform a field reconnaissance of the Main Stem and the East and West Branches of the Black River. SCS will use this field reconnaissance to verify areas of critical streambank erosion and the rate of erosion by reach for the entire river obtained from aerial photo interpretation. If possible, the river will be floated by the SCS. However, if flows are too low to permit floating, other methods (such as helicopter) will be used.

d. Geology of the Area - A description of the geology of the study area shall be provided as part of this study of streambank erosion. The description, consisting of geologic maps and text, will include the regional bedrock and surficial geology of the entire Black River drainage basin, as well as the detailed local geology of the Main Stem and East and West Branch river channels and adjacent banks. Emphasis will be given to interpretation of stream form and streambank erosion with respect to geologic deposits and conditions.

e. Interim Report - From the results of the field reconnaissance and comparison of the 1938 and 1979 river patterns, the SCS will prepare an interim report documenting the areas of streambank erosion found to be occurring in the Black River and its branches. The report will consist of a written text and maps showing the historical changes in the river pattern. In the interim report, the SCS will furnish their recommendation as to whether or not further study of streambank erosion and a detailed assessment of its contribution to sedimentation in Lorain Harbor is warranted. If additional work is recommended, the SCS will submit for approval a detailed proposal for work items to be performed in the next study phase. The proposal

sh ld include the approximate number of eroding sites identified for further study. The number of selected sites will be determined jointly by the SCS and Buffalo District and will be sufficient to be representative of the entire system and should also include those sections experiencing the most severe erosion.

Followup In-Depth Study of Streambank/Channel Erosion (If Necessary) - If this preliminary study shows that further study is required, a consulting engineering firm will be hired to do a more detailed study of those streambank areas found to be critically eroding. The objective of the in-depth study will be to determine the feasibility of implementing a streambank erosion control program to reduce the amount of annual dredging at Lorain Harbor. The tasks that would be accomplished under this contract are as follows (See Figure 2 of Appendix E for CPM showing the schedule for this work):

a. Volume of Sediment From Streambank Erosion - The method of analysis will depend on site conditions, but the in-depth data collected at each critical streambank site would include its length, bank height, estimate of annual bank recession based on field observations, mechanism of bank failure, soil types and thicknesses, geologic classification of bank materials, and type of vegetation. The estimated long-term bank recession rates by the SCS would be used as a check on any field estimates of bank erosion by the Contractor. Once the refined erosion rate is established for the specific sites under study, volumetric estimates of eroded soil will be made for those reaches, as well as for other eroding reaches having similar characteristics. Prior to completion of the detailed field work, the Contractor shall establish survey control by installing permanent reference bench marks at selected major sites of erosion. The exact number of sites to be surveyed will be determined after submission of the SCS's report. The initial survey shall be performed by the Contractor to determine distances between banklines and established bench marks. The results of the initial survey will be submitted and will serve as baseline data to be used by the Contracting Officer in determining future erosion rates from followup surveys.

b. Bank Sampling - The Contractor shall obtain samples of bank materials at each eroding site and perform laboratory gradation analysis on each sample. The stream's sediment transport capacity shall be determined from an analysis of the gradation of bank materials and USGS flow and sediment discharge data.

c. Preparation of Streambank Erosion Data - The Contractor will prepare, at a scale approved by the Contracting Officer, a series of maps showing the river divided into broad geologic reaches and subreaches identifying sites of critical streambank erosion. From the collected data, the Contractor will calculate the annual amount of sediment contributed from each eroding site. A cumulative contribution from streambank erosion shall be tabulated and the annual delivery rate to the harbor estimated.

d. Industrial and Municipal Waste Discharge Study - In order to adequately define all major sources of sediment dredged from Lorain Harbor annually, the Contractor shall estimate sediment production from industrial

activities and municipal waste treatment plants in the lower portion of the Black River. This analysis shall be based in a review of Environmental Protection Agency industrial and municipal waste discharge records for major near-river treatment plants and factories, as well as laboratory tests performed on samples of harbor sediments. The Buffalo District will furnish to the Contractor the results of sediment quality testing performed by the EPA and the Corps of Engineers.

e. Study of Sediment Contribution from Identifiable Nonpoint Sources - The Contractor shall perform a separate study to identify and quantify sediment produced from identifiable nonpoint sources. These identifiable nonpoint sources are areas where highly visible gully erosion is taking place on disturbed areas adjacent to the river channel. Typical examples of these areas are: sand and gravel pits; surface mining or stripping operations; landfill sites; construction sites (i.e., highway construction, residential development). These areas of erosion can be identified from interpretation of aerial photography and supplemented by field observations.

f. Preparation and Evaluation of Preliminary Plans to Reduce Streambank Erosion - From the data collected and analyzed, the Contractor will formulate preliminary alternative structural and nonstructural plans for controlling streambank erosion. Estimates of quantities and costs for these alternatives will be obtained. Based on estimates of the amount of sediment, and hence harbor dredging reduction, the Contractor will then determine the reduction in annual maintenance dredging cost which would be the quantifiable benefits attributable to plans of improvement for reducing streambank erosion. He will also perform an environmental assessment for the erosion control methods investigated, and ultimately conclude whether or not implementation of streambank erosion control is warranted. Further, more detailed studies of streambank erosion (comparable to a Stage 3 effort) will be initiated by Buffalo District, as appropriate.

Preliminary Feasibility Report (PFR) on Erosion, Sedimentation, and Harbor Dredging - If a Contractor is engaged to perform the in-depth streambank erosion study, he will also be utilized to prepare this PFR. Otherwise, the Buffalo District will prepare the report. This report will include the U.S. Geological Survey's report on Stream Gaging, the U.S. Soil Conservation Survey's preliminary report on streambank erosion, the Buffalo District's report on Upland Erosion and the Contractor's own in-depth study on streambank erosion. This preliminary erosion and sedimentation report is scheduled for completion in February 1982. It will be submitted to higher authority for review and approval as an intermediate report.

Detailed Investigation of Erosion, Sedimentation, and Harbor Dredging (Stage 3 Effort) - The Stage 3 effort on Erosion and Sedimentation will depend upon the findings of the preliminary feasibility study. If alternatives developed in Stage 2 are deemed worthy of further investigation, a Stage 3 investigation will be initiated. During Stage 3 refinements of study parameters, costs and benefits will be performed. The result of Stage 3 will be a recommendation as to whether or not there are feasible alternatives

to reduce the quantity of sediment reaching Lorain Harbor by controlling either or both sources of sediment, upland erosion or streambank erosion.

Irrespective of the conclusions and recommendations, the District's study of Erosion, Sedimentation, and Harbor Maintenance Dredging will be presented as a separate volume in the Lorain Harbor Final Feasibility Report (See Figure 2 of Appendix A for CPM showing the schedule for this work).

RECREATIONAL NAVIGATION (SMALL-BOAT HARBOR AT LORAIN)

Preliminary Feasibility Study (Stage 2 Effort) - As is the case for the feasibility study on Erosion and Sedimentation, Stage 2 and Stage 3 studies of the Recreationa Navigation needs at Lorain Harbor will be undertaken concurrently with the Stage 3 investigation of Commercial Navigation. An intermediate report of the Stage 2 results will be prepared. Stage 3 results will be presented as a separate volume in the Lorain Harbor Final Feasibility Report.

The Stage 2 effort on Recreational Navigation is being performed by a consulting engineering firm under contract to Buffalo District. The Contractor, Tetra Tech, will perform a Preliminary Feasibility Study and prepare a Preliminary Feasibility Report on a small-boat harbor at, or in the vicinity of, Lorain Harbor, OH, at the cost of $165,000 . The work shall include public involvement and coordination, site identification and selection, determination of regional and local marina capacity demand over the project evaluation period, preliminary designs and cost estimates for a range of alternative small-boat harbor plans, economic forecasting analysis and evaluation, environmental assessment, project evaluation, and report preparation. The Contractor will use the iterative planning process of problem identification, formulation of alternatives, impact assessment, and evaluation established in Principles and Standards for this work. The content of the report can be modified, as appropriate, to present information needed to fully describe the local conditions and study results. The Contractor will furnish all personnel, equipment, materials, computer services, and travel necessary to satisfactorily accomplish the work items listed below.

a. Orientation, Review, and Use of Prior Reports and Documents - The Contractor will review and use to the maximum extent practicable, all prior reports and documents prepared to date.

b. Coordination - Included in this task is the following:

(1) Coordination with Other Studies and Projects - The Contractor will coordinate this Stage 2 study with the following studies or projects that may have an effect on the small-boat harbor design:

(a) Feasibility Study for Commercial Navigation at Lorain Harbor - Undertaken by Buffalo District concurrent with this study. Some of the alternatives being considered for harbor modification for commercial navigation include encroachment into the East Basin which could introduce a

constraint to a small-boat harbor development at the East Shorearm Breakwater.

(b) Construction of Temporary Breakwater for a Marina at the East Shorearm - Lorain Port Authority is presently developing a temporary marina at the East Shorearm site.

(2) Public Involvement and Coordination of Study Activities -

(a) Coordination of Study with Contracting Officer and Buffalo District Staff - Generally, coordination with Buffalo District will be through the Project Manager for the Lorain Harbor Study.

(b) Coordination with Other Non-Federal Study Interests - Except for the workshops discussed below, which involve Buffalo District staff, the Contractor will perform all the coordination (letters, telephone calls, informal meetings, etc.) he deems necessary to obtain input from non-Corps officials, special interest groups, and the private sector.

(c) Coordination with U. S. Fish and Wildlife Service, Columbus, OH - Under the 1958 Fish and Wildlife Coordination Act, it is required that Corps planning and design be coordinated with the USF&WLS. As input to this Stage 2 report, the Buffalo District will contract with the F&WLS to provide an Intermediate Report addressing the impacts of the various alternatives on the natural environment. Therefore, after coordination with the District's Environmental Section, the Contractor will initiate periodic discussions with and forward information on the various alternatives, to the F&WLS in Columbus as the information becomes available.

(3) Workshops - Three workshops will be held during the course of this work. The Orientation Workshop will be held as soon as practicable after completion of Review of Reports and after a cursory evaluation of potential small-boat harbor sites in the study area. This workshop has been scheduled for 4 November 1980. The purpose of the Orientation Workshop is to outline the planning process, define the study objectives, and obtain general input from the Workshop participants. The Initial Iteration Workshop will be held as soon as practicable after completion of Site Selection, but prior to initiation of preliminary designs for the Preferred Site Alternatives. The Alternatives Workshop will be held late in the study, but before completion of the Draft Report. The purposes of these three workshops are: (1) to review the study objectives and present a status report on progress to date; (2) present results of "Site Selection" or "Evaluation of Preferred Site Alternatives" studies, as appropriate; (3) solicit input and comments from the workshop participants on the results of work performed; and (4) identify other sites or alternatives that the participants think should be considered. For each of these workshops, the Contracting Officer or his designated Corps representative will conduct the workshop, and the Contractor make the presentation of the work accomplished for that particular phase of the study.

c. Plan Formulation - In formulation of a plan, equal consideration will be given to the national objectives of National Economic Development (NED) and Environmental Quality (EQ), as set forth in the Water Resources Council's

Principles and Standards. These plans, or candidate plans, will be identified. From these plans, the overall formulation process ultimately leading to the Selected Plan (Stage 3) consists of a series of trade-offs in order to minimize conflicts and maximize compatibility. The NED plan will address the planning objectives while maximizing net economic benefits. The EQ plan will address the planning objectives, but emphasizes contributions to aesthetic, ecological, and cultural values. A set of planning objectives identified from an analysis of the problems, needs, concerns, and opportunities within the area will be developed and used as a general guideline in the formulation process. Technical, economic, and environmental criteria will be used to develop and select justifiable plans that best respond to the Recreational Navigation problems and needs at, or in the vicinity of Lorain Harbor. A System of Accounts will be used to display significant beneficial and adverse contributions of each alternative. The System of Accounts will describe each alternative and display the planning objectives; present each plan's performance against the specified evalution criteria, and indicate such factors as geographical incidence, uncertainty and actuality associated with the evaluation of significant impacts.

e. Site Selection - The Contractor will perform an initial preliminary screening of potential sites to identify and evaluate possible small-boat harbor sites with a minimum of 400-slip capacity in Lorain Outer Harbor (East and West Basins), the Black River, and along the shoreline of Lake Erie for a distance 2 miles east and 2 miles west of Lorain Harbor. Input from the Orientation Workshop will be considered in site selection. A typical conceptual layout of a harbor will be prepared for each location by the Contractor. A matrix of the qualitative advantages and disadvantages (i.e., required protective structures, dredging, environmental impacts, costliness, social impacts, location benefits, etc.) for each site shall be prepared, and a conclusion and recommendation made for the preferred location identified based on this evaluation. For the preferred (most promising) location, the Contractor will prepare a range of alternative conceptual layouts that have the potential for satisfying the small-boat needs at the preferred site. This evaluation will be presented by the Contractor at an Initial Iteration Workshop (described above) to be held in the Lorain area about 2 months after issuance of the Notice to Proceed. Activities include, but are not limited to:

(1) Location of potential harbor sites.
(2) Conceptual (line drawings) layout of harbor for each site.
(3) Evaluation matrix and discussion of each location.
(4) Conclusion and recommendation for preferred site.
(5) Participation at Initial Iteration Workshop (see Task 2).
(6) Agreement between Contracting Officer and Contractor on the Selected Site.

f. Harbor Capacity, Preliminary Designs and Layouts for Alternative Plans at the Preferred (Selected) Site - After agreement between the Contractor and Contracting Officer on the Selected Site, the Contractor will identify and prepare preliminary designs for Alternative Plans that serve the recreational navigation needs at the Selected Site. These Alternative Plans will be discussed with the District's Project Manager early in this task to

insure agreement with the alternatives to be evaluated. One alternative that must be carried through the planning process is the "No Action" or "Do Nothing" Alternative.

g. Consideration of Recreational Breakwater and Pier Fishing as a Planning Objective - Dependent upon the local excess demand, desires of local interests, and the types and layout of harbor structures for the Alternative Plans, the potential for recreational breakwater fishing may exist. The Contractor will evaluate this potential and include it as a project purpose, as appropriate. If included, related costs, benefits, and economic evaluations for recreational breakwater fishing will be prepared.

h. Quantity and Cost Estimates- The Contractor will prepare quantity and cost estimates for each Alternative Plan. Price levels used in the estimate will be based on current prices and identified in the cost estimates. The breakdown of the estimate into features and subfeatures will be as complete as possible and will include quantities and unit costs for all main construction items.

i. Economic Analysis - EM 1120-2-113, Benefit Evaluation and Cost-Sharing for Small-Boat Harbor Projects, 11 June 1959, will be used as the basis for the boating benefit analysis. The Water Resources Council Procedures for Evaluating NED Benefits and Costs (Federal Register, 14 December 1979) will be used in the recreational breakwater fishing benefit analysis if it is concluded in Task 5 that this alternative is to be included as a project purpose. The Contractor shall submit to the Buffalo District within 60 calendar days after issuance of the Notice to Proceed an outline showing the methodology to be used in the economic evaluation for this project. This submittal will be reviewed to insure conformance to criteria, and any changes required in the methodology will be discussed with the Contractor.

j. Environmental Assessment - Definition of environmental considerations and an environmental assessment (impacts and effects) will be performed by the Contractor for each of the Alternative Plans. Available data and reports will be used in the assessment. If mitigation of adverse environmental impacts is required for the Alternative Plans, such mitigation will be identified, preliminary plans, designs, and costs prepared, and an evaluation of each made.

k. Preparation of the Preliminary Feasibility Report on Recreational Navigation (Intermediate Report) - The Contractor shall prepare the Preliminary Feasibility Report on Recreational Navigation and insure that it meets all applicable engineering regulations. The report will consist of a main report and appropriate technical and nontechnical appendices. The findings of the preliminary feasibility study will be presented along with conclusions as to whether further study of recreational navigation is warranted. If further study is warranted, the Contractor will determine specific activities to be undertaken for Stage 3. This Preliminary Feasibility Report is presently scheduled to be completed in October 1981. It will be submitted to higher headquarters for review and approval as an intermediate report on Recreational Navigation.

Detailed Investigation of Recreational Navigation Needs at Lorain Harbor (Stage 3 Effort) - The Stage 3 effort on Recreational Navigation will depend upon the findings of the Preliminary Feasibility Study. If alternatives developed in Stage 2 are deemed worthy of further study, a Stage 3 investigation will be initiated. During Stage 3 refinements of study parameters, costs and benefits will be performed. The result of Stage 3 would be a recommendation as to whether or not there are feasible alternatives for constructing a small-boat harbor in the Lorain, OH area. The results will be presented in a separate volume in the Final Feasibility Report on Lorain Harbor.

MILESTONE SCHEDULES

The milestone dates for Stage 3 on Commercial Navigation and Stages 2 and 3 for Recreational Navigation, and Erosion, Sedimentation, and Harbor Maintenance Dredging are shown in Figure 2 of Appendix F. A tabulation of historical and scheduled milestones for these three study purposes is presented in Table 99. From the tabulation, completion of Stage 2 reports on Recreational Navigation (Milestone 5A) and Erosion and Sedimentation (Milestone 5B) are scheduled for November 1981 and March 1982, respectively. Submission of the Draft Final Feasibility Report/Draft EIS (Milestone 6) is scheduled for March 1983, and the FFR/EIS (Milestone 11) for September 1983.

STUDY COSTS FOR STAGE 3

The current (October 1980) estimated cost for the entire Lorain Harbor Feasibility Study is $1,403,000. Of this amount, $104,000 was expended to prepare the Reconnaissance Report (Stage 1); $394,000 was expended during Fiscal Year 1979 ($160,000) and 1980 ($234,000) to perform this Stage 2 Study on Commercial Navigation; and a total of $905,000 will be required to complete the remaining study effort on Commercial Navigation, Recreational Navigation, and Sedimentation.

A breakdown, by organizational unit, of estimated costs to complete the remainder of the Lorain Harbor Feasibility Study is shown in Table 100, following.

Table 99 - Milestone Schedule for the Lorain Harbor, Ohio Feasibility Study

Study Purpose	Milestone 1/ and Date										
	1	2	3	4	5	6	7	8	9	10	11
Commercial Navigation	10/77	4/79	10/80	10/80	12/80	3/83	4/83	5/83	5/83	10/83	10/83
Recreational Navigation 2/	10/77	4/79	9/81	10/81	11/81	3/83	4/83	5/83	5/83	10/83	10/83
Erosion and Sedimentation 3/	10/77	4/79	1/82	2/82	3/82	3/83	4/83	5/83	5/83	10/83	10/83

1/ Milestones
1 - Study Initiation
2 - Approval of Recon Report
3 - Submit Stage 2 Report
4 - Stage 2 Checkpoint
5 - Complete Action on MFR
6 - Submit Draft Report and DEIS
7 - Stage 3 Checkpoint
8 - Complete Action on MFR
9 - Coordinate Draft Report/DEIS
10 - Submit Final Report/EIS
11 - Division Engineer Notice

2/ Stage 2 Report on Recreational Navigation is submitted as an Intermediate Report with corresponding Milestones of 3A, 4A, and 5A.

3/ Stage 2 Report on Erosion and Sedimentation is submitted as an Intermediate Report with corresponding Milestones of 3B, 4B, and 5B.

ESTIMATED COST PER ORGANIZATIONAL UNIT

Table 100

Organizational Element	FY 81 Costs ($1,000)				FY 82 Costs ($1,000)				FY 83 Costs ($1,000)	FY 84
	Commercial Navigation	Recreational Navigation	Erosion & Sedimentation	Total	Commercial Navigation	Recreational Navigation	Erosion & Sedimentation	Total		
Planning (JR)	34.2	5.0	4.5	43.7	20.0	18.0	17.0	55.0	81.4	
Coastal (JD)	0.5	-	-	0.5	-	10.0	-	10.0	6.0	
F&M (JL)	4.7	0.5	0.5	5.7	1.0	8.0	11.0	20.0	3.0	
General Engineering (JB) (JC) (JF)	-	0.5	-	0.5	1.0	5.0	10.0	16.0	25.0	
Economics (JW)	16.8	1.1	-	17.9	4.9	7.7	3.0	15.6	27.0	
Environmental (JX)	11.8	0.9	-	12.7	14.5	10.7	6.5	31.7	53.0	
Drafting (JJ)	1.5	-	-	1.5	2.5	0.7	-	3.2	12.0	
Real Estate (RE)	1.0	-	-	1.0	-	-	-	-	-	
Typing (GE)	0.3	-	-	0.3	-	-	-	-	-	
Reproduction (GD)	1.0	-	-	1.0	-	-	-	-	12.0	
Survey (KV)	-	-	-	-	-	-	-	-	-	
SCS	-	-	23.5	23.5	-	-	-	-	-	
F&WLS	4.0	5.0	10.0	19.0	4.0	4.0	15.8	23.8	-	
Contracts (CN)	0.7	143.0	13.0	156.7	-	22.0	24.0	46.0	14.0	
H&H (JB)	-	1.0	-	1.0	-	-	10.0	10.0	7.0	
S&A, Overhead (LA) (CA)	11.5	-	11.0	22.5	14.7	-	29.0	43.7	38.6	
USGS	-	-	32.5	32.5	-	-	-	-	-	
Total	88.0	157.0	95.0	340.0	62.6	86.1	126.3	275.0	279.0	

SECTION G
CONCLUSIONS

POTENTIAL STUDY DIRECTIONS

Stage 3 Alternatives for Modifications to Accomodate Class X Vessels - The need for improvements to allow safe and efficient use of Lorain Harbor by the new larger size vessels (Class X) will increase as more and more companies convert their existing fleets from the smaller, less efficient vessels to the more efficient Class X vessels. The Stage 3 portion of this study will look in-depth at needed modifications to make safe and efficient use of Lorain Harbor by Class X vessels possible. This report has shown that direct delivery to the lakefront by Class X vessels and transshipment of the bulk material upriver is the best concept. Since any transshipment mode would be the responsibility of local interests, it is suggested that one water and one land mode of transshipment should be investigated in-depth to determine the preferred mode, the apparent "best" alternatives that incorporate these two modes are: Alternative 10 - transshipment in a special purpose vessel; and Alternative 11 - transshipment upriver by rail. As discussed in Section F, if the study of congestion at the mouth of the Black River warrants further harbor modifications by incorporating the Riverside Park Cut on to the plan, that would be done in Stage 3.

LOCAL SUPPORT

Strong support for improvements has been expressed by local interests during the entire study process. Republic Steel is presently operating Class X vessels and would benefit from improvements. Amship would like to see improvements made such that tugs would not be necessary to launch newly constructed Class X vessels. U.S. Steel's fleet presently is nearing the end of its useful life and new vesels being purchased are Class X vessels. They would like to take advantage of the economies of Class X vessels at the Lorain works. The Port Authority would like improvements that would enhance Lorain's position to hold present and attract new port users.

CONCLUSIONS

The conclusion of this report is that the most feasible alternatives for fulfilling the commercial navigation planning objective is direct delivery of iron ore in Class X vessels to a lakefront transshipment facility and moving the ore upriver by either conveyor, special purpose vessel, rail or truck. Since any mode of transshipment is the responsibility of local interests, which of these modes should be studied further in Stage 3 will be determined by local interests at the beginning of the Stage 3 study. However, it is suggested that one land and one water mode of transshipment be investigated. Alternative 10 is the only water mode and therefore is one suggested alternative. Alternative 11, rail transshipment, is the suggested land mode, since it has the maximum net benefits and benefit/cost ratio, as determined by this preliminary feasibility investigation. The Riverside Park Cut would be added to both Alternatives 10 and 11, if the congestion problem previously identified and discussed indicate that such action is warranted.

SECTION H
RECOMMENDATIONS

It is recommended that the District proceed with a Stage 3 level investigation and prepare a Final Feasibility Report for the Lorain Harbor Study.

This study and report will address the following water resources needs at Lorain Harbor:

a. Commercial navigation (detailed design of alternatives - Stage 3).

b. Recreational navigation (preliminary design - Stage 2, and details design - Stage 3).

c. Harbor maintenance dredging (both preliminary and final design stages).

In addition, it is recommended that the authorized, but incompleted, commercial navigation improvements at Lorain Harbor be reviewed and reevaluated with the objective of incorporating these authorized improvements into the selected plan or recommended for deauthorization, as appropriate.

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