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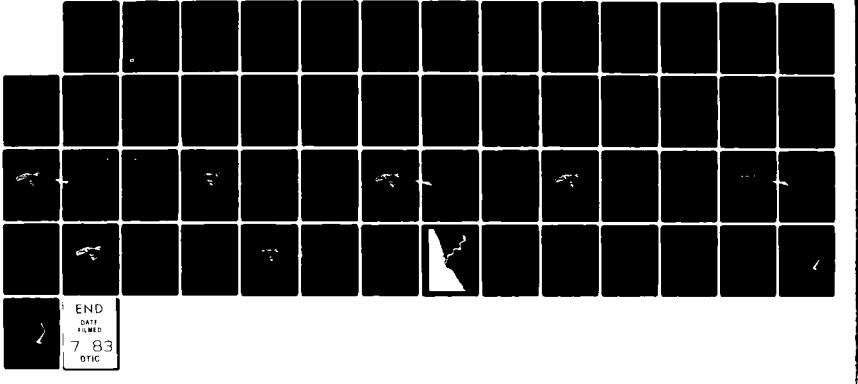

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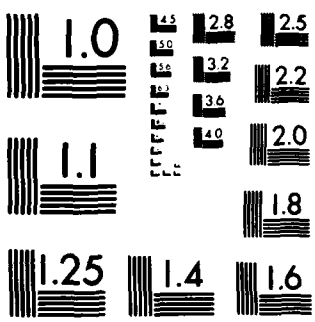

Draft
Final Feasibility Report

(10)

Lorain Harbor, Ohio

Summary Report

Commercial Navigation
Recreational Navigation
Sedimentation and Erosion

US Army Corps of Engineers
Buffalo District

May 1983

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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This report summarizes alternative water and land management plans developed that are compatible with the development goals at Lorain Harbor. The following principle water resource problems were identified and studied; Commercial Navigation, Small-Boat Harbor needs and Erosion and Sedimentation needs.

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SUMMARY REPORT
LORAIN HARBOR STUDIES

TABLE OF CONTENTS

TABLE

PLATES

TABLE OF CONTENTS (Cont'd)

PLATES (Cont'd)

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This Final Feasibility Report was prepared through the efforts of many individuals on the Interdisciplinary Team within the Buffalo District, Corps of Engineers and from other agencies and industry representatives involved in the Lorain Harbor project. The following are the Corps personnel who were most instrumental in conducting the investigation and preparing the text presented here:

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Ohter agencies have contributed to this report through the preparation of supplemental reports and participation in agency workshops. The individuals involved are numerous and not easily identified. Therefore, recognition is provided by the names of their employing agencies as follows:

Lorain Port Authority
United States Fish and Wildlife Service, Columbus Field Office
United States Soil Conservation Service
United States Geological Service
United States Army Reserve, Cleveland, Ohio
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The Buffalo District Engineer during the initial phase of this report was Colonel George P. Johnson and the District Engineer during the final phase was Colonel Robert R. Hardiman. The Chief of the Engineering Division was Donald M. Liddell and the Chief of the Planning Division was Charles E. Gilbert.

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INTRODUCTION

STUDY AUTHORITY

In response to a resolution by the Committee on Public Works and Transportation of the House of Representatives, dated 23 September 1976, a feasibility study of the water and related land resource needs at Lorain Harbor, OH, was performed. The resolution is quoted below:

> "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 modifications 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 resolution is the authority under which this Feasibility Report was prepared.

PURPOSE AND SCOPE

The purpose of this report is to summarize alternative water and related land management plans developed that are compatible with the development goals at Lorain Harbor, OH. As a result of public involvement and coordination activities undertaken during the preparation of this report, the following principal water resources problems and needs were identified and studied:

a. Harbor modifications for commercial navigation;

b. Additional marina facilities to serve existing and future demands for recreational small craft and;

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

These three water resource problems have each been addressed in detail in three accompanying volumes of the overall Lorain Harbor Study. Commercial Navigation is addressed in Volume 1, Recreational Navigation in Volume 2, and Erosion and Sedimentation in Volume 3.

AREA OF STUDY

Lorain Harbor is located on the southern shore of Lake Erie, approximately 25 miles west of Cleveland, OH, and 90 miles east of Toledo, OH. The city of Lorain is situated on both sides of the mouth of the Black River as shown on Plate 1. The existing harbor consists of a triangular shaped area protected by four breakwater structures which comprise the Outer Harbor. The Inner Harbor consists of an improved navigation channel extending approximately 3 miles up the Black River, and presently permits safe and efficient navigation of commercial vessels up to 730 feet in length.

PROBLEM IDENTIFICATION AND SOLUTIONS CONSIDERED

GENERAL

The purpose of this section is to identify the problems and needs associated with commercial navigation, recreational navigation, and sedimentation and erosion in the Lorain Harbor area. This section presents information concerning existing conditions and discusses the problems and needs for commercial navigation, recreational navigation, and for sedimentation and erosion.

EXISTING CONDITIONS

Water Bodies and the Natural Environment.

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, OH.

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 in 1979 were quite similar to those obtained in 1974. The data from the 1979 survey demonstrated a 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 decreased dissolved oxygen levels in the lower river. Concentrations as low as 2 to 3 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 ug/l was recorded near U.S. Steel while the present water quality standard is 25 ug/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 to the confluence of the East and West Branches, has been classified as water quality limiting. (Source: Black River Water Load Allocation Report, prepared by the U.S. Environmental Protection Agency, 1980).

Sediment Quanity and Quality - Based on studies performed by Buffalo District for the Erosion and Sedimentation Study (Vol. 3 of this report), it is estimated that about 835,000 tons of sediment are produced annually in the upland areas of the Black River Watershed. Of this amount, 80,000 tons are delivered to the Black River and require dredging under the annual maintenance dredging program at Lorain Harbor. In addition, an estimated 12,000 tons of sediment are delivered and dredged from the harbor as the result of streambank erosion along the Black River and its tributaries. In total, the upland and streambank components of sediments delivered to Lorain Harbor account for about 68 percent of the 136,000 tons of sediment dredged from Lorain Harbor on an average annual basis.

Sediment testing in Lorain Harbor was conducted by the U.S. Environmental Protection Agency (USEPA) in 1975 and by the Buffalo District Corps of Engineers in November 1981.

Based on USEPA's 1975 testing, the entire harbor, except for a small portion located in the lake approach channel, has been determined to be polluted and, therefore, unacceptable for open-water disposal. These polluted dredgings are placed in the diked disposal area adjacent to the Lorain Harbor East Breakwater Shorearm. Dredgings from the remaining portion of the harbor that were tested in 1975 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. All sites tested by the Buffalo District COE, inside the East Breakwater in 1981 indicate the sediments are highly polluted for cyanide, phosphorus and arsenic. Some sites are highly polluted for Chemical Oxygen Demand (COD), Total Nitrogen Kjeldahl (TKN), copper, iron, manganese, and zinc. Some sites are moderately polluted for COD, oil and grease, TKN, chromium, copper, iron, lead, manganese, nickel, and zinc. No significant concentrations of organic compounds, including mirex, DDT, and PCB's were detected at any of the sites sampled by Buffalo District in 1981.

Based on these results, the upper 2 feet of channel bottom material in that portion of the harbor to be deepened has been determined to be polluted and therefore unacceptable for open-lake disposal. Dredgings below that depth and from the remaining portion of the Outer Harbor may be disposed of at the established open-lake disposal site. This decision is based on USEPA criteria related to chemical and biological data as well as field observations.

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

has established the pattern of land use development for the remainder of the city of Lorain. In recent years, the city and local civic organizations, have 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.

Water Use: Commercial - Lorain Harbor is a deep draft commercial harbor serving the Port of Lorain which is almost exclusively a bulk cargo 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 8,151,400 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 gill netters operate out of Lorain Harbor 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 Municipal Water Pollution Control Plant and the U.S. Coast Guard Station and has berthings for 70 boats. The other, privately owned, is located upriver adjacent to the berthing capacity of 23 boats. Due to the limited berthing capacity available at Lorain, trailering has been necessary.

The demand for recreational boating faciliites is so great that the Lorain planning agencies, Lorain Port Authority, and private interests are seeking additional locations and financial aid to provide new faciliities. A current plan of the city is to use the recently constructed diked disposal area as part of a large recreational-marina complex after the anticipated 10-year fill-in period. The harbor area immediately west of the disposal area could provide space for about 600-800 boats and additional boat-launching ramps, if developed. The Port Authority has constructed a temporary rubber-tire floating breakwater in the east basin of Lorain Harbor immediately west of the disposal area that will provide dockage for recreational craft until permanent small-boat facilities are constructed.

Population - According to an advance report, 1980 Census of Population and Housing, U.S. Department of Commerce, Bureau of the Census, the 1980 population of Lorain County was 274,909. The population in 1970 was 256,843, representing a 7 percent change.

In 1980, the population of the city of Lorain was 75,416, a -3.5 percent change from the 1970 population of 78,185 (Advance Report, 1980 Census of Population and Housing, U.S. Department of Commerce, Bureau of the Census).

Employment and Income - Lorain County's employment population, conservatively estimated, is predicted to reach 125,902 in the year 2030. Mean family income figures for 1978 show Lorain County with an average of $19,409. This level is a bit above the State's 1978 average of $18,505 and is most likely a result of the urban-industrialized nature of the economy.

The Lorain Chamber of Commerce estimates 107,007 people were employed in Lorain County in 1981, with an average unemployment rate of 13.3 percent. In 1980, 110,338 people were employed on an average and the unemployment rate average 13 percent, while in 1979, 113,515 were employed and the unemployment rate was 7.4 percent.

Business and Industry - Manufacturing plays a major role in the local economy and in 1978, 40,997 people or 38.6 percent of the labor force was employed by the 55 diversified manufacturing industries in the area. The 10 largest firms, located along the banks of the Black River in the immediate project area, provide employment for up to 12,300 people.

Local Development - The Lorain Port Authority was created in 1964, to facilitate growth within the harbor area and has financed a $7,000,000 dry-dock modification and related improvements for American Ship Building Company through an industrial revenue bond issue. Their participation in a $5,000,000 terminal project for Allied Oil Company has also added to transportation resources within the harbor.

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 Cleveland Harbor, OH, and to inland steel plants. The facility is capable of accommodating 1,000-foot self-unloading bulk vessels, and expects to transship about 7.5 million tons of iron ore per year in the next few years. This facility has played a major role in the recent increase in annual waterborne commerce at Lorain.

PROBLEMS AND NEEDS

This subsection summarizes the water resource needs and presents the methodology conducted to satisfy these needs for each of the three major study components. These deal with Commercial Navigation, Recreational Navigation, and Sedimentation and Erosion. As noted previously, detailed discussions of these three study components are presented in Volumes 1-3 of this report, respectively.

Commercial Navigation.

Lorain Harbor has a well developed system of breakwaters and channels for commercial traffic designed for a seaway class vessel (730 feet long, 75 feet wide, and 25.5 foot draft). The existing Federally improved harbor is shown on Plate 1. However, there is a need to reappraise the existing facilities to determine what improvements, if any, would be required to permit the safe and efficient operation of 1,000-foot long, bulk cargo vessels into the harbor and upriver to American Shipbuilding and the U.S. Steel facilities.

Based on numerous workshop meetings and correspondence, the improvements desired for commercial navigation are summarized as follows:

a. Improvements to the lakefront harbor entrance to permit safe navigation of the harbor by 1,000-foot vesels,

b. Improvements to the Erie Avenue Bridge to permit the launching of 1,000-foot vessels from the American Shipbuilding Company 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.

From these expressed needs, a number of possible concepts were developed to satisfy these needs.

First Iteration - Development of Concepts:

The following initial structural and nonstructural concepts were developed to meet the needs for commercial navigation for both Outer Harbor and upriver improvements. These concepts for harbor improvements are as follows:

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 maximum size 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 maximum size vessels and transshipment to Lorain.

Of these nine initial concepts, six were eliminated in the early study stages as potential solutions due to overriding functional, economic, environmental, or operational problems. The six concepts eliminated were Concepts 4, 5, 6, 7, 8, and 9.

Second Iteration - Development of Alternatives:

Each of the concepts not eliminated (Concept 1, 2, and 3) was investigated in greater detail to determine what modifications would be necessary

for implementation. These three concepts were developed into 16 structural alternatives. A matrix listing the principal project features (construction items) for these 16 alternative plans is shown in Table 1, below. Plate 2 shows the location of these features as they relate to the existing Lorain Harbor project. The description; costs, benefits economic evaluation, and environmental assessments for each of these 16 plans are described in the "Assessment and Evaluation of Preliminary Plans" section of Volume 1.

Based on input from the local sponsor and other local interests the recommendation was made that Concept 3 (lakefront transshipment) offered the best potential solution to the navigation problems at Lorain. Concept 3 includes Alternatives 9 through 16 listed in Table 1. From these meetings with the locals, it was determined that only Alternatives 9 and 10 warranted further consideration. The other alternatives (11-16) were eliminated either due to a lack of local support or due to a lack of economic justification. Also from these meetings, commercial interests identified a congestion problem at the mouth of the Black River and a need to investigate possible solutions to this problem.

In summary, the results of this iteration indicated that two alternatives addressing Concept 3 (Alternatives 9 and 10) and two alternatives dealing with the congestion problems (Alternatives 9A and 10A) should be carried into detailed planning. These alternative plans are shown on Plates 4-7 at the end of this Summary Report.

Third Iteration - Development of Detailed Alternatives:

Prior to the development of the detailed plans, the District received information regarding a change in the fleet mix to deliver iron ore to the upriver U.S. Steel facility. U.S. Steel stated that vessels 767 feet by 72 feet would be the largest vessels involved in direct upriver trade for the foreseeable future. This is in contrast to 1,000-foot vessels used to develop the alternatives. Associated with the use of these vessels, U.S. Steel stated a need to light-load due to constrictions in the existing river channel. To address these problems and concerns, two additional alternatives were developed for detailed study. These alternatives, designated Alternatives 18 and 18A, are shown on Plates 8 and 9, respectively. Principal features of these plans are Outer Harbor improvements including channel deepening and breakwater modifications, and channel enlargements at several locations on the Black River. Whereas Plan 18 would utilize the existing Black River channel alignment for vessel passage, Plan 18A would incorporate a new cut through Riverside Park, thereby eliminating an existing congestion problem at the mouth of the Black River and at the same time provide a better approach to the Erie Avenue Bridge which is skewed to the existing river channel.

Even though this input from U.S. Steel indicated that the most probable future is that 767x72-foot vessels would be the longest vessels in upriver trade, the District considered that this should not eliminate from further consideration the alternatives which considered the use of 1,000-foot vessels and transshipment facilities if sometime in the future, 1,000-foot vessels should be involved in upriver trade. Therefore, a total of six alternatives

Table 1 - Lorain Harbor Navigation Improvements for 1,000-Foot Vessel Option

Construction Item	Alternatives															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A. Enlarge or reorient Outer Harbor entrance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B. Construct new channel through Riverside Park	X				X								X	X	X	X
C. Replace Erie Avenue Bridge with high level structure		X				X										
D. Replace Erie Avenue Bridge movable bridge			X				X									
E. Replace Erie Avenue Bridge with tunnel under river				X				X								
F. Enlarge channel	X	X	X	X	X	X	X	X								
G. Enlarge the lower turning basin					X	X	X	X								
H. Enlarge the upper turning basin	X	X	X	X												
I. Replace 21st Street Bridge with higher structure	X	X	X	X												
J. Construct conveyor transfer facility below 21st Street					X	X	X	X								
K. Construct conveyor system upriver from 21st Street					X	X	X	X								
L. Construction transshipment facility at lakefront									X	X	X	X	X	X	X	X
M. Construct upriver conveyor system									X				X			
N. Construct upriver special purpose vessel facility										X				X		
O. Construct upriver rail facility											X				X	
P. Construct upriver truck system												X				X

were investigated in this phase - four dealing with Outer Harbor improvements for 1,000-foot vessels and transshipment upriver (Alternatives 9, 9A, 10, and 10A and two plans (Alternatives 18 and 18A) consisting of Outer Harbor improvements and direct delivery upriver in 767-foot vessels. These plans were evaluated against each other and against the No-Action Plan to arrive at the plan which best satisfied the planning objectives. The results of this evaluation are discussed in Volume 1 in the section entitled "Comparison of Detailed Plans" and the conclusion reached are summarized in the following section of this Summary Report.

Recreational Navigation.

In its current condition, Lorain Harbor offers very little in recreational facilities for boaters who desire to use Lake Erie. The existing small-boat facilities, located in the harbor area, consist of two relatively small marinas with a total capacity for about 100 boats.

Local officials and the boating public consider demand for additional small-boat facilities so great that the Lorain Port Authority recently constructed (August 1981) a temporary floating tire breakwater in the East Basin of the Outer Harbor. This breakwater will provide single-point mooring spaces for about 36 small craft. The city of Lorain has recently applied for a Department of the Army permit to reconstruct a municipal boat launching facility located at the Municipal Pier in Lorain Harbor.

From information obtained from numerous public workshops and meetings the local interests expressed an immediate need for additional boat slips and expressed their desires for a small-boat harbor at Lorain. The recreational boating demand analysis performed for this study shows a present need for an additional 883 slips by 1990. Also, from these meetings, an interest in additional land-based fishing improvements at Lorain was expressed.

Potential recreational harbor improvements in Lorain Harbor proper are constrained by existing or planned commercial navigation uses at Lorain Harbor - i.e. - the desire to promote viable commercial navigation uses will take priority over recreational uses as expressed by the local sponsor, the Lorain Port Authority.

First Iteration - Site Selection:

The primary resource need investigated under this study was to increase capacity for small-boat berthing. As the first step in this process it is necessary to identify potential sites in the area, which could be developed into a suitable marina.

A total of five potential small-boat harbor sites were investigated during this phase of preliminary planning (see Plate 10). General site locations included:

Site 1 - East Basin of the Outer Harbor,

Site 2 - East of the Diked Area (in this open lake)

Site 3 - West Basin of the Outer Harbor,

Site 4 - the Black River channel,

Site 5 - at the mouth of Beaver Creek which is located about 4 miles west of the commercial harbor.

Based on a comparison of these proposed sites in terms of engineering, economic, environmental, and social characteristics, and from public opinion obtained from a workshop meeting, the Inside East Breakwater site (Site 1) was selected as the site which exhibited overall superiority and had excellent potential for implementation. In summary, Site 1 provides an opportunity to utilize an advantageous water area (existing depths, wave protection and shoreline armoring are favorable). No other site investigated fulfilled these criteria without incurring substantial additional cost.

Second Iteration - Development of Alternative Plans:

After the selection of Site 1 as the preferred site for small-boat harbor development, a total of five preliminary plans, with a variety of physical slip capacities, were developed. These five preliminary plans are shown on Plates 11 through 15, This site, although advantageous for small-boat development, is located along the alignment of the commercial navigation channel through Riverside Park that is also under consideration. In order to provide for both possible uses at this location, two of the plans (Alternative 3, Plate 13, and Alternative 4, Plate 14, formulated for the small-boat harbor addressed the possibility of a commercial channel realignment through Riverside Park.

An evaluation of the five alternative plans proposed in this phase concluded that the trade-off analyses between these plans deal mainly with compatibility to potential commercial harbor plans and with economic efficiencies. At the time of the development of these plans consideration was still being given to construction of the Riverside Park Cut in the Commercial Navigation Study. Based on a more detailed analysis of the Park Cut in the Commercial Navigation Study, this feature has proved to be economically unjustified. Therefore, it was concluded that the small-boat plans (Alternatives 3 and 4) which considered the Park Cut feature no longer warrant consideration.

Of the three remaining plans, Alternative 1 with a 300-slip capacity was eliminated because it did not make efficient utilization of the water area available as compared to the other two remaining plans.

The two remaining plans (Alternatives 2 and 5) are similar and provide for efficient use of the available water area and allow for potential expansion beyond the initial 600-boat capacity, if warranted.

Third Iteration - Development of Detailed Plans:

During this iteration, the emphasis was on further developing and refining the two alternatives carried forward into detailed planning. The

major difference between these two plans is that Alternative 5 provides for additional safety and convenience. This is achieved in Alternative 5 because it provides for a dual entrance/exit to the marina. See Plates 16 and 17 .

These two plans were evaluated against each other and against the No-Action Plan to arrive at the plan which best satisfies the planning objectives. The results of the evaluation are summarized in the following "Conclusions" section of this Summary Report.

Sedimentation and Erosion.

Study Objective and Methodology:

The primary objective of this study is to determine the feasibility of reducing annual maintenance dredging at Lorain harbor by reducing the sediment contributed to the harbor from streambank and upland sources. This study was conducted in two parts, one dealing with streambank erosion, the other addressing upland erosion. As previously stated, an in-depth discussion of the study and its results are provided in Volume 3 of this report.

The Black River Streambank Erosion portion concentrated on identifying active areas of streambank erosion on the Black River and its tributaries. In addition, this portion concerned itself with estimates of streambank erosion to both the total sediment yield of the watershed and the quantity dredged annually from the navigation channel in Lorain Harbor, OH. Study results were utilized to determine the feasibility of undertaking streambank stabilization measures in order to reduce sediment yield from the source.

The Black River Upland Erosion portion of this study concentrated on identifying and estimating the amount of sediment which was produced and delivered to the river from diffuse sources throughout the drainage basin. The method of analysis which was employed utilized the Universal Soil Loss Equation and included information gathered by the Soil Conservation Service field sampling program which was performed in the basin.

These two studies of the Black River were merged in an effort to gather qualitative and quantitative information to be used in defining the sediment-related problems and needs of the Black River Watershed Study Area.

Summary results of the contribution of streambank and upland components to the sediment dredged from Lorain Harbor are discussed below.

Streambank Erosion Component:

The Black River consists of 120 miles of stream. The District performed a field survey on 97 miles of streambank to identify those areas experiencing erosion and to determine an estimate of the rate of streambank erosion. The results of this survey indicate that of the streambank investigated, only 11 miles were actively eroding. From this survey it is estimated that streambank erosion yields 12,000 tons of sediment which requires annual dredging. This amount of sediment amounts to approximately 8.8 percent of the average annual amount of dredging at Lorain Harbor.

In order to eliminate this source of sediment from the dredging requirements, streambank erosion treatment methods were selected and cost estimated for the banks considering bank height, severity of erosion, cost maintenance, and environmental surroundings.

Upland Erosion Component:

This portion of the erosion study was concerned with dislodgement and detachment of soil particles from the land surface and delivery of this sediment to a stream channel of the Black River. This analysis estimates sheet and rill erosion from agricultural and other nonurban areas which are generally referred to as diffuse sources of sediment. This portion of the report presented details of the upland erosion calculations and delivery of sediment to the river. Also, possible erosion reductions are estimated and some Best Management Practices for agricultural land management are prescribed.

Results of this study indicate the approximately 835,000 tons of sediment is dislodged through sheet and rill erosion annually. Of this amount, it is estimated that about 80,000 tons is actually delivered to the Black River and requires dredging. This amounts to about 59 percent of the total amount of sediment dredged from Lorain Harbor annually.

The conclusion reached regarding the feasibility and implementability of programs to control streambank and upland erosion in the Black River Watershed are discussed in the following section of this Summary Report.

CONCLUSIONS

GENERAL

Lorain Harbor, Ohio, is located on the south shore of Lake Erie, at the mouth of the Black River, approximately 25 miles west of Cleveland, Ohio, and 90 miles east of Toledo, Ohio. The harbor includes a breakwater protected Outer Harbor and improved navigation channels on the Black River.

The purpose of the Lorain Harbor Study was to investigate the principal water resource problems and needs as related to:

a. Harbor modification for commercial navigation;

b. Additional marina facilities to serve existing and future demands for recreational small crafts; and

c. Reduction of sedimentation on the Black River, and thus reduce harbor maintenance dredging and improve water quality.

Each of these areas has been investigated in this Final Feasibility Report and the results of these studies are contained in three separate volumes dealing with each of these topics. The conclusions of these studies are presented below.

COMMERCIAL NAVIGATION

The present configuration of the breakwaters and navigation channels limit the effective utilization of the vessels which transport bulk commodities into Lorain Harbor. Significant transportation savings could be realized if the harbor were modified to permit the more efficient use of these vessels. The primary objective of this portion of the Lorain Harbor study is to develop a plan which provides for more efficient and economical movement of bulk cargos through the harbor. As possible solutions to these needs, six structural alternatives (Alternatives 9, 9A, 10, 10A, 18, and 18A) were developed in detail in this study in addition to the "No-Action" Plan.

An assessment and evaluation of these six detailed plans in terms of meeting the planning objectives, indicated the three alternatives involving construction of the Riverside Park Cut (Alternatives 9A, 10A, and 18A) should be eliminated from further consideration due to a lack of incremental economic feasibility. The three remaining structural plans (Alternatives 9, 10, and 18) and the "No-Action Plan warranted consideration as the Tentatively Selected Plan.

Based on the results of this Final Feasibility Study, it has been determined that Alternative 18 (Direct Delivery to U.S. Steel in 767-foot Vessels - Upriver Bend Cuts) is economically justified and environmentally viable and is the one plan considered in detailed planning which meets the "most probable" future fleet mix at Lorain Harbor. This plan is shown on Plate 7. Of the three structural plans warranting consideration (Alternatives 9, 10, and 18), Alternative 18 is the plan which has the highest potential for implementation

by local interests and is tentatively recommended for construction. However, the views of local interests will be given serious consideration before the final decision is made.

Plan Implementation

The total project costs for Alternative 18 are currently estimated to be $27,486,000 ($23,108,000 Federal, $4,378,000 Non-Federal) and has an overall benefit/cost ratio of 2.1.

RECREATIONAL NAVIGATION

GENERAL

Corps studies have shown there is a need for expanded small boat facilities at Lorain Harbor. They have shown that these needs can be best met by the construction of a small boat harbor in Lorain Outer Harbor's East Basin. The plan selected is Alternative 5 - the detached breakwater 600-slip plan.

This plan provides an all-weather recreational harbor with capacity for 600 slips. The structural features are an 800-foot breakwater, a 425-foot detached breakwater, and two entrance channels, each 275 feet wide. The plan utilizes a portion of the diked disposal area for parking and support facilities. Because of the relatively deep water available at the site, no dredging is planned.

In addition to meeting the projected demand of 600 slips in 1990, the plan allows for future expansion beyond the 600 slips. The plan also provides two entrances to minimize any interference with commercial navigation entering or existing the Black River Channel.

Recreational fishing is enhanced in the plan by providing an 8-foot wide path on the top of the 800-foot long main breakwater. Small-boat-harbors traditionally provide excellent areas for ice fishing as they usually freeze early and stay frozen later than the rest of the lake.

Plan Implementation

The total project costs for Alternative 5 are currently estimated to be $9,050,000 ($1,750,000 Federal, $7,300,000 Non-Federal) and has a benefit/cost ratio of 3.7.

Since the Federal portion of the cost estimate for this small-boat-harbor plan is less than $2 million, it is possible to construct the project under Section 107 of the River and Harbor Act of 1960, as amended. If this path was followed, and the report approved, we would recommend moving directly into plans and specifications. Some of the considerations that affect this decision are:

a. Cost limitation for the Federal share under the Section 107 authority is $2,000,000. Any costs over $2,000,000 must be paid by the local sponsor.

b. Construction of the small-boat harbor before the confined disposal is complete (scheduled 1990) could restrict parking and hinder operation of the marina because of a dredge pumpout pipe going through the mooring and parking areas (Figure 7). Also, it is probable that there would be 4 or 6 weeks of maintenance dredging on the commercial channels during the summer months. This dredged disposal is expected to continue until about 1990 when the disposal area is scheduled to be filled.

Since the earliest construction scheduled would complete construction during 1986, if the Section 107 path were followed, we estimate that at least 8 acres would be available for parking and support facilities. This area is sufficient to support a 600-foot marina. Although dredge disposal in the confined disposal area during the summer is undesirable, the presence of the pumpout pipe near the shore would disrupt the marina development and restrict use of the boat launching ramps to boats that can get under the pipe. The clearance between the water and the bottom of the pipe is about 10 feet (Pipe to Low Water Datum). Since the average gage at Lorain is less the 2 feet, one might expect at least 8 feet of clearance on any summer day. This restriction only exists when dredging is underway because a section of the pipe is removed after the annual maintenance dredging is completed.

The utilization of the small project authority (Section 107 of the River and Harbor Act of 1960, as amended) could accelerate the construction schedule of the project. While there would be some conflict with the filling of the confined disposal area that could hinder immediate development of a 600-foot slip marina, the early construction of the project still seems desirable. However, considering the much larger contribution required from the local sponsor, their comments will be given serious consideration before the final decision is made.

EROSION AND SEDIMENTATION STUDY

The purpose of this section is to briefly summarize the results of this investigation. This section presents information on the results of streambank erosion and the upland erosion control studies.

Summary Results of Streambank Erosion Control Studies

The purpose of the streambank erosion control studies conducted for this study was to identify and quantify sources of streambank erosion and to determine the feasibility of implementing streambank erosion control measures. The streambank component study area consisted of the main stem of the Black River, in addition to the East Branch, West Branch, and West Fork of the Black River.

Results of the studies conducted for this report indicated that of the 241 bank miles of streambank in the study area, only 11 percent were actively eroding. The studies also indicated that annual streambank erosion produces 10,700 cubic yards of sediment. Of this 10,700 cy of sediment, it is estimated that 8,900 cy is transported to Lorain Harbor (with an expected 100 percent delivery) and requires annual maintenance dredging. This volume of sediment represents 8.8 percent of the total volume of sediment annually dredged.

The study also concluded that past meander changes contributed 1,920 cubic yards of sediment each year. However, the majority of meander changes, and subsequently, the amount of bank displacement occurred between 1938 and 1951. Therefore, the bank displacement is not representative of the present condition.

The cost of the proposed streambank erosion treatment methods amounts to $8.0 million with negative net benefits of $589,000 and a benefit-cost ratio of 0.06. It has been determined that further study is not economically feasible and no overriding environmental or social benefits would be derived from implementation of these erosion treatments. Therefore, the conclusion of this report for streambank erosion control is that the no-action (do nothing) plan is the only course of action and no further investigation of streambank erosion is warranted.

Summary Results of Upland Erosion Control Studies

The purpose of this study of upland erosion in the Black River Watershed was to identify and estimate the amount of sediment produced from diffuse sources throughout the drainage basin and delivered to the Black River System. A series of management measures has been developed to control erosion in the upland area. Implementation of these programs must, however, be pursued by other (local) interests.

Results of the analysis indicate that there is considerable erosion occurring in the upland portions of the watershed. The Universal Soil Loss Equation analysis estimates the annual soil loss to be 835,000 tons. Approximately 80 percent of this erosion (663,000 tons) occurs on cropland areas of the

watershed at a rate of 4.7 tons/acre/year. Of this 835,000 tons of sediment produced it is estimated that 80,000 tons (USGS) is delivered to the Black River and requires annual dredging. This represents approximately 58.8 percent of the total amount of sediment dredged. Therefore, in order to significantly reduce dredging costs at Lorain Harbor, an effective erosion control program must be implemented in these eroding areas.

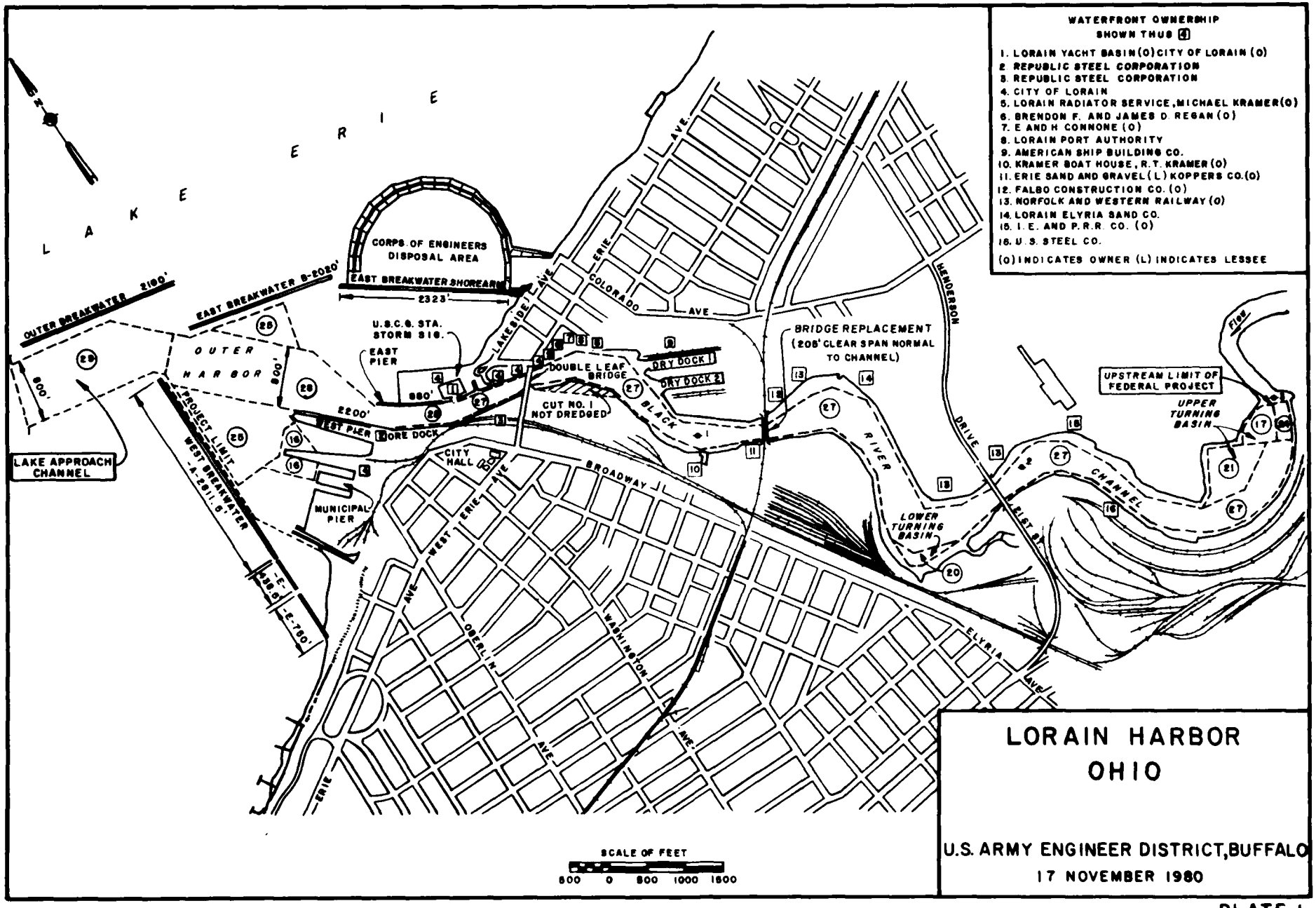
Implementation of maximum reduction tillage and reduced tillage techniques will reduce potential gross erosion by 39.9 percent and 24.5 percent, respectively. Greater reductions are not possible because nearly half of the cropland erosion occurs on soils which are somewhat poorly to very poorly drained and hydraulic conductivity is so slow that even tile does not provide adequate drainage. This indicates that implementation of alternative land management practices on these soils for erosion control purposes would not be feasible. Some erosion reductions would be realized by implementation of no-till and reduced tillage techniques in the southern, upland portions of the watershed where soils are most suitable. Analysis of Best Management Practices for agricultural land management indicates that costly and involved methods of erosion control, rather than a simple change in tillage technique, are necessary to significantly reduce erosion in the Black River Watershed.

Based on sampling program results, approximately 10 percent of the 835,000 tons of eroded material is delivered to the Black River system annually and subsequently transported to Lorain Harbor.

In conclusion, the streambank component and upland component account for 67.6 percent of the amount of sediment dredged from the navigational channel at Lorain Harbor. The remainder of the sediment (32.4 percent) can probably be attributed to the following factors. Only 84 percent of the entire Black River Watershed was accounted for in the Upland Component. The remaining 16 percent of the watershed is located downstream of the Elyria Gaging Station, which was not included as part of this study. Therefore, a possibility exists that a sizeable amount of sediment generated from French Creek Basin, located downstream of Elyria, was unaccounted for. Inaccuracies may have existed in the Universal Soil Loss Equation (USLE), conversion factors, dredging records, and field survey estimates. Also, the magnitude of sediment contribution from local sources, such as industry, runoff from streets, etc., have not been accounted for and could be significant.

Since the streambank erosion control improvements cannot be economically justified, the District recommended that no further consideration be given to streambank erosion control improvements in the Black River Basin and that the sedimentation and erosion portion of the Lorain Harbor Study be terminated.

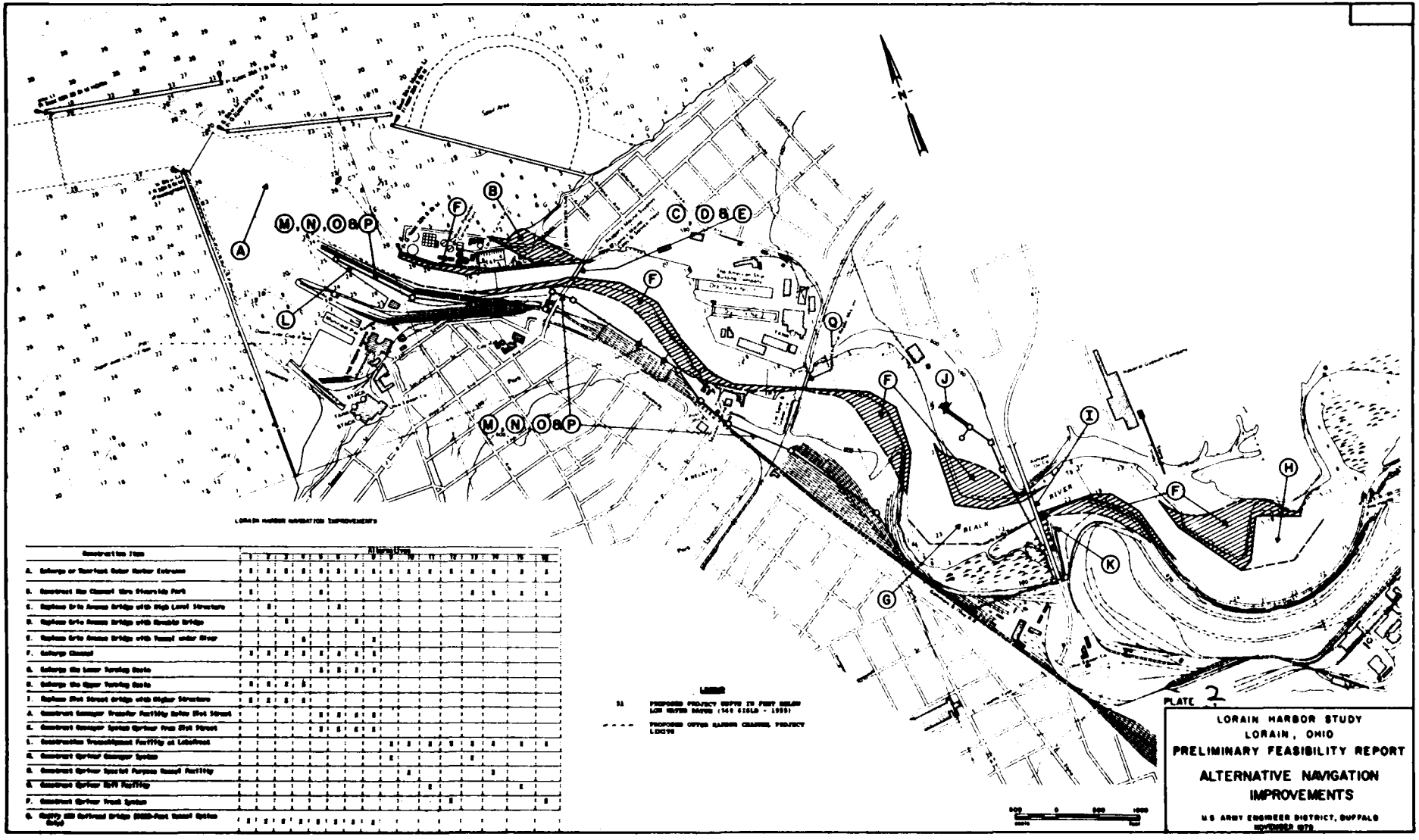
PLATES



LORAIN HARBOR
OHIO

U.S. ARMY ENGINEER DISTRICT, BUFFALO
17 NOVEMBER 1980

PLATE 1



LORAIN HARBOR NAVIGATION IMPROVEMENTS

Construction Item	Beginning Year																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A. Enlarge or Shorten Outer Harbor Entrance																		
B. Construct the Channel thru Privately Port																		
C. Replace Erie Avenue Bridge with High Level Structure																		
D. Replace Erie Avenue Bridge with Movable Bridge																		
E. Replace Erie Avenue Bridge with Tunnel under River																		
F. Enlarge Channel																		
G. Enlarge the Lower Turning Basin																		
H. Enlarge the Upper Turning Basin																		
I. Replace 32nd Street Bridge with Higher Structure																		
J. Construct Conveyor Transfer Facility below 32nd Street																		
K. Construct Conveyor System Upriver from 32nd Street																		
L. Construction Transshipment Facility at Lakefront																		
M. Construct Upriver Conveyor System																		
N. Construct Upriver Special Purpose Vessel Facility																		
O. Construct Upriver Silt Facility																		
P. Construct Upriver Truck System																		
Q. Replace 28th Railroad Bridge 28th-East Tunnel Option																		

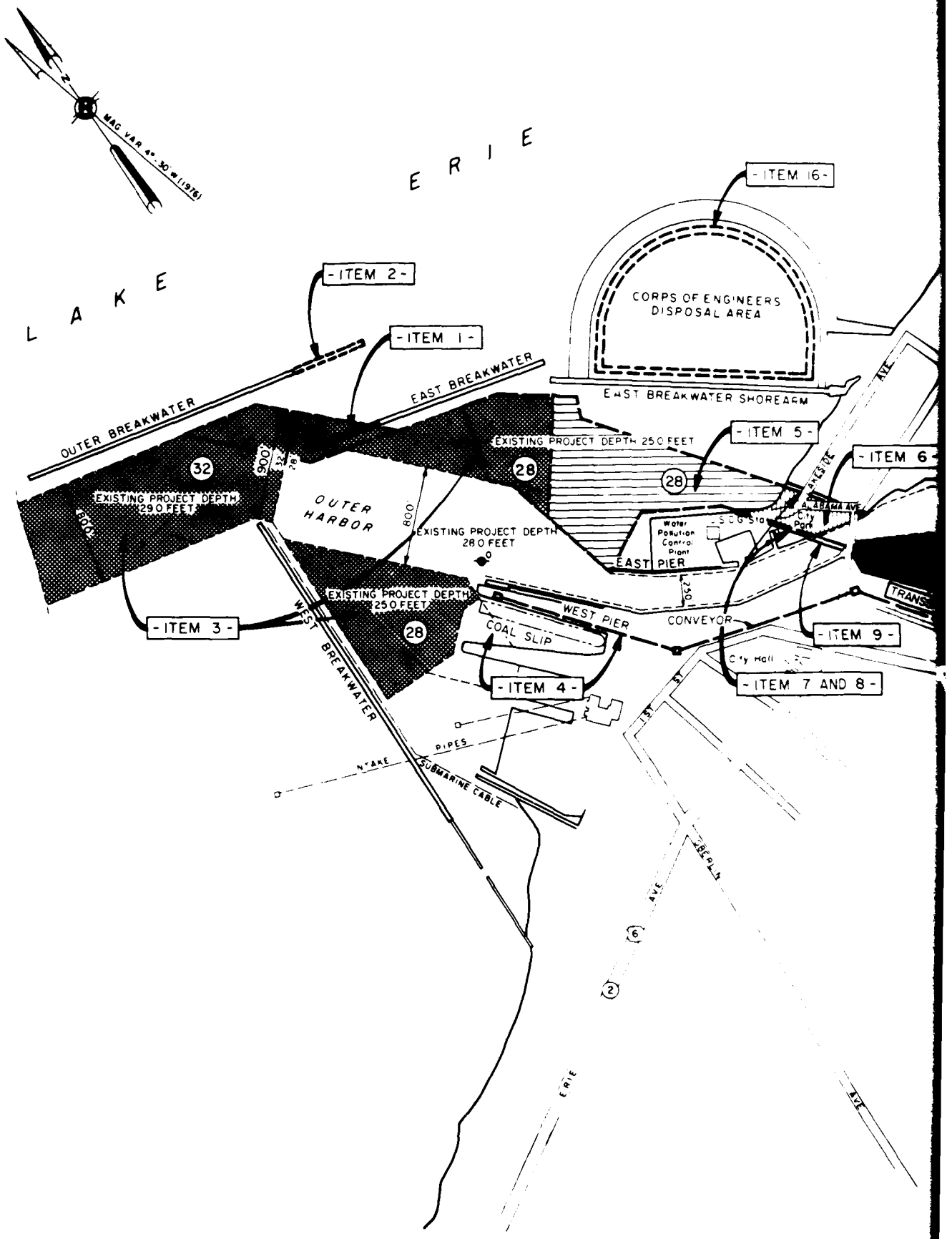
LEGEND

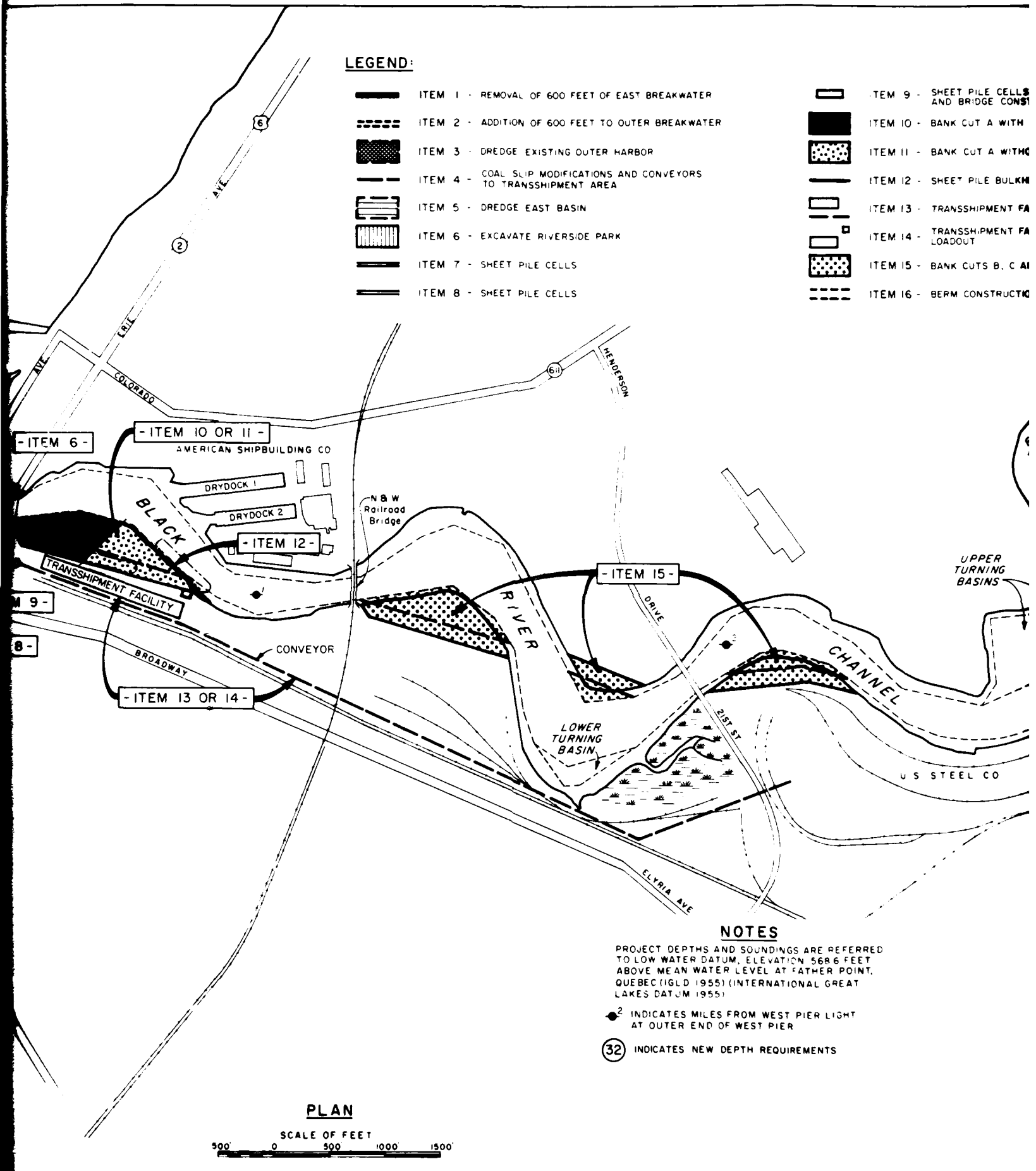
32 PROPOSED PROJECT DEPTH IN FEET BELOW LOW WATER DATUM (1985 DATUM - 1955)

PROPOSED OUTER HARBOR CHANNEL PROJECT LIMITS

PLATE 2

LORAIN HARBOR STUDY
LORAIN, OHIO
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE NAVIGATION IMPROVEMENTS
U.S. ARMY ENGINEER DISTRICT, BUFFALO
NOVEMBER 1979


N
MAG VAR 4° 30' W (1976)
LAKE ERIE
- ITEM 16 -
CORPS OF ENGINEERS DISPOSAL AREA
- ITEM 2 -
- ITEM 1 -
EAST BREAKWATER
OUTER BREAKWATER
EAST BREAKWATER SHOREARM
- ITEM 5 -
- ITEM 6 -
EXISTING PROJECT DEPTH 25.0 FEET
32
28
900'
EXISTING PROJECT DEPTH 29.0 FEET
OUTER HARBOR
800'
EXISTING PROJECT DEPTH 28.0 FEET
Water Pollution Control Plant
EAST PIER
1290'
- ITEM 3 -
WEST BREAKWATER
EXISTING PROJECT DEPTH 25.0 FEET
WEST PIER
CONVEYOR
COAL SLIP
- ITEM 9 -
- ITEM 4 -
- ITEM 7 AND 8 -
PIPES
SUBMARINE CABLE
ERIE


LEGEND:
ITEM 1 - REMOVAL OF 600 FEET OF EAST BREAKWATER
ITEM 2 - ADDITION OF 600 FEET TO OUTER BREAKWATER
ITEM 3 - DREDGE EXISTING OUTER HARBOR
ITEM 4 - COAL SLIP MODIFICATIONS AND CONVEYORS TO TRANSSHIPMENT AREA
ITEM 5 - DREDGE EAST BASIN
ITEM 6 - EXCAVATE RIVERSIDE PARK
ITEM 7 - SHEET PILE CELLS
ITEM 8 - SHEET PILE CELLS
ITEM 9 - SHEET PILE CELLS AND BRIDGE CONST
ITEM 10 - BANK CUT A WITH
ITEM 11 - BANK CUT A WITHO
ITEM 12 - SHEET PILE BULKH
ITEM 13 - TRANSSHIPMENT FA
ITEM 14 - TRANSSHIPMENT FA LOADOUT
ITEM 15 - BANK CUTS B, C AI
ITEM 16 - BERM CONSTRUCTIO
ERIE AVE
COLORADO
HENDERSON
- ITEM 6 -
- ITEM 10 OR 11 -
AMERICAN SHIPBUILDING CO
DRYDOCK 1
DRYDOCK 2
BLACK
- ITEM 12 -
N & W Railroad Bridge
TRANSSHIPMENT FACILITY
- 9 -
- 8 -
CONVEYOR
BROADWAY
- ITEM 13 OR 14 -
- ITEM 15 -
RIVER
DRIVE
CHANNEL
UPPER TURNING BASINS
LOWER TURNING BASIN
21ST ST
U S STEEL CO
ELYRIA AVE
NOTES
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT RATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)
2 INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER
32 INDICATES NEW DEPTH REQUIREMENTS
PLAN
SCALE OF FEET
500' 0 500 1000' 1500'

FEET OF EAST BREAKWATER

FEET TO OUTER BREAKWATER

OUTER HARBOR

CATIONS AND CONVEYORS
IT AREA

IN

IDE PARK

ITEM 9 - SHEET PILE CELLS RIVER DIVERSION AND BRIDGE CONSTRUCTION

ITEM 10 - BANK CUT A WITH SHEET PILE PROTECTION

ITEM 11 - BANK CUT A WITHOUT SHEET PILE PROTECTION

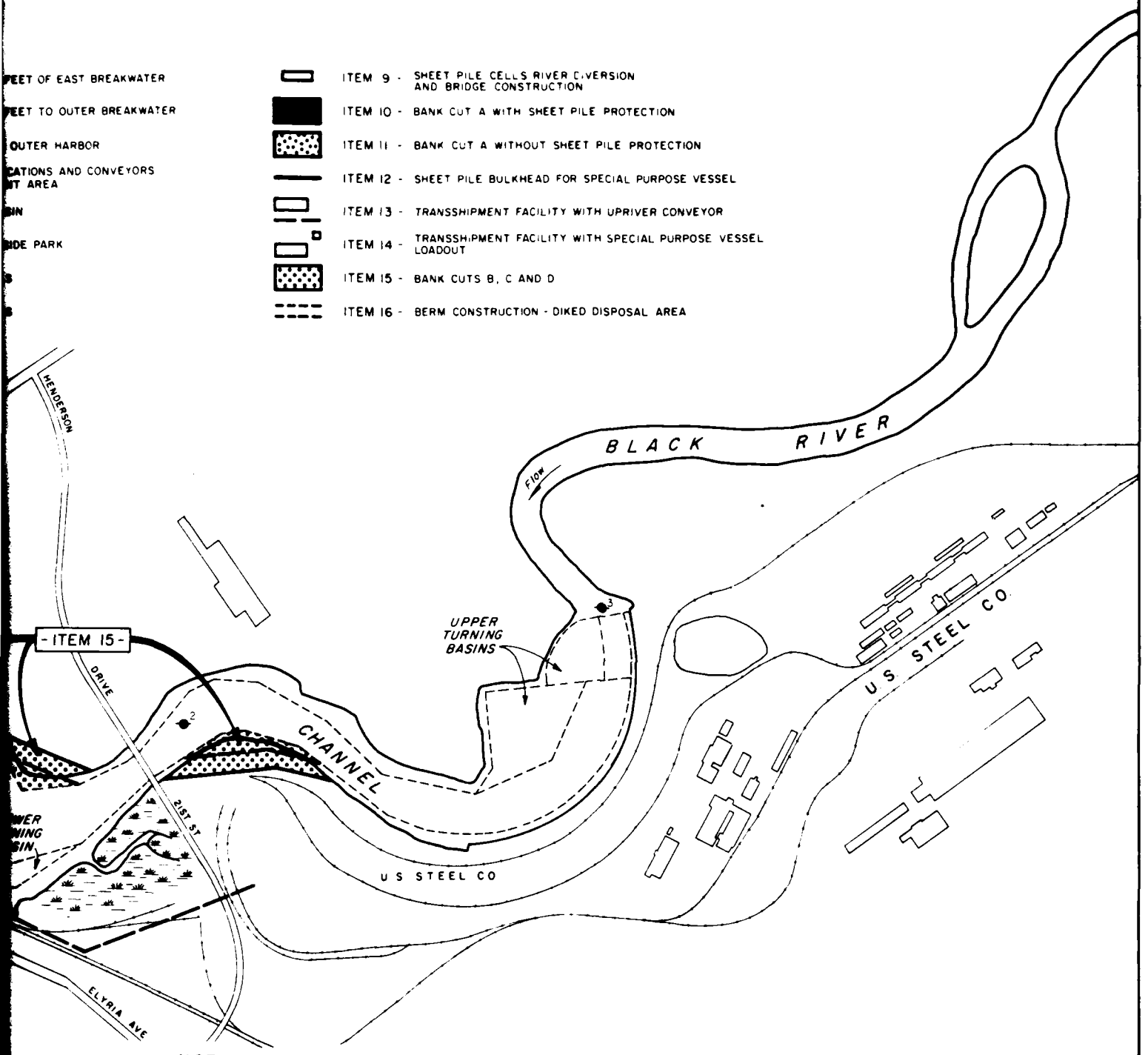
ITEM 12 - SHEET PILE BULKHEAD FOR SPECIAL PURPOSE VESSEL

ITEM 13 - TRANSSHIPMENT FACILITY WITH UPRIVER CONVEYOR

ITEM 14 - TRANSSHIPMENT FACILITY WITH SPECIAL PURPOSE VESSEL LOADOUT

ITEM 15 - BANK CUTS B, C AND D

ITEM 16 - BERM CONSTRUCTION - DIKED DISPOSAL AREA



NOTES

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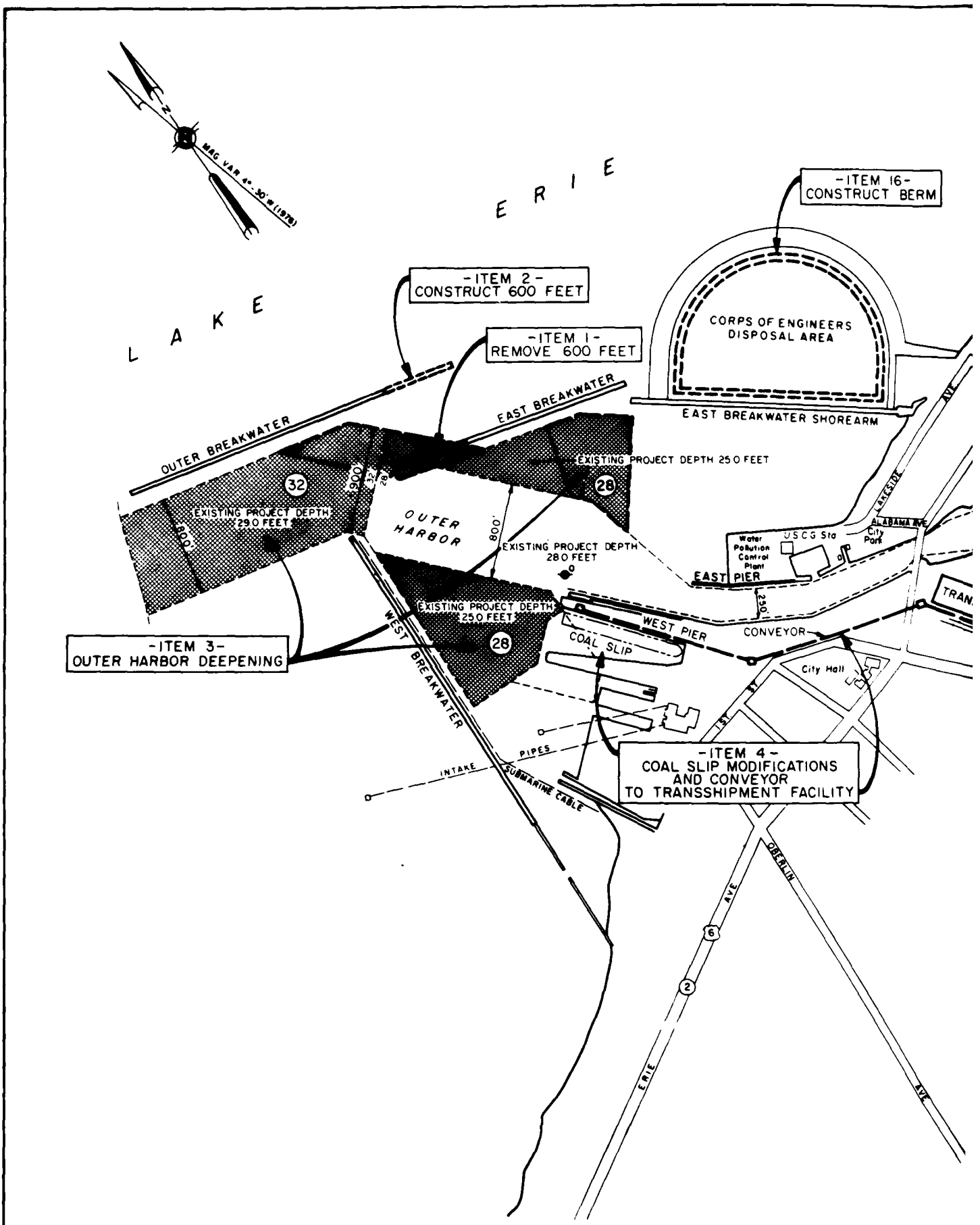
$\bullet^{2}$ INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

(32) INDICATES NEW DEPTH REQUIREMENTS

LORAIN HARBOR, OHIO
LORAIN HARBOR STUDY

ALTERNATIVE NAVIGATION IMPROVEMENTS

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1983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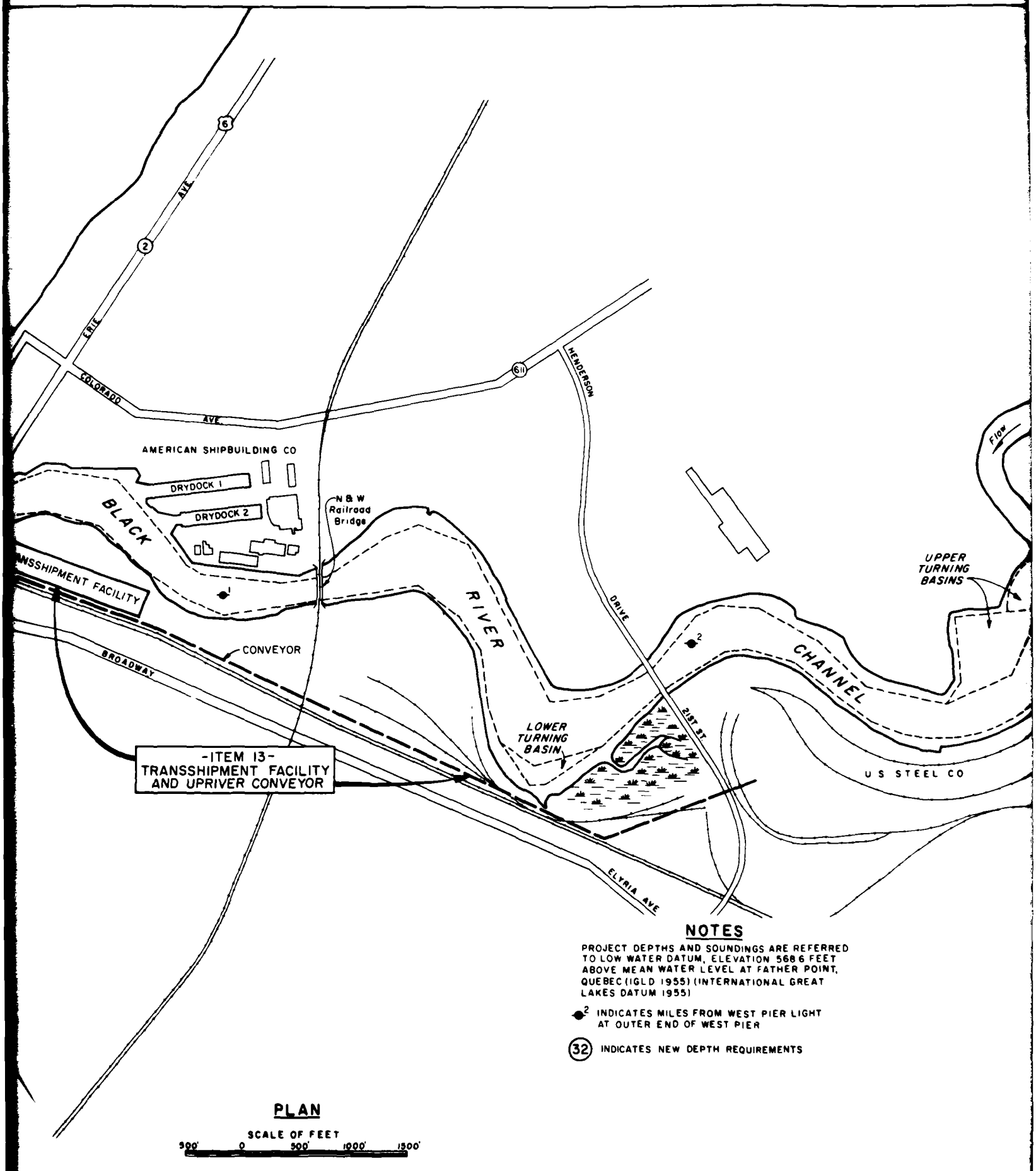
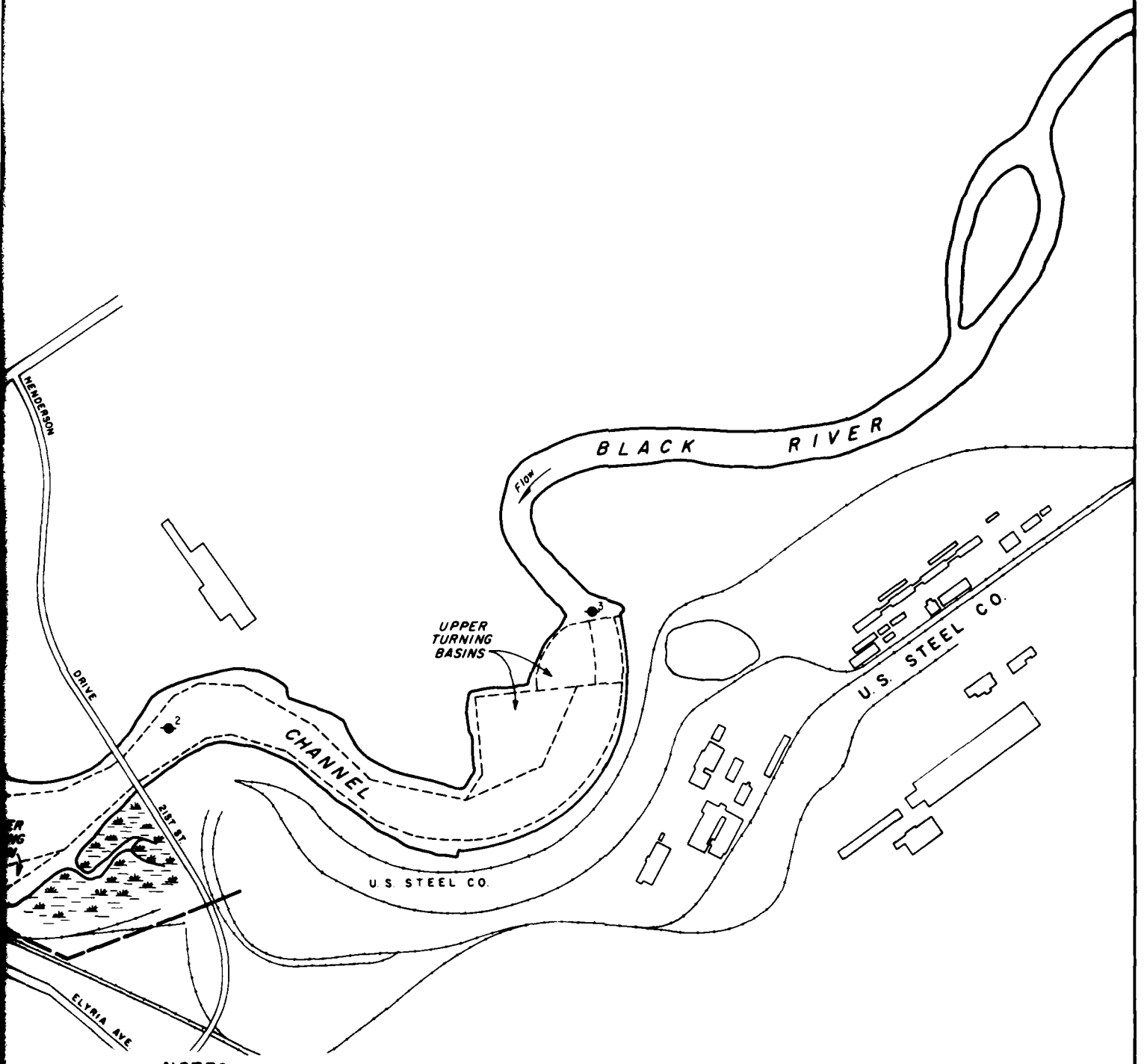
LAKE ERIE
-ITEM 16-
CONSTRUCT BERM
-ITEM 2-
CONSTRUCT 600 FEET
-ITEM 1-
REMOVE 600 FEET
CORPS OF ENGINEERS
DISPOSAL AREA
EAST BREAKWATER SHOREARM
OUTER BREAKWATER
EAST BREAKWATER
EXISTING PROJECT DEPTH 25.0 FEET
32
28
900'
32'
29'
EXISTING PROJECT DEPTH
29.0 FEET
OUTER
HARBOR
800'
EXISTING PROJECT DEPTH
28.0 FEET
Water
Pollution
Control
Plant
USCG Sta
City
Park
ALABAMA AVE
LAKESIDE AVE
EAST PIER
250'
EXISTING PROJECT DEPTH
25.0 FEET
28
WEST PIER
CONVEYOR
-ITEM 3-
OUTER HARBOR DEEPENING
WEST
BREAKWATER
COAL SLIP
City Hall
1ST ST
PIPES
INTAKE
SUBMARINE CABLE
-ITEM 4-
COAL SLIP MODIFICATIONS
AND CONVEYOR
TO TRANSSHIPMENT FACILITY
OBERLIN AVE
ERIE AVE
6
2


6
2
ERIE AVE
COLORADO AVE
6 11
HENDERSON DRIVE
AMERICAN SHIPBUILDING CO
DRYDOCK 1
DRYDOCK 2
BLACK RIVER
N & W Railroad Bridge
TRANSSHIPMENT FACILITY
CONVEYOR
BROADWAY
-ITEM 13-
TRANSSHIPMENT FACILITY
AND UPRIVER CONVEYOR
LOWER TURNING BASIN
21ST ST
CHANNEL
UPPER TURNING BASINS
Flow
U S STEEL CO
ELYRIA AVE
NOTES
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)
2 INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER
32 INDICATES NEW DEPTH REQUIREMENTS
PLAN
SCALE OF FEET
500' 0 500' 1000' 1500'



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●^{2} INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

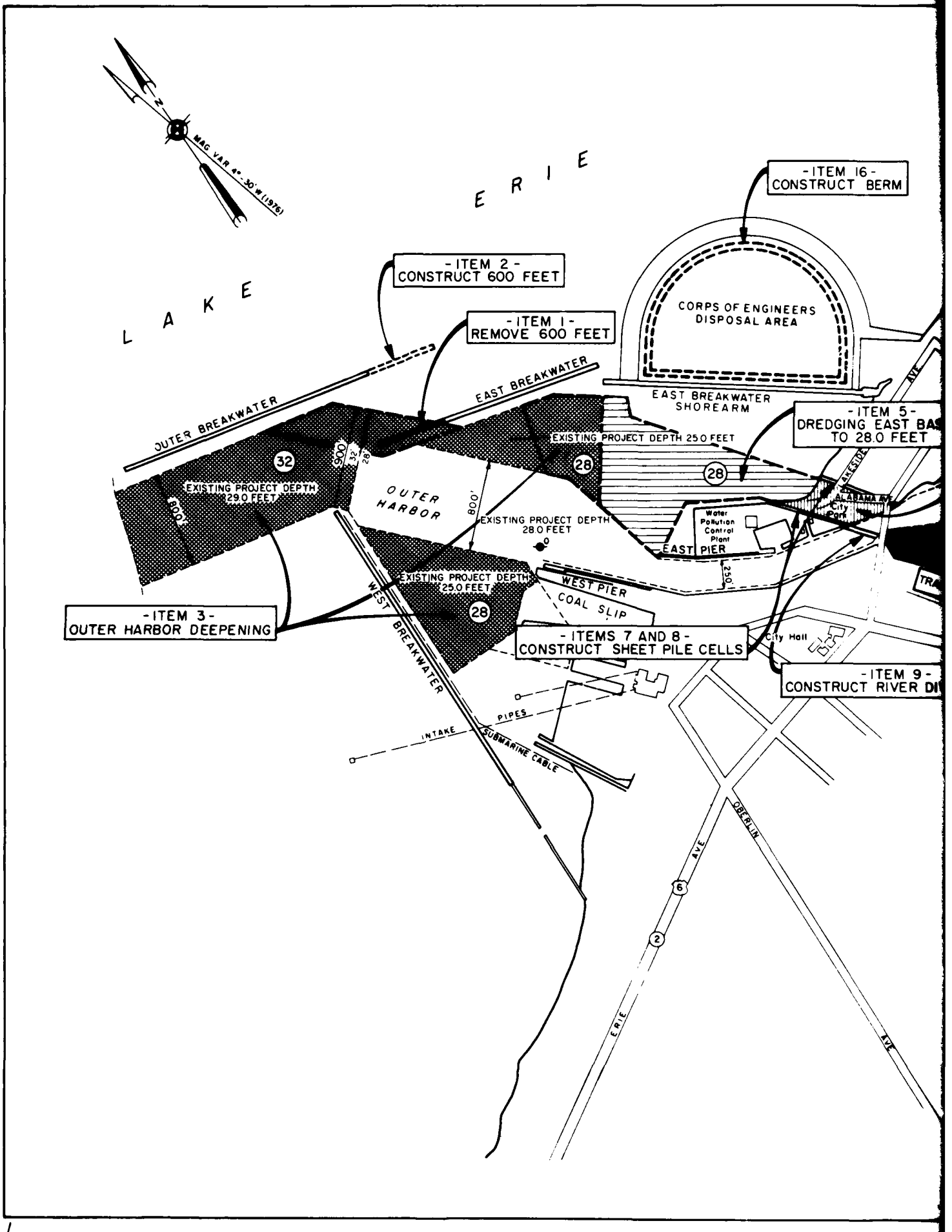
(32) INDICATES NEW DEPTH REQUIREMENTS

LORAIN HARBOR, OHIO
LORAIN HARBOR STUDY

ALTERNATIVE 9
LAKEFRONT TRANSSHIPMENT-CONVEYOR UPRIVER

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1983

PLATE 4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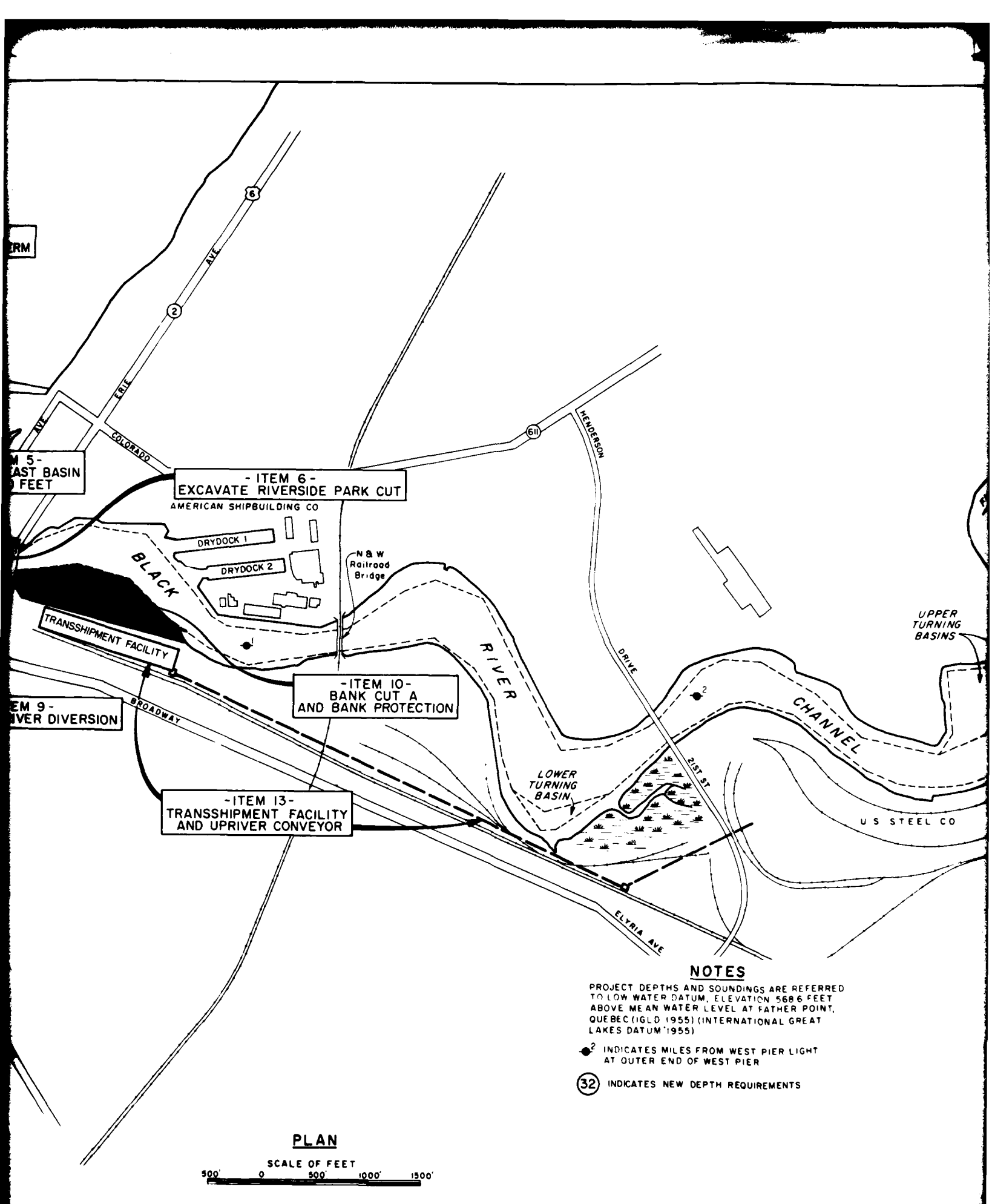
MAG VAR 4° 30' W (1976)
LAKE ERIE
-ITEM 16-
CONSTRUCT BERM
-ITEM 2-
CONSTRUCT 600 FEET
-ITEM 1-
REMOVE 600 FEET
CORPS OF ENGINEERS
DISPOSAL AREA
EAST BREAKWATER
SHOREARM
OUTER BREAKWATER
EAST BREAKWATER
EXISTING PROJECT DEPTH 25.0 FEET
-ITEM 5-
DREDGING EAST BA
TO 28.0 FEET
32
500'
33'
28'
28
EXISTING PROJECT DEPTH
29.0 FEET
600'
OUTER
HARBOR
800'
EXISTING PROJECT DEPTH
28.0 FEET
Water
Pollution
Control
Plant
EAST PIER
ALABAMA AVE
City
Carp
250'
EXISTING PROJECT DEPTH
25.0 FEET
WEST PIER
COAL SLIP
-ITEM 3-
OUTER HARBOR DEEPENING
WEST BREAKWATER
-ITEMS 7 AND 8-
CONSTRUCT SHEET PILE CELLS
City Hall
-ITEM 9-
CONSTRUCT RIVER DI
PIPES
INTAKE
SUBMARINE CABLE
OBERLIN
AVE
6
2
ERIE
AVE



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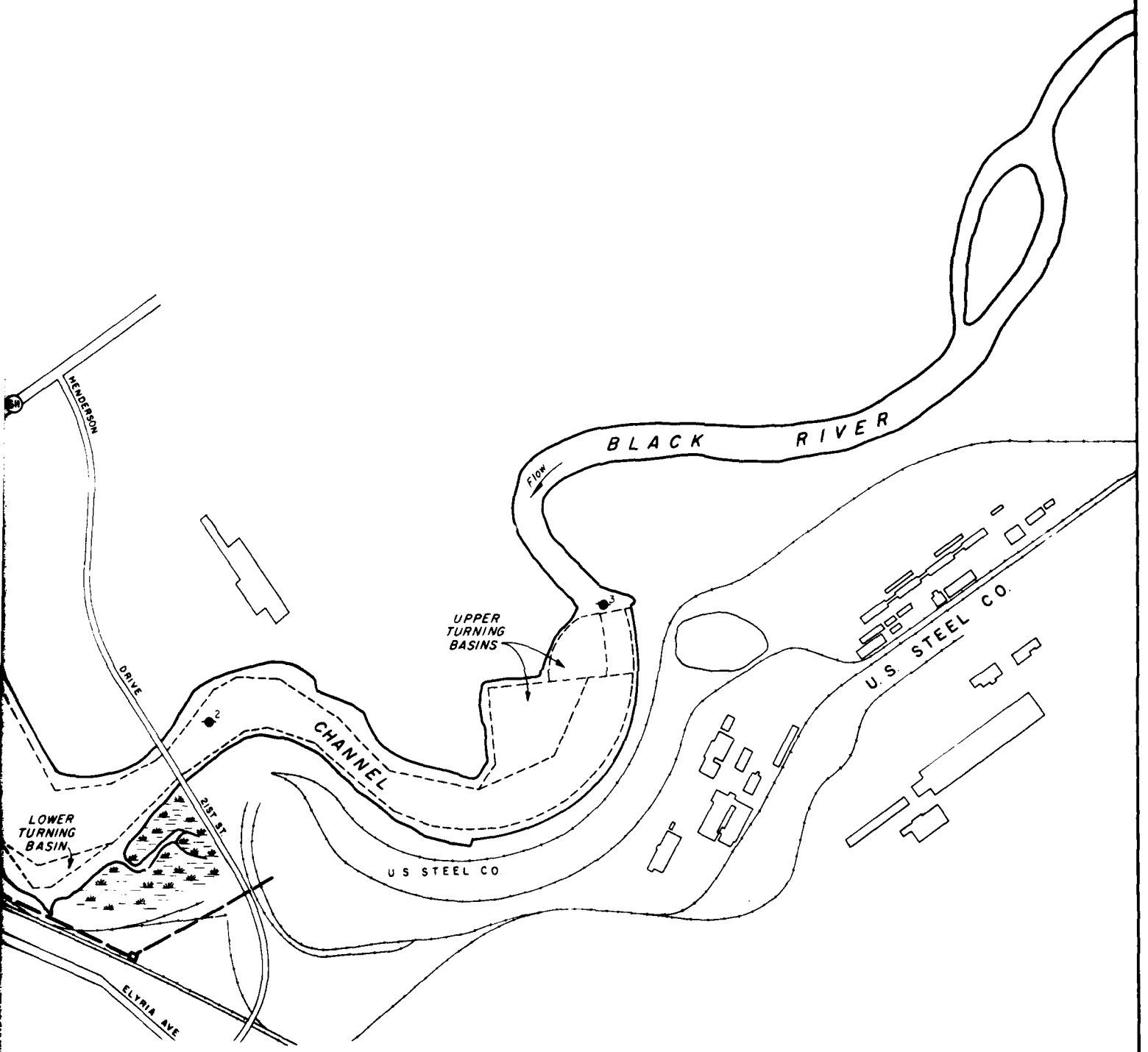
●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

(32) INDICATES NEW DEPTH REQUIREMENTS

PLAN

SCALE OF FEET

500' 0 500' 1000' 1500'



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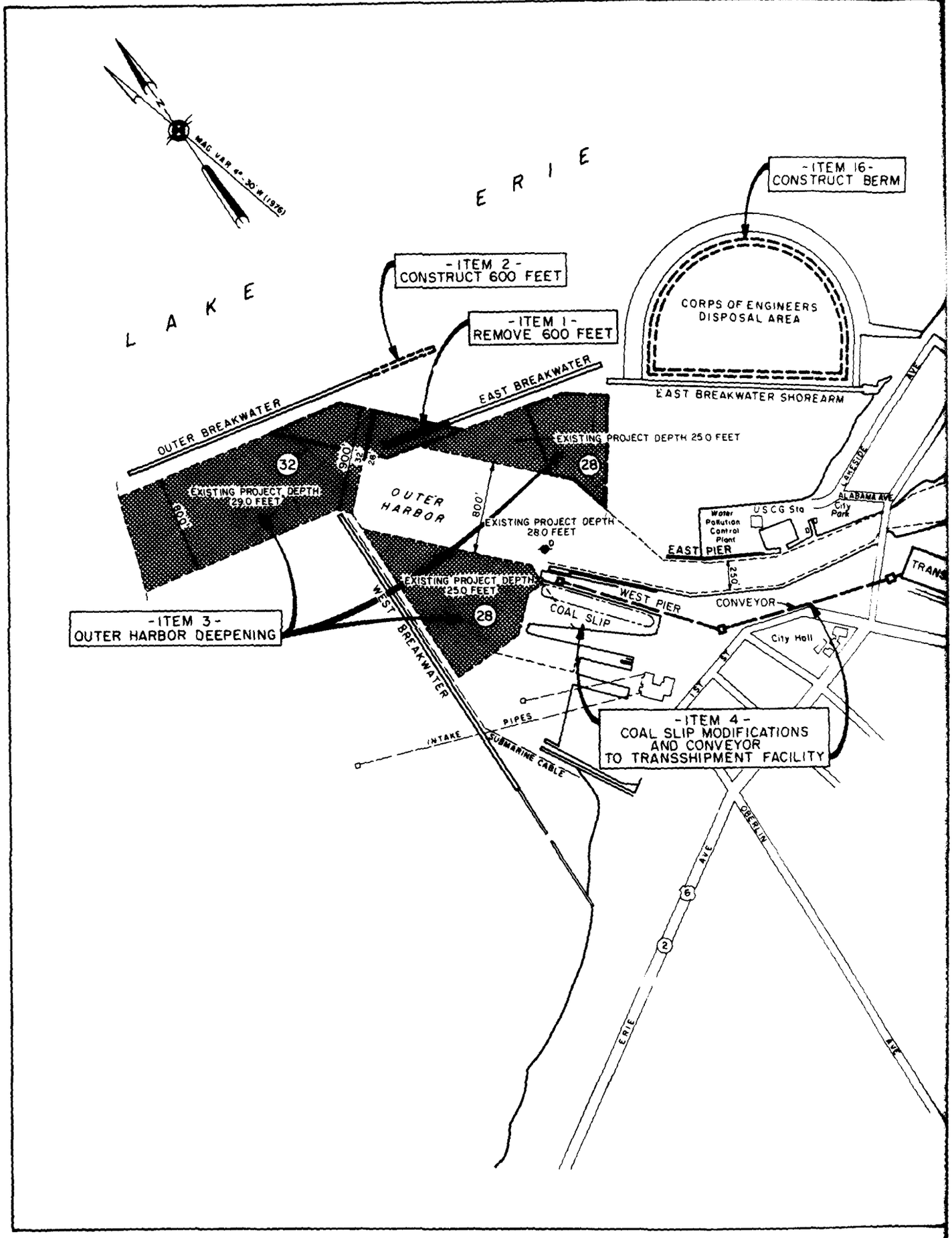
●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

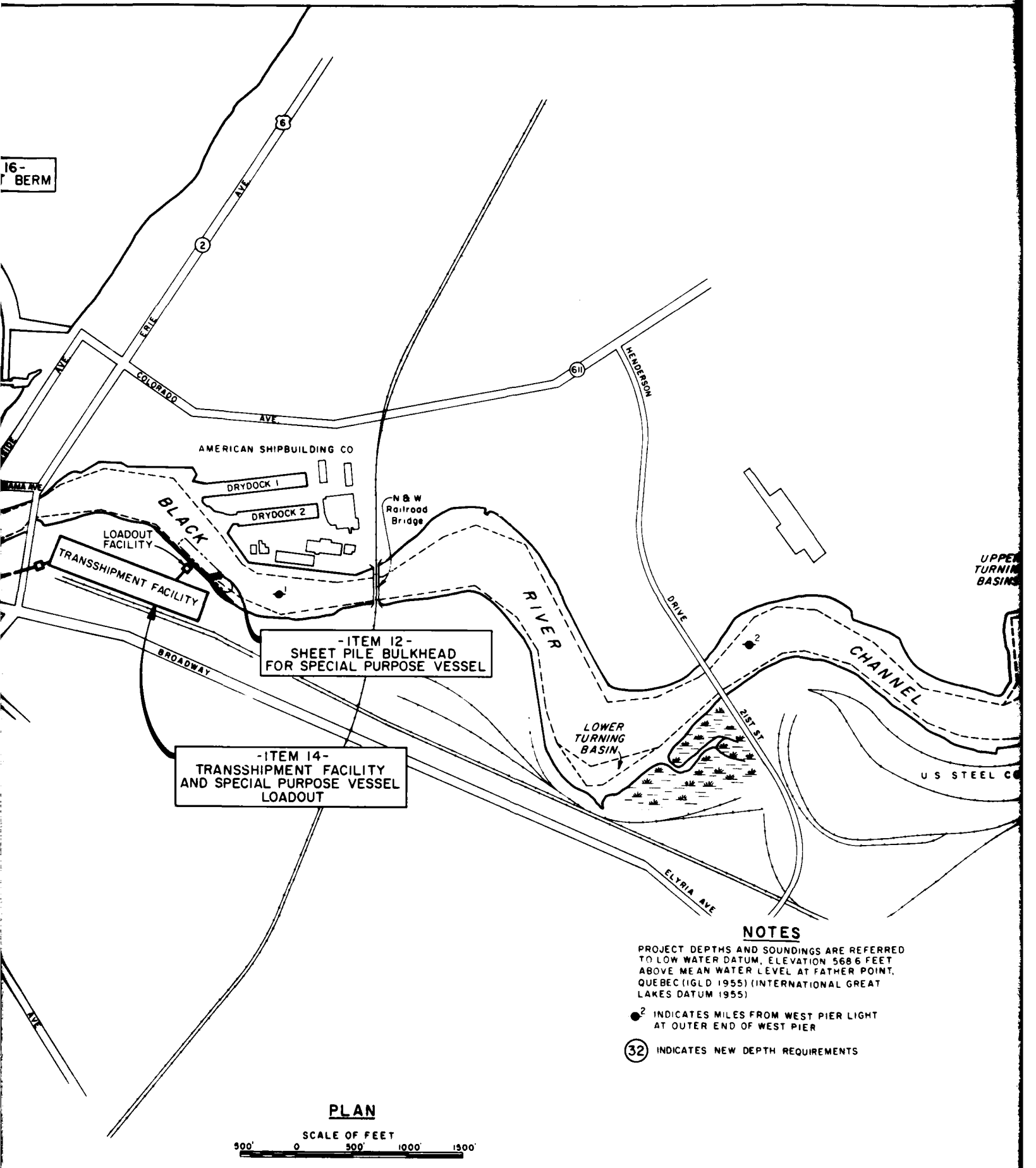
(32) INDICATES NEW DEPTH REQUIREMENTS

LORAIN HARBOR, OHIO
LORAIN HARBOR STUDY
ALTERNATIVE 9A

RIVERSIDE PARK CUT CONVEYOR UPRIVER

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1983


N
MAG VAR 4° 30' W (1976)
LAKE ERIE
-ITEM 16-
CONSTRUCT BERM
-ITEM 2-
CONSTRUCT 600 FEET
-ITEM 1-
REMOVE 600 FEET
CORPS OF ENGINEERS
DISPOSAL AREA
EAST BREAKWATER SHOREARM
OUTER BREAKWATER
EAST BREAKWATER
EXISTING PROJECT DEPTH 25.0 FEET
32
28
900'
300'
EXISTING PROJECT DEPTH
29.0 FEET
OUTER
HARBOR
800'
EXISTING PROJECT DEPTH
28.0 FEET
Water
Pollution
Control
Plant
USCG Sta
City
Park
ALABAMA AVE
LAKESIDE AVE
EAST PIER
250'
TRANS
EXISTING PROJECT DEPTH
25.0 FEET
WEST PIER
CONVEYOR
-ITEM 3-
OUTER HARBOR DEEPENING
COAL SLIP
City Hall
1ST ST
WEST BREAKWATER
PIPES
INTAKE
SUBMARINE CABLE
-ITEM 4-
COAL SLIP MODIFICATIONS
AND CONVEYOR
TO TRANSSHIPMENT FACILITY
OBERLIN AVE
6
2
ERIE AVE



NOTES

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)

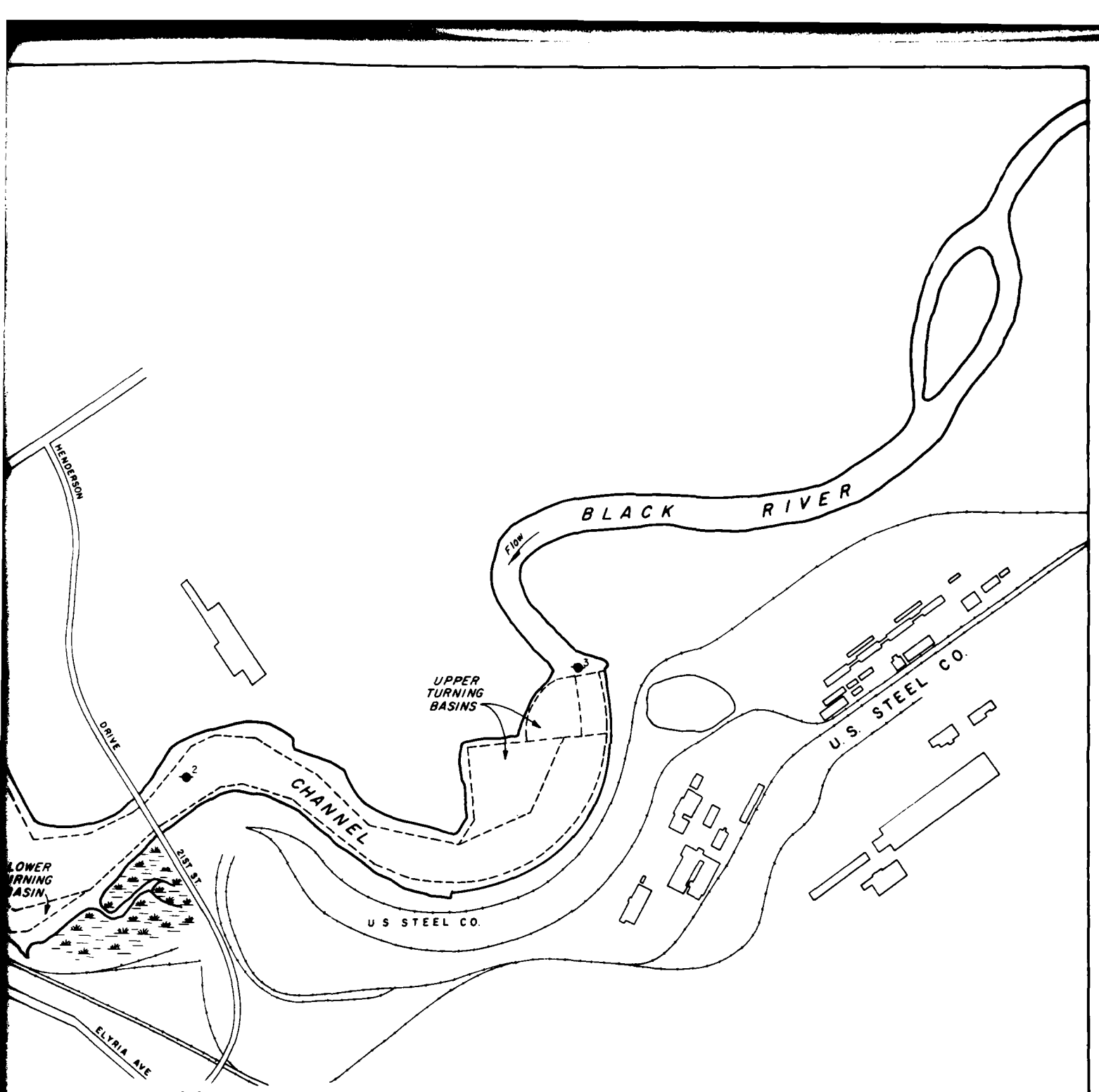
●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

(32) INDICATES NEW DEPTH REQUIREMENTS

PLAN

SCALE OF FEET

500' 0 500' 1000' 1500'



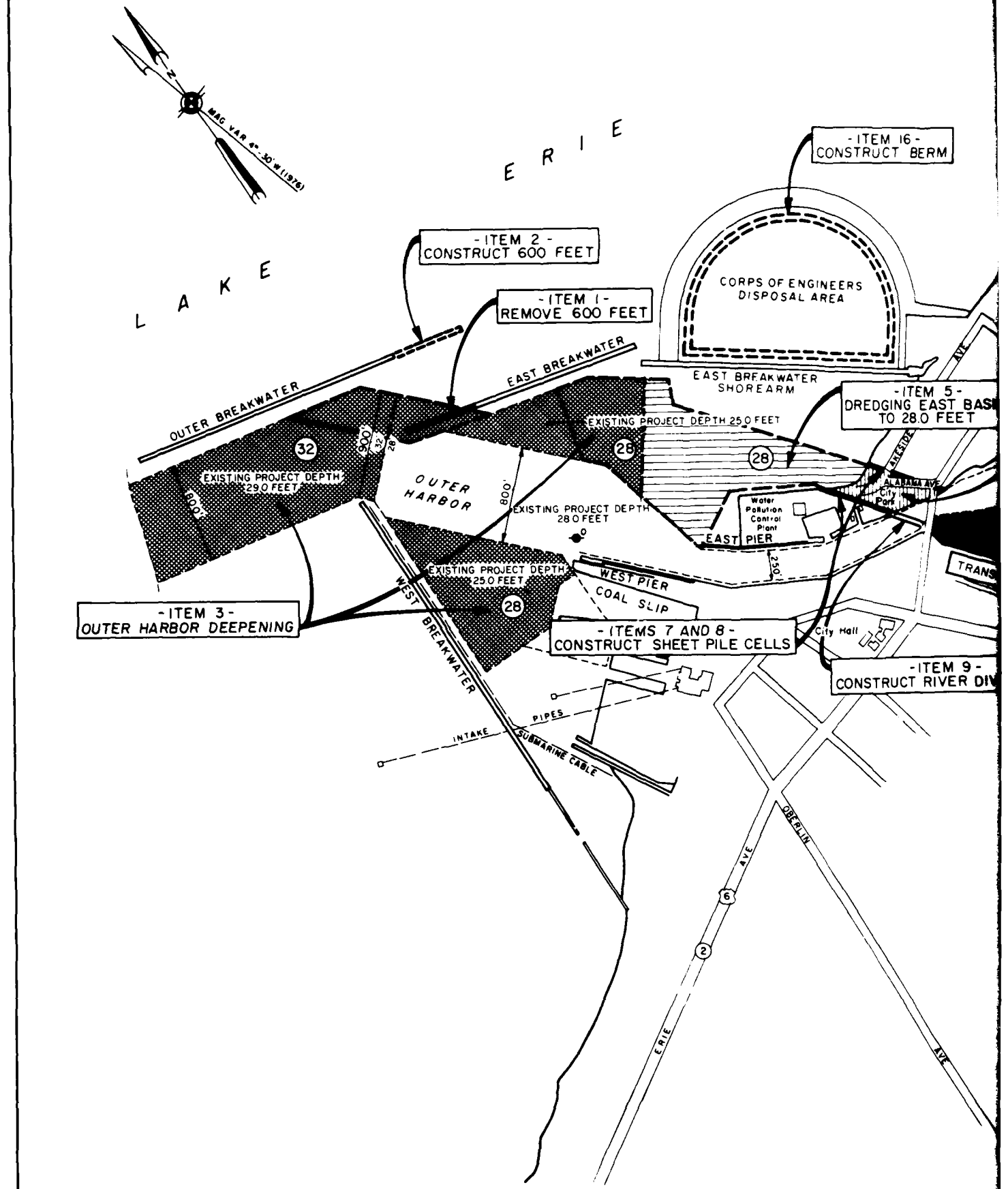
NOTES

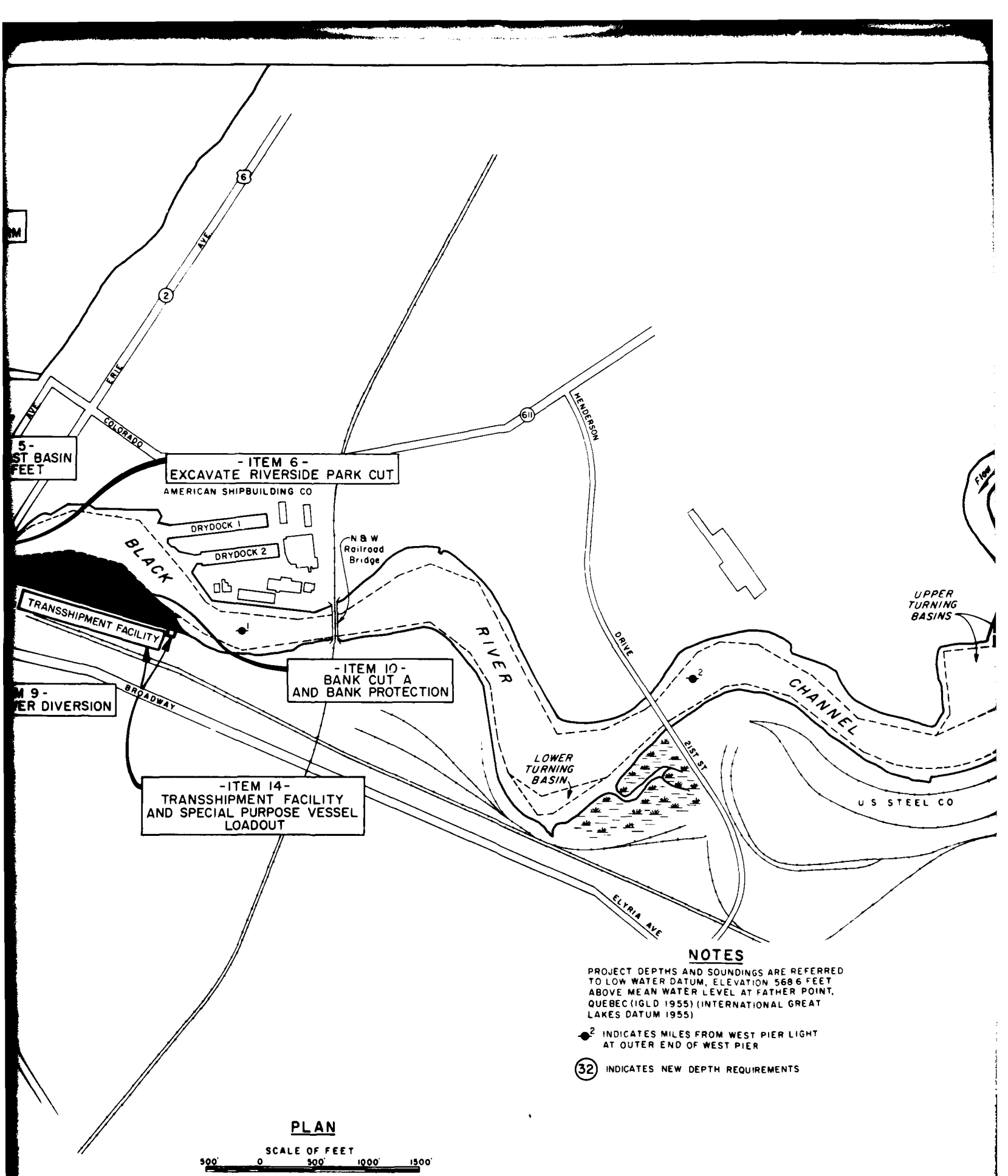
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)

●^{2} INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

(32) INDICATES NEW DEPTH REQUIREMENTS

LORAIN HARBOR, OHIO
LORAIN HARBOR STUDY
ALTERNATIVE 10
LAKEFRONT TRANSSHIPMENT SPECIAL PURPOSE VESSEL UPRIVER
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1983


MAG VAR 4° 30' W (1976)
LAKE ERIE
-ITEM 16-
CONSTRUCT BERM
-ITEM 2-
CONSTRUCT 600 FEET
-ITEM 1-
REMOVE 600 FEET
CORPS OF ENGINEERS
DISPOSAL AREA
EAST BREAKWATER
SHOREARM
OUTER BREAKWATER
EAST BREAKWATER
-ITEM 5-
DREDGING EAST BASI
TO 28.0 FEET
EXISTING PROJECT DEPTH 25.0 FEET
32
900'
32
28
28
28
EXISTING PROJECT DEPTH
29.0 FEET
800'
OUTER
HARBOR
800'
EXISTING PROJECT DEPTH
28.0 FEET
ARLEIGH AVE
ALABAMA AVE
City Park
Water
Pollution
Control
Plant
EAST PIER
250'
TRANS
EXISTING PROJECT DEPTH
25.0 FEET
WEST PIER
COAL SLIP
28
-ITEM 3-
OUTER HARBOR DEEPENING
-ITEMS 7 AND 8-
CONSTRUCT SHEET PILE CELLS
City Hall
-ITEM 9-
CONSTRUCT RIVER DIV
WEST BREAKWATER
PIPES
INTAKE
SUBMARINE CABLE
OBERLIN AVE
6
2
ERIE AVE



NOTES

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)

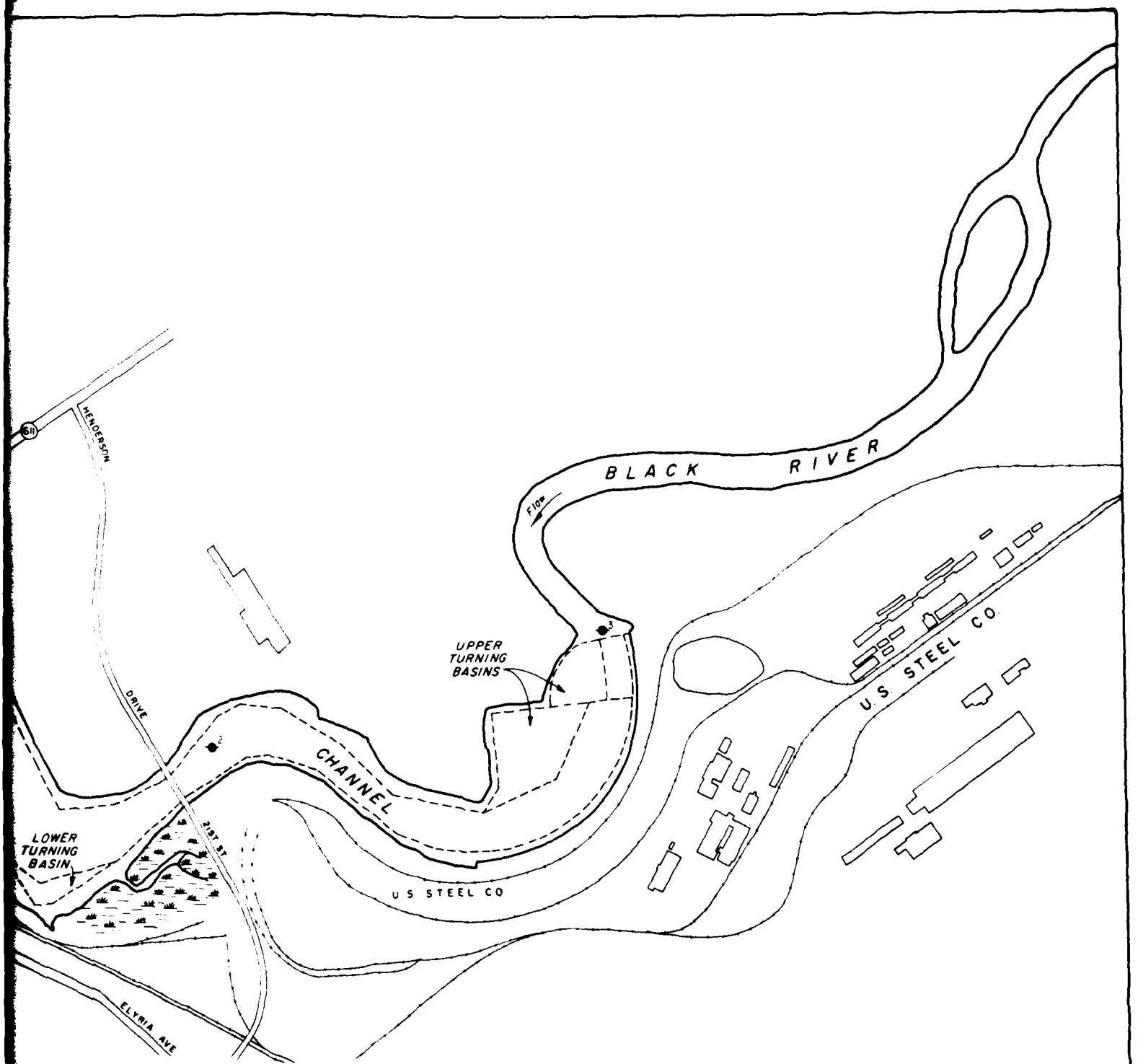
●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

(32) INDICATES NEW DEPTH REQUIREMENTS

PLAN

SCALE OF FEET

500' 0 500' 1000' 1500'



NOTES

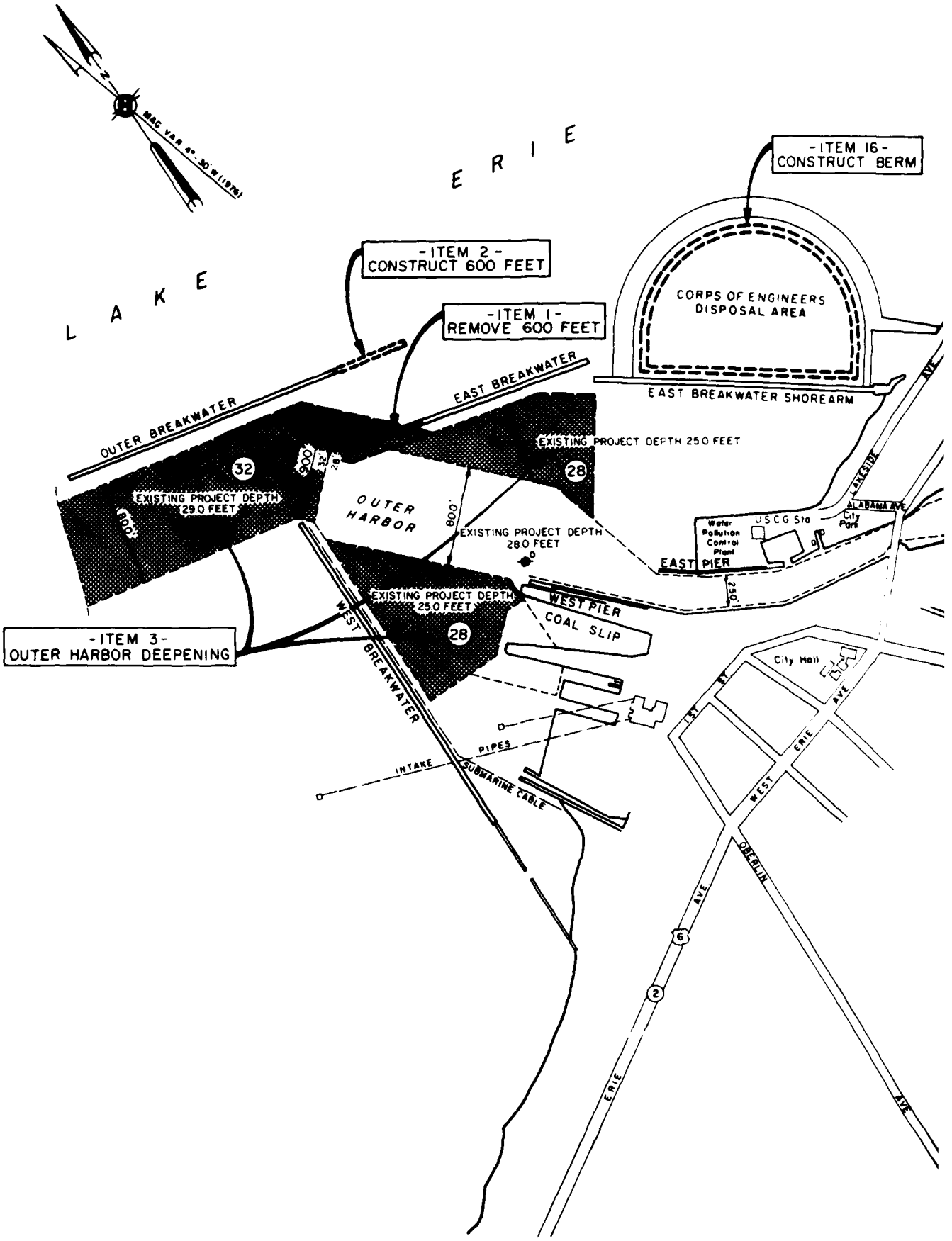
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)

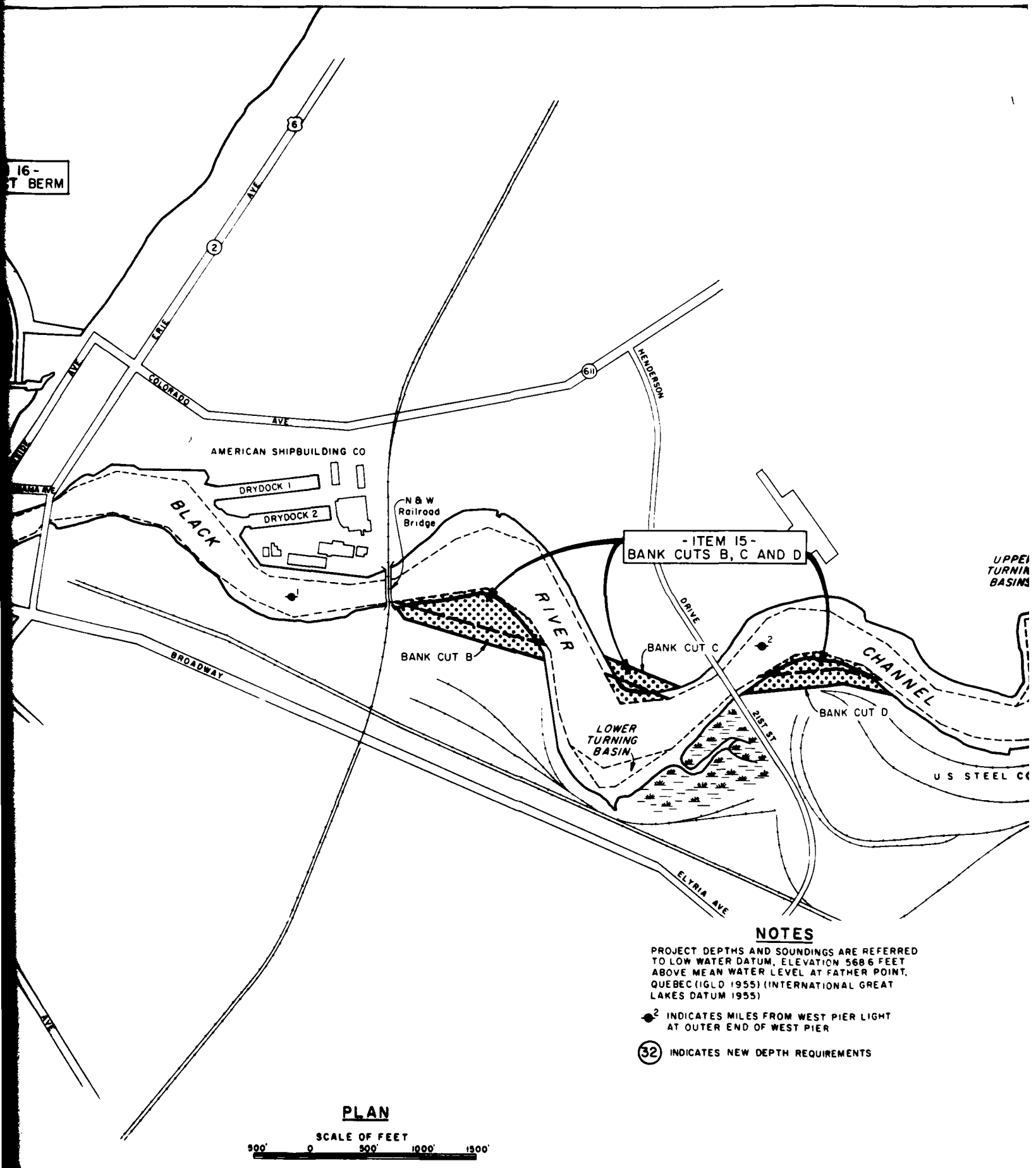
●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

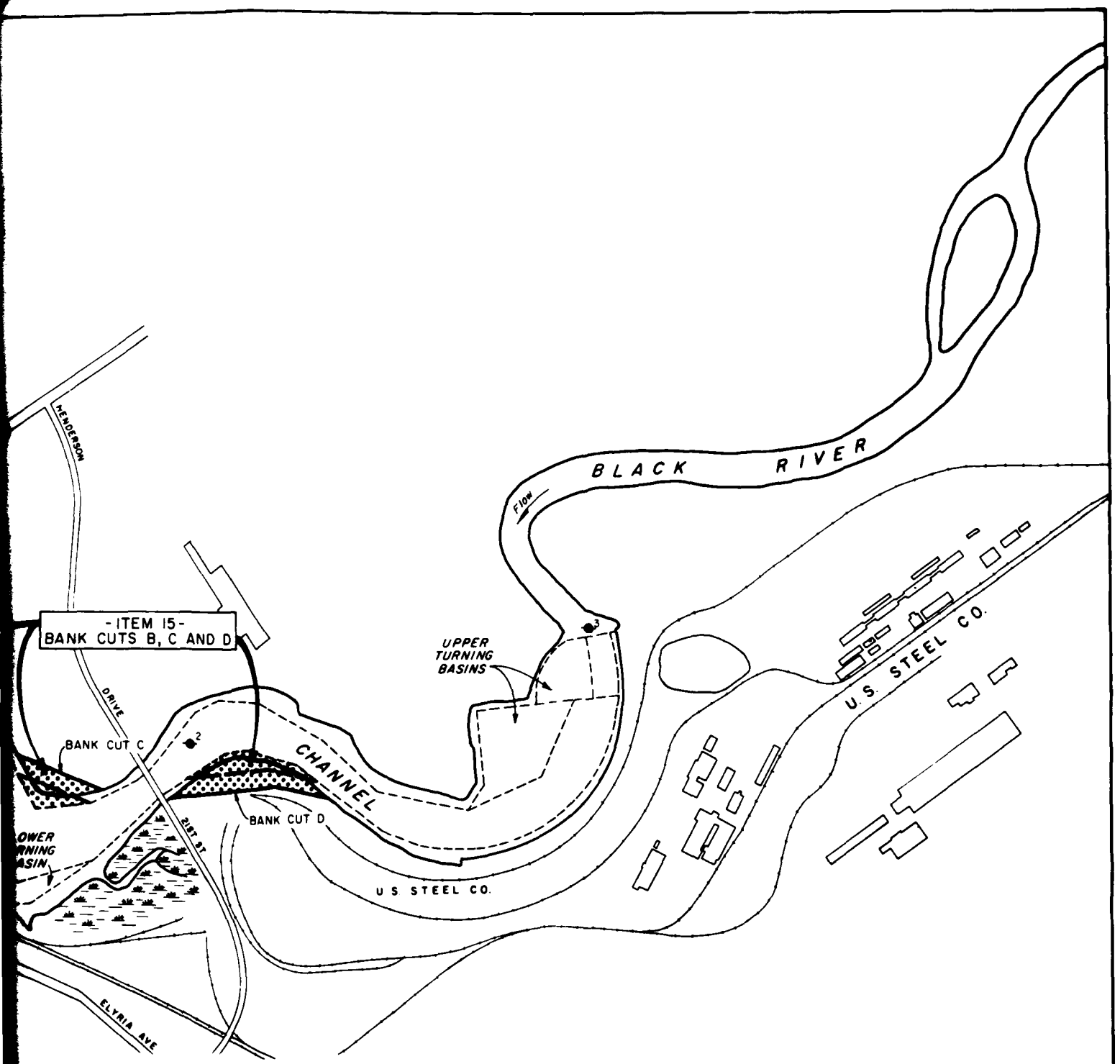
(32) INDICATES NEW DEPTH REQUIREMENTS

LORAIN HARBOR, OHIO
LORAIN HARBOR STUDY
ALTERNATIVE 10A
RIVERSIDE PARK CUT
SPECIAL PURPOSE VESSEL
UPRIVER
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1983

PLATE 7


MAG VAR 6° 30' W (1978)
LAKE ERIE
-ITEM 16-
CONSTRUCT BERM
-ITEM 2-
CONSTRUCT 600 FEET
-ITEM 1-
REMOVE 600 FEET
CORPS OF ENGINEERS
DISPOSAL AREA
EAST BREAKWATER SHOREARM
OUTER BREAKWATER
EAST BREAKWATER
EXISTING PROJECT DEPTH 25.0 FEET
32
28
900'
800'
EXISTING PROJECT DEPTH
29.0 FEET
OUTER
HARBOR
EXISTING PROJECT DEPTH
28.0 FEET
EXISTING PROJECT DEPTH
25.0 FEET
-ITEM 3-
OUTER HARBOR DEEPENING
WEST BREAKWATER
WEST PIER
COAL SLIP
PIPES
INTAKE
SUBMARINE CABLE
Water Pollution Control Plant
USCG Sta
City Park
EAST PIER
ALABAMA AVE
LAKESIDE AVE
City Hall
1ST ST
ERIE AVE
WEST ERIE AVE
OBERLIN AVE
6
2


16 -
T BERM
6
2
ERIE AVE
ERIE AVE
COLORADO AVE
61
HENDERSON
AMERICAN SHIPBUILDING CO
DRYDOCK 1
DRYDOCK 2
BLACK
N & W Railroad Bridge
- ITEM 15 -
BANK CUTS B, C AND D
RIVER
DRIVE
BANK CUT B
BANK CUT C
2
CHANNEL
BANK CUT D
BROADWAY
LOWER TURNING BASIN
21ST ST
U S STEEL CO
ELYRIA AVE
AVE
NOTES
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)
2 INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER
32 INDICATES NEW DEPTH REQUIREMENTS
PLAN
SCALE OF FEET
500' 0 500' 1000' 1500'



NOTES

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)

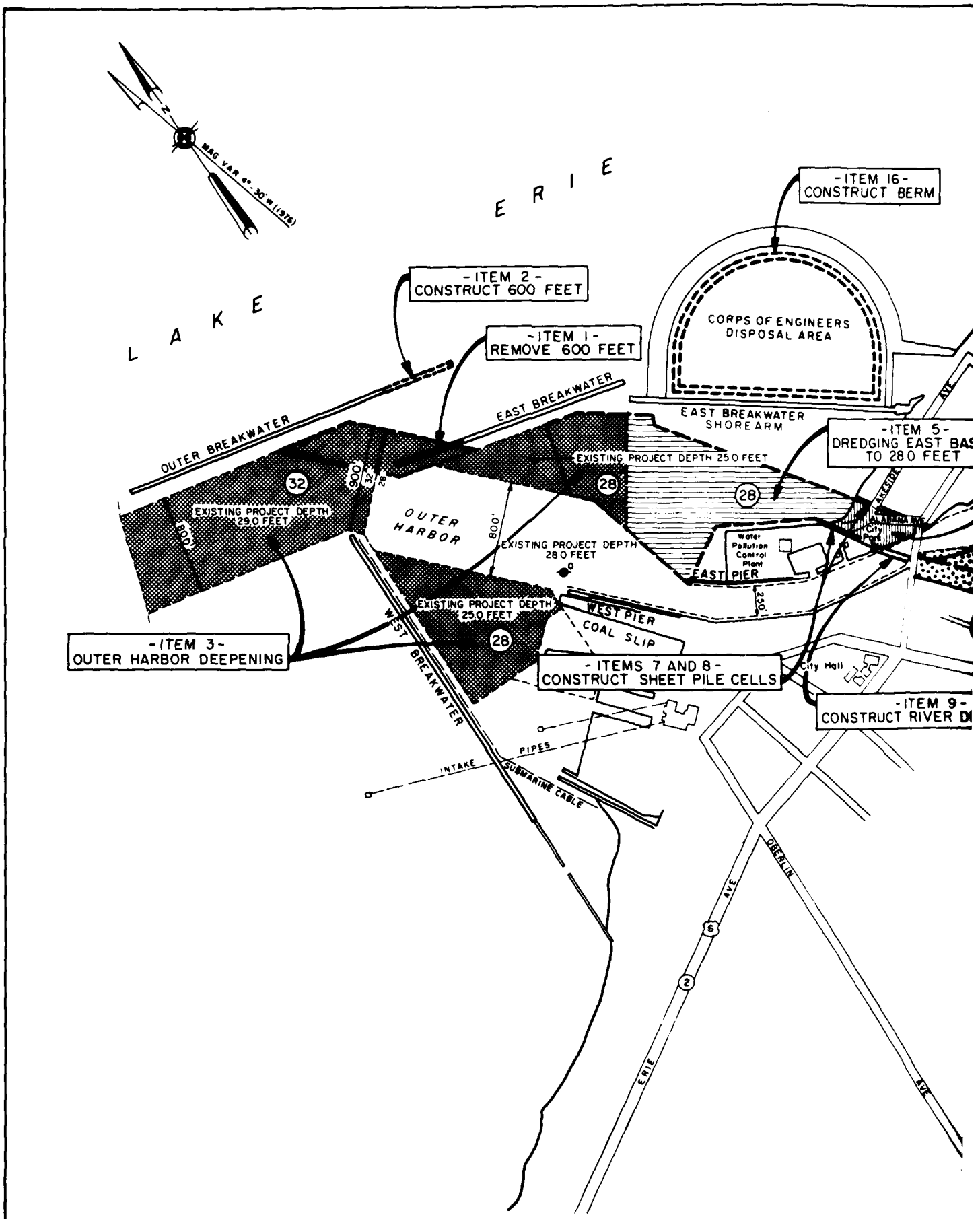
●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

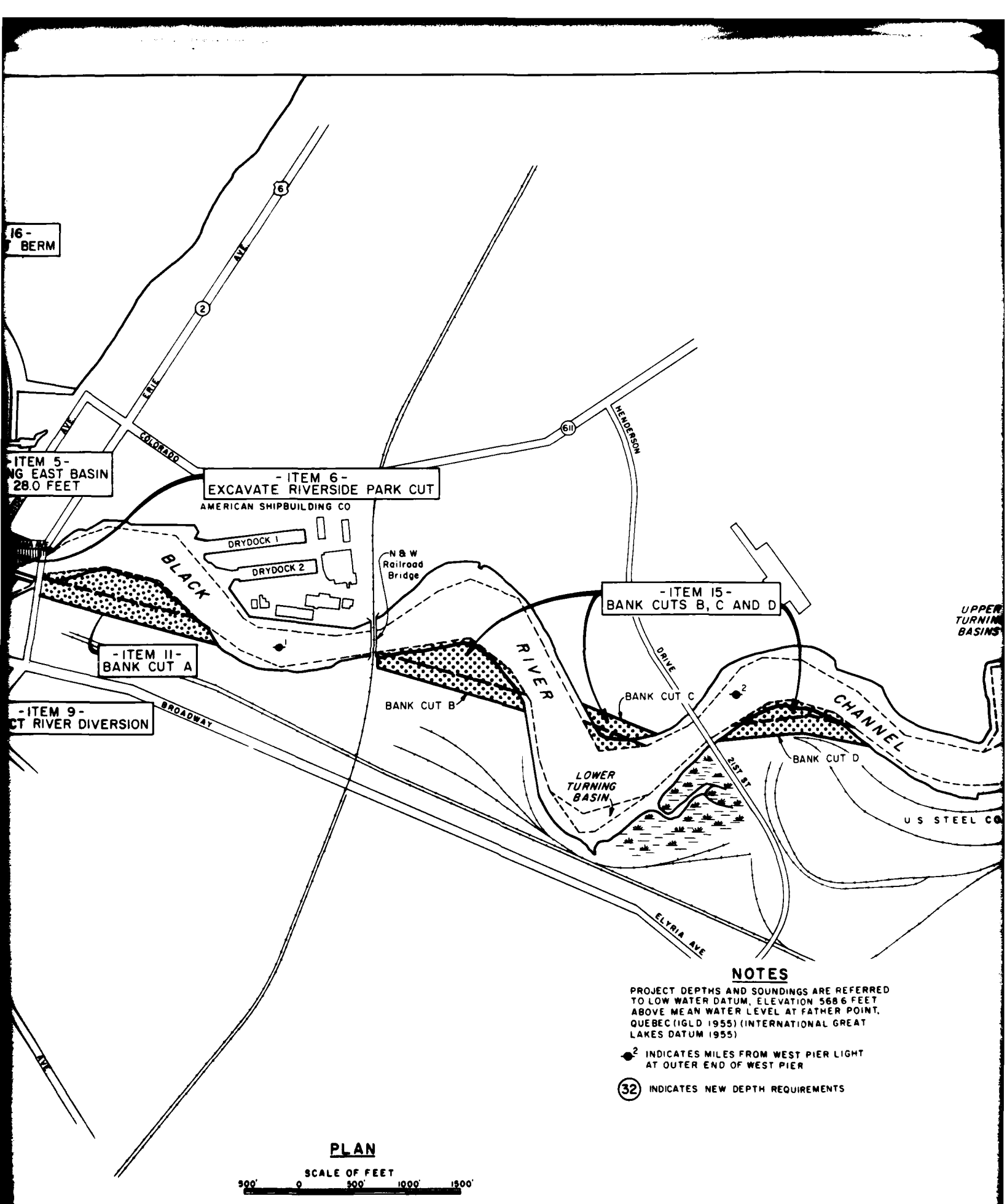
(32) INDICATES NEW DEPTH REQUIREMENTS

LORAIN HARBOR, OHIO
LORAIN HARBOR STUDY
ALTERNATIVE 18

DIRECT DELIVERY 767 FOOT VESSELS

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1983


MAG VAR 6° 30' W (1976)
L A K E
E R I E
-ITEM 16-
CONSTRUCT BERM
-ITEM 2-
CONSTRUCT 600 FEET
-ITEM 1-
REMOVE 600 FEET
CORPS OF ENGINEERS
DISPOSAL AREA
EAST BREAKWATER
SHOREARM
OUTER BREAKWATER
EAST BREAKWATER
-ITEM 5-
DREDGING EAST BAS
TO 28 0 FEET
EXISTING PROJECT DEPTH 25 0 FEET
EXISTING PROJECT DEPTH
29 0 FEET
OUTER
HARBOR
EXISTING PROJECT DEPTH
28 0 FEET
Water
Pollution
Control
Plant
EAST PIER
EXISTING PROJECT DEPTH
25 0 FEET
WEST PIER
COAL SLIP
-ITEM 3-
OUTER HARBOR DEEPENING
-ITEMS 7 AND 8-
CONSTRUCT SHEET PILE CELLS
City Hall
-ITEM 9-
CONSTRUCT RIVER DI
WEST BREAKWATER
PIPES
INTAKE
SUBMARINE CABLE
ERIE
AVE
OBERLIN
AVE
6
2
32
28
900'
800'
600'
250'



NOTES

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955)

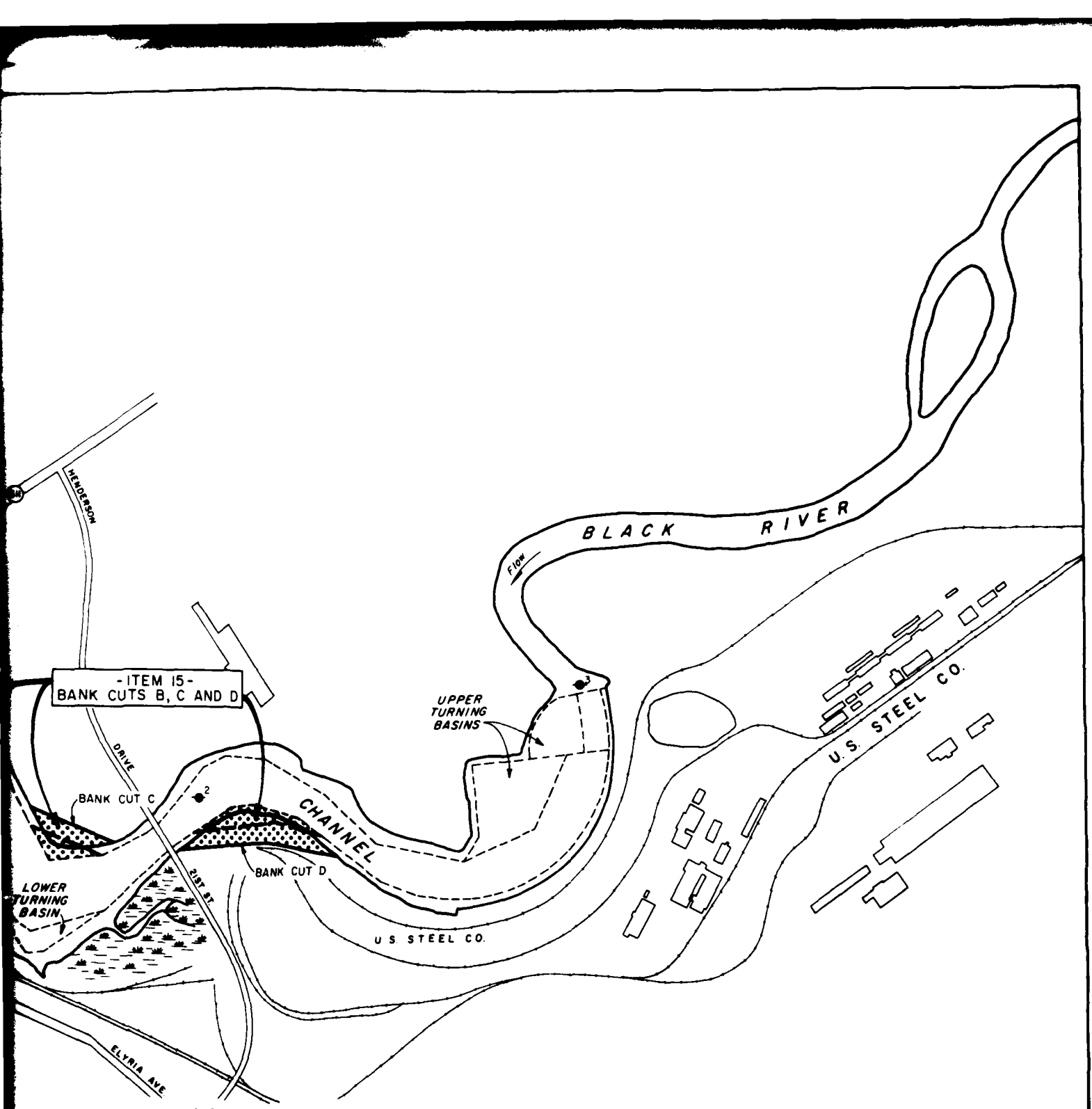
●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

(32) INDICATES NEW DEPTH REQUIREMENTS

PLAN

SCALE OF FEET

900' 0 500' 1000' 1500'



NOTES

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955).

●² INDICATES MILES FROM WEST PIER LIGHT AT OUTER END OF WEST PIER

(32) INDICATES NEW DEPTH REQUIREMENTS

LORAIN HARBOR, OHIO
LORAIN HARBOR STUDY

ALTERNATIVE 18A
DIRECT DELIVERY
767 FOOT VESSELS
RIVERSIDE PARK CUT

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1983

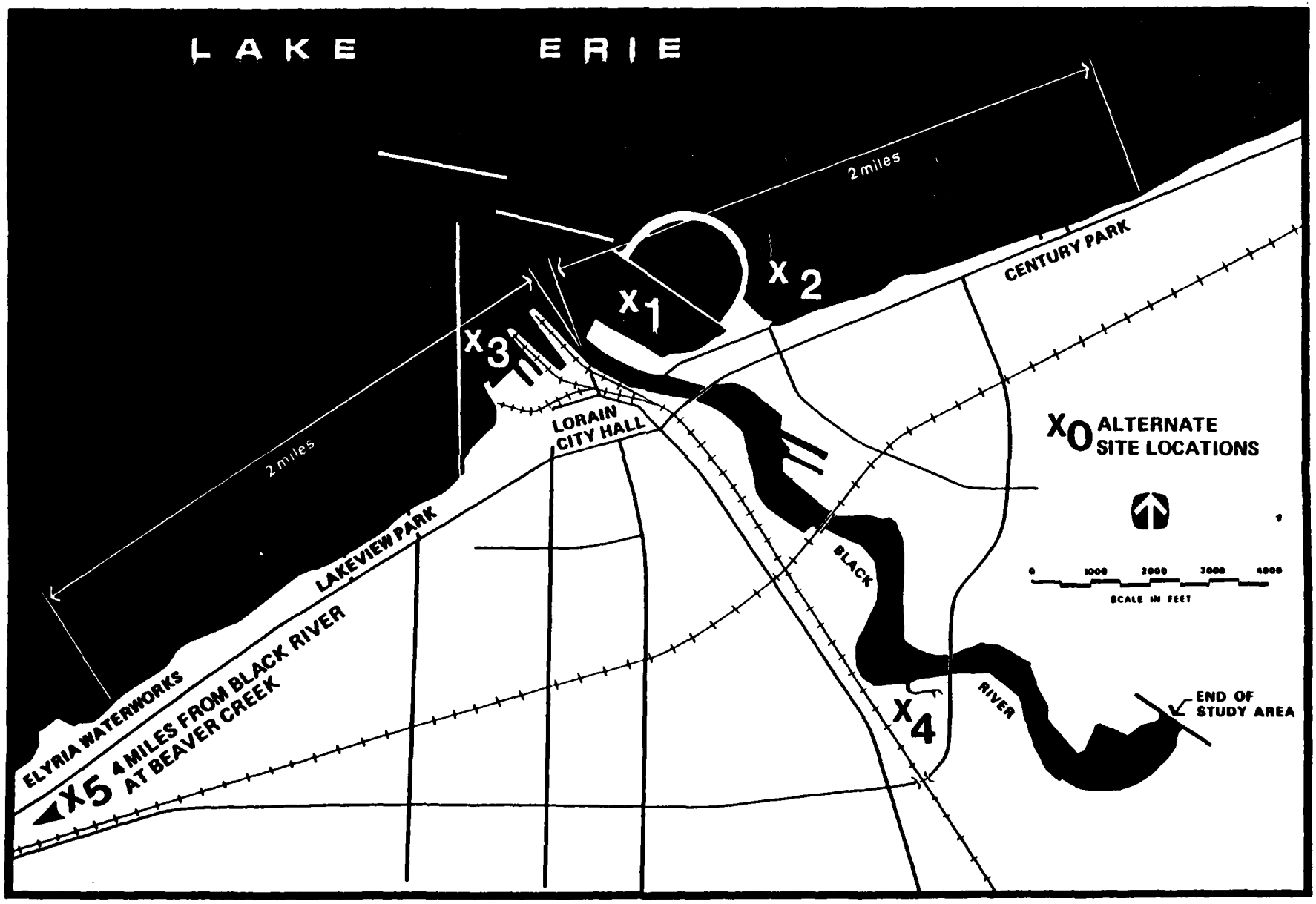
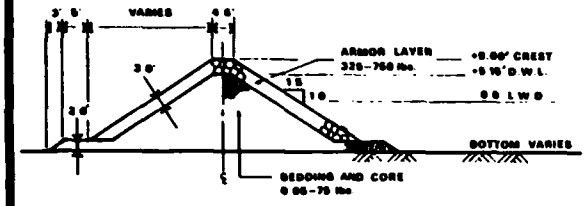
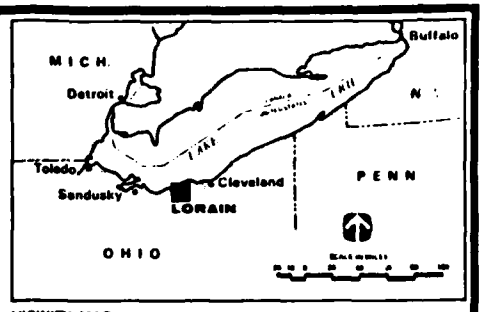


PLATE 1C ALTERNATIVE SITE LOCATIONS

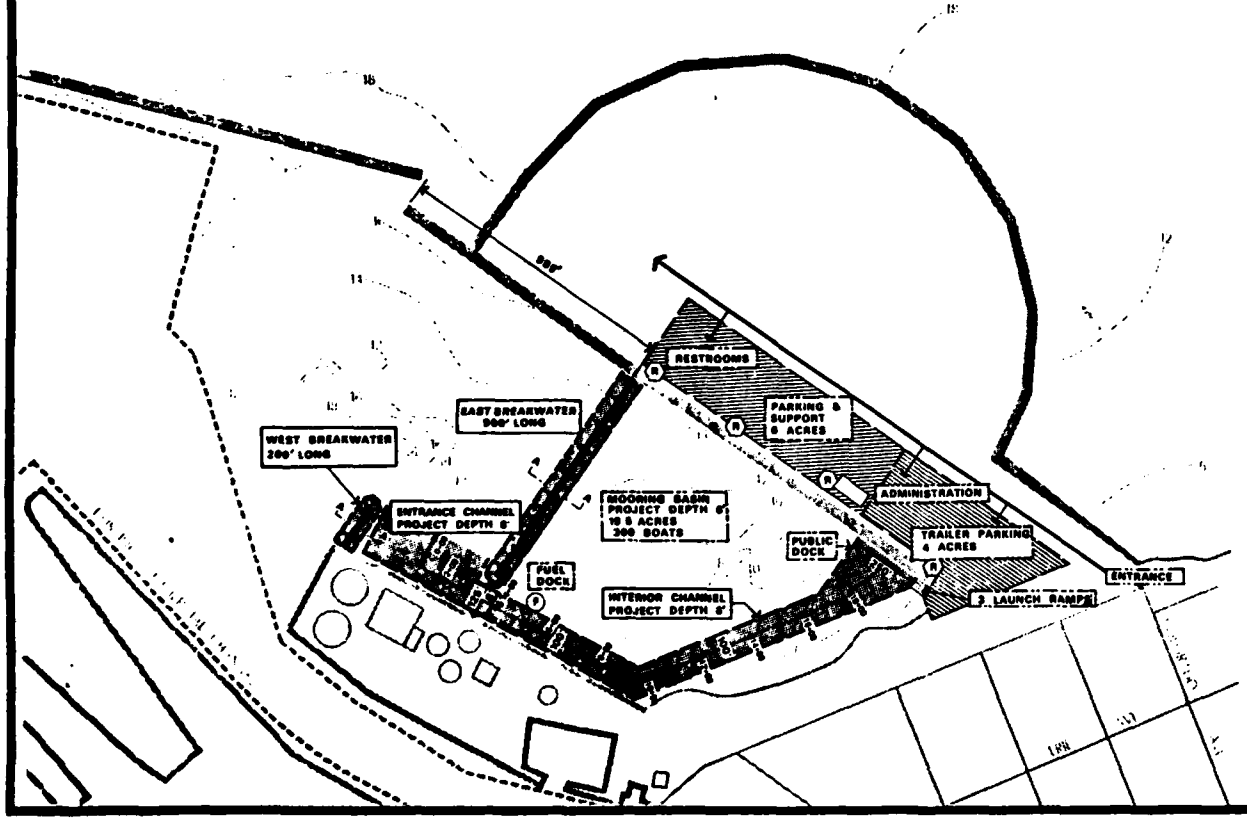


SECTION A - A

LAKE ERIE



VICINITY MAP



NOTES:

1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L W D.), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. D.W.L.-DESIGN WATER LEVEL

LEGEND:

COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON-FEDERAL).

COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A *NON-FEDERAL RESPONSIBILITY*.

(F) FUEL DOCKS

(R) RESTROOMS

0 100 200 300 500

SCALE IN FEET

BUFFALO DISTRICT
CORPS OF ENGINEERS
BUFFALO, NEW YORK

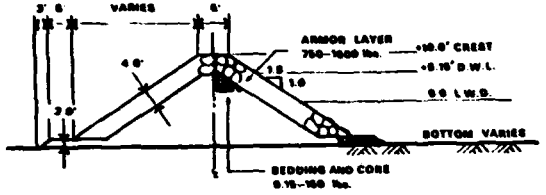
LORAIN, OHIO
SMALL-BOAT HARBOR
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 1

DESIGNED
DRAWN
TRACED
CHECKED
QUANTITIES
RECOMMENDED
APPROVED
DATE

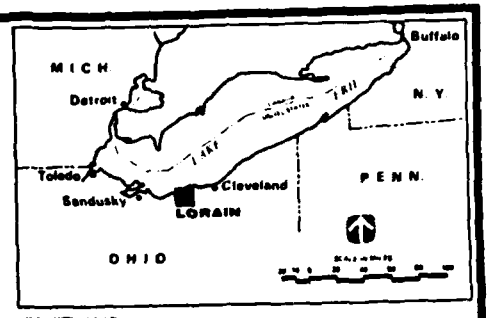
PLATE 11

300 SLIP CAPACITY WITHOUT RIVERSIDE PARK CUT



SECTION A - A

LAKE ERIE



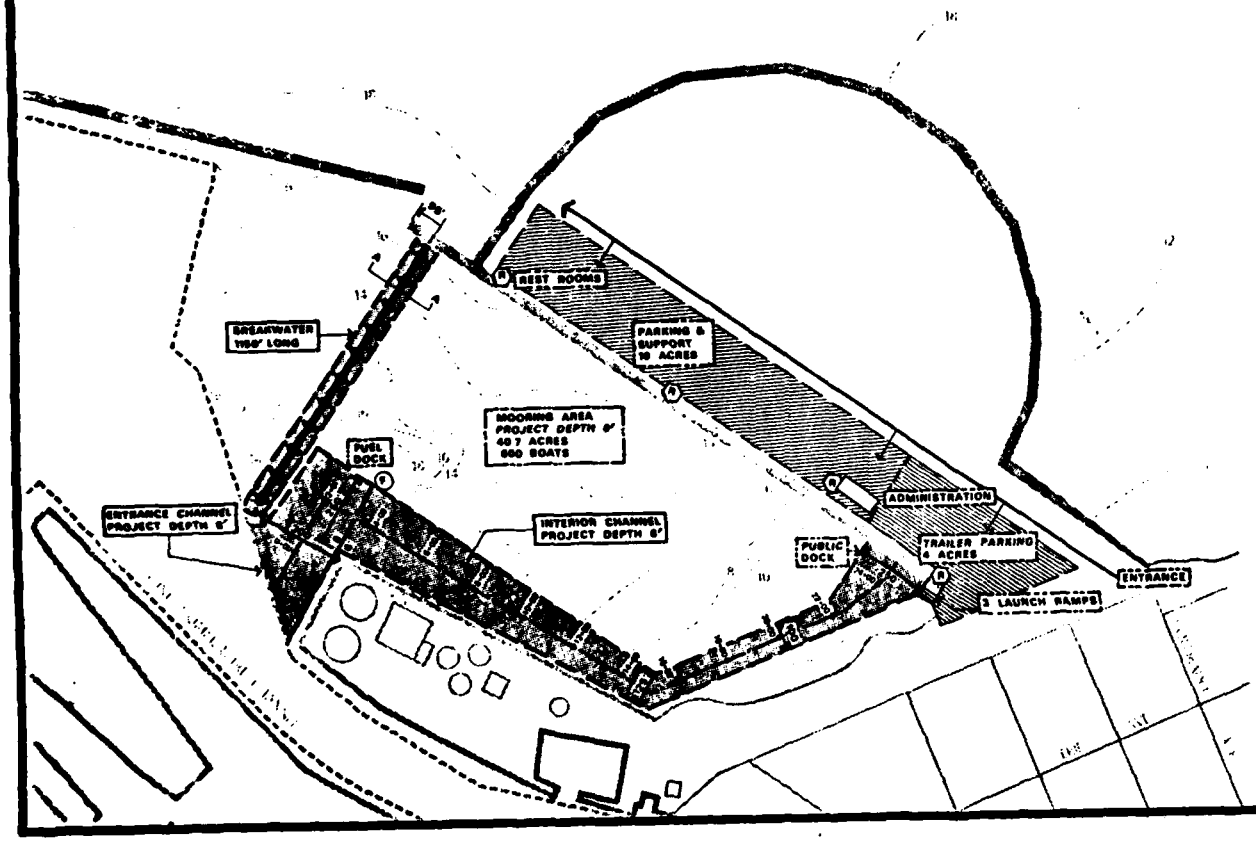
VICINITY MAP

NOTES:

1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L.W.D.) ELEVATION 568.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. D.W.L.-DESIGN WATER LEVEL

LEGEND:

- COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON FEDERAL)
- COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON FEDERAL RESPONSIBILITY
- (F) FUEL DOCKS
- (R) RESTROOMS



0 100 200 300 500

SCALE IN FEET

BUFFALO DISTRICT
CORPS OF ENGINEERS
BUFFALO NEW YORK

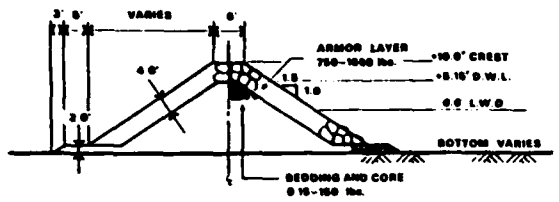
LORAIN, OHIO
SMALL BOAT HARBOR
PRELIMINARY FEASIBILITY REPORT

ALTERNATIVE 2

DESIGNED
DRAWN
TRACED
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
DATE

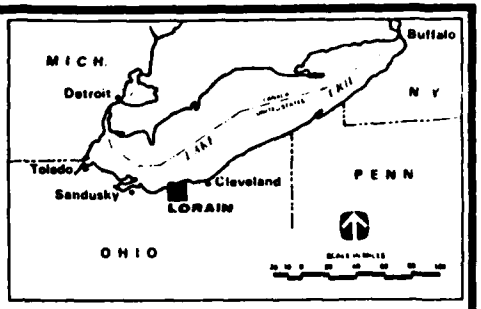
PLATE 12

600 SLIP CAPACITY WITHOUT RIVERSIDE PARK CUT

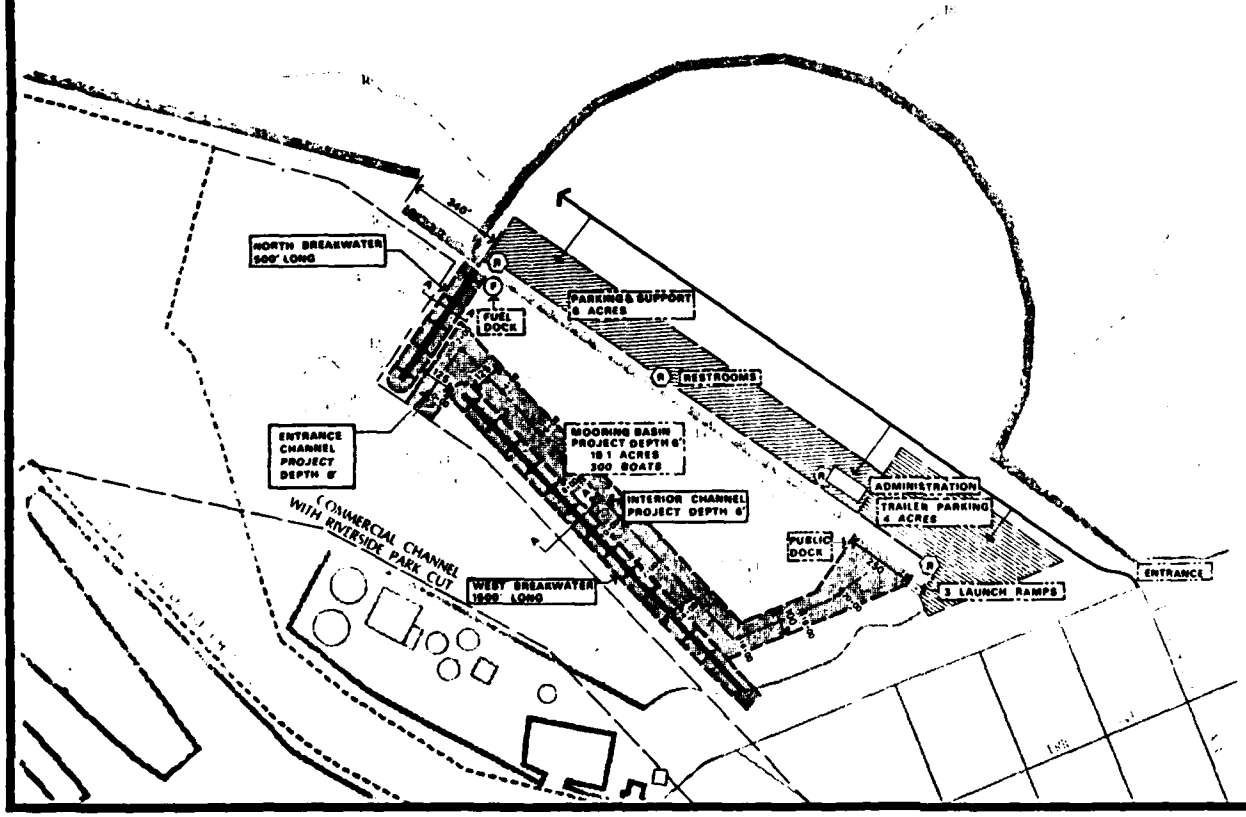


SECTION A - A

LAKE ERIE



VICINITY MAP



NOTES:

1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L W D), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. D W L DESIGN WATER LEVEL

LEGEND:

- COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% *NON FEDERAL*)
- COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A *NON FEDERAL* RESPONSIBILITY
- (F) FUEL DOCKS
- (R) RESTROOMS

0 100 200 300 500

SCALE IN FEET

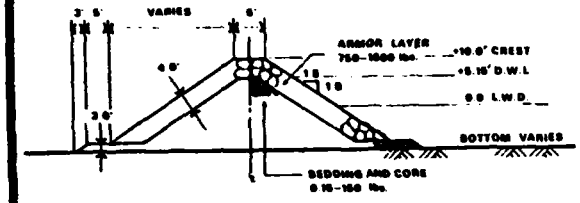
BUFFALO DISTRICT
CORPS OF ENGINEERS
BUFFALO NEW YORK

DESIGNED
DRAWN
TRACED
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
DATE

LORAIN OHIO
SMALL BOAT HARBOR
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 3

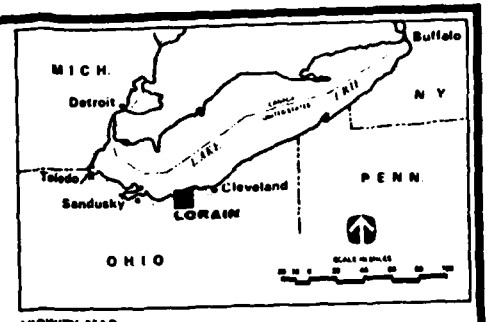
PLATE 13

300 SLIP CAPACITY WITH RIVERSIDE PARK CUT

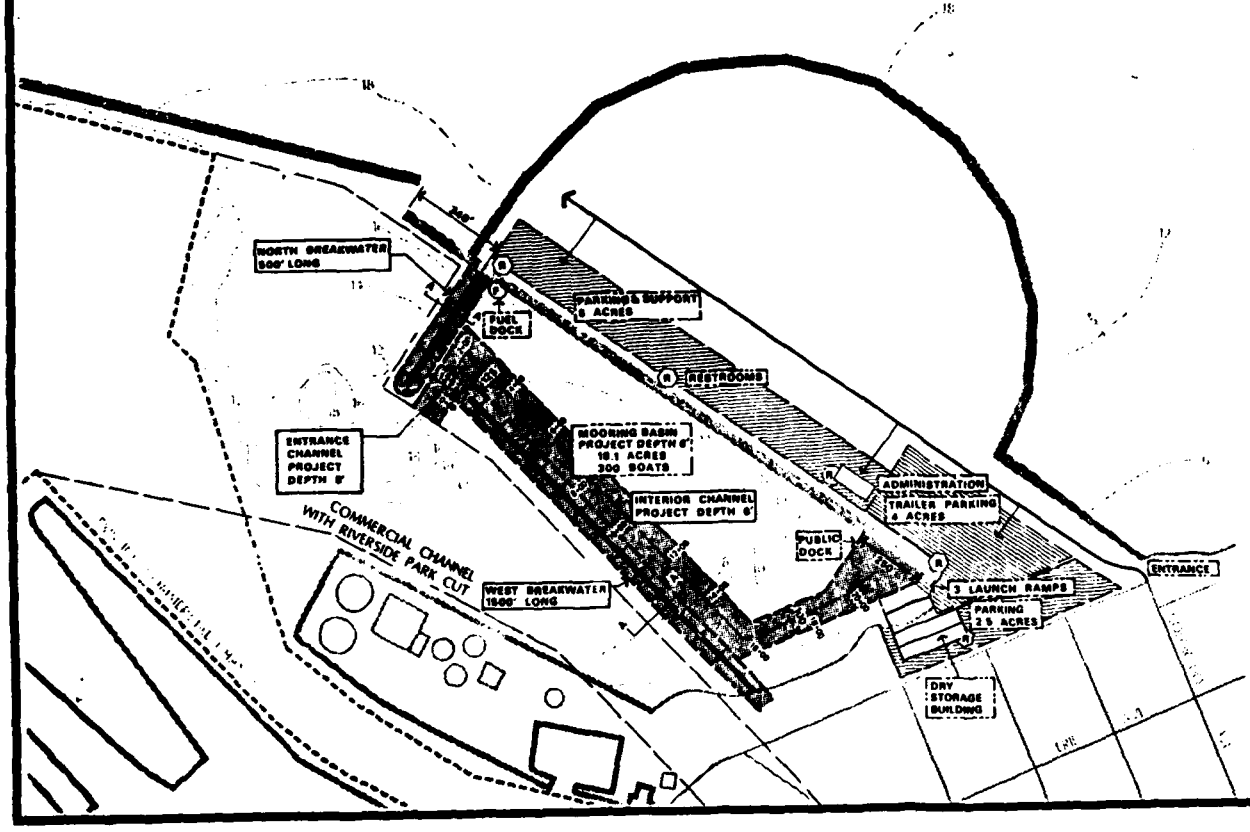


SECTION A - A

LAKE ERIE



VICINITY MAP



NOTES:

1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L.W.D.), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. D.W.L.-DESIGN WATER LEVEL

LEGEND:

- COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON-FEDERAL).
- COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON-FEDERAL RESPONSIBILITY
- (F) FUEL DOCKS
- (R) RESTROOMS

0 100 200 300 600

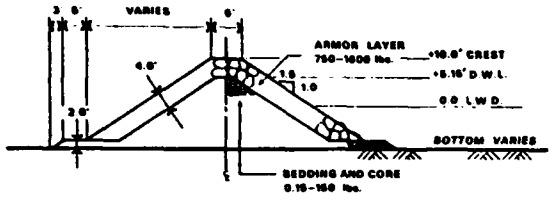
SCALE IN FEET

BUFFALO DISTRICT
CORPS OF ENGINEERS
BUFFALO NEW YORK

LORAIN OHIO
SMALL BOAT HARBOR
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 4

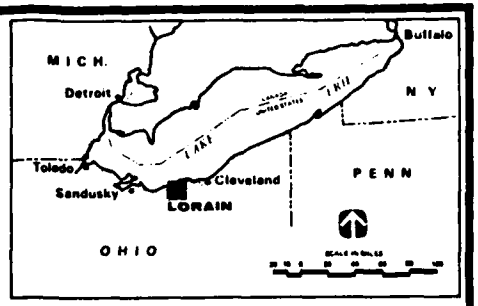
PLATE 14

600 SLIP CAPACITY WITH RIVERSIDE PARK CUT

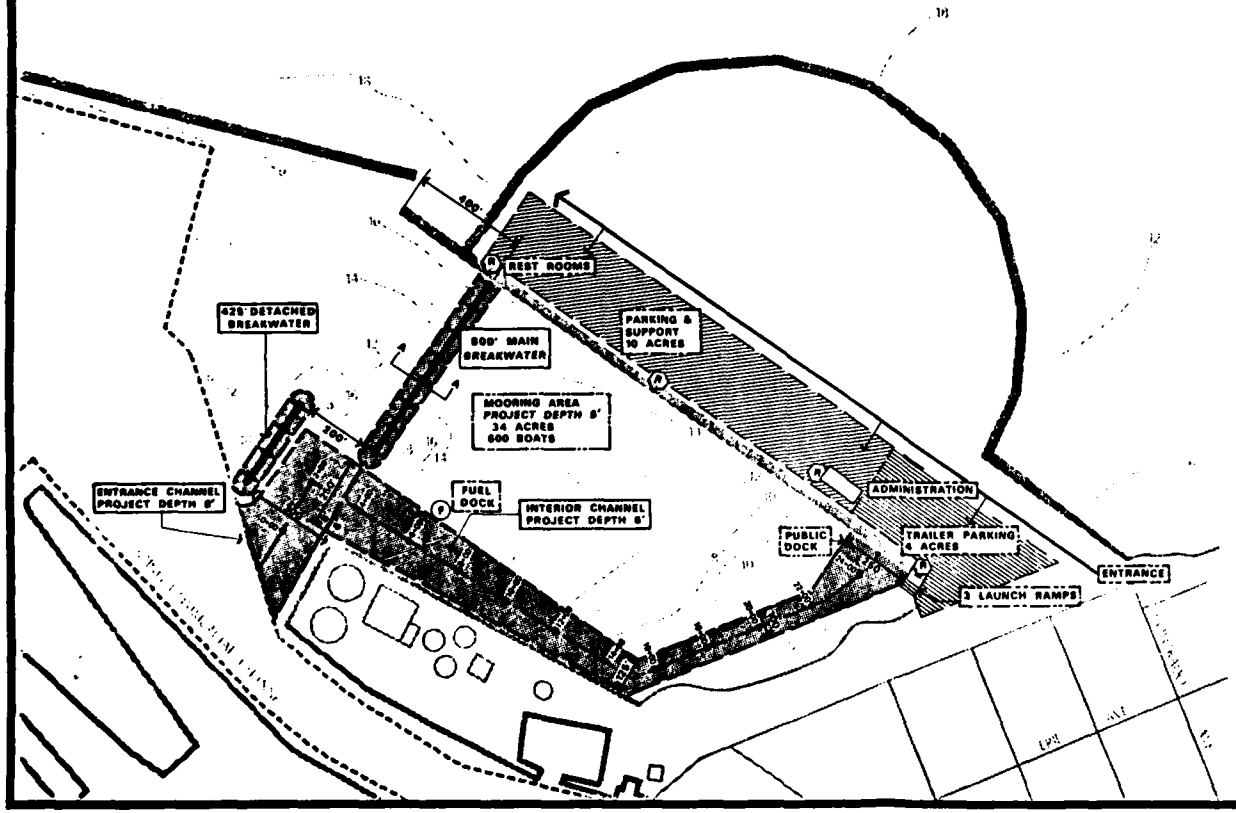


SECTION A - A

LAKE ERIE



VICINITY MAP



NOTES:

1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L.W.D.), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. D.W.L.-DESIGN WATER LEVEL

LEGEND:

- COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON FEDERAL)
- COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON FEDERAL RESPONSIBILITY
- (F) FUEL DOCKS
- (R) RESTROOMS

0 100 200 300 500

SCALE IN FEET

BUFFALO DISTRICT
CORPS OF ENGINEERS
BUFFALO NEW YORK

DESIGNED
DRAWN
TRACED
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
DATE

LORAIN OHIO
SMALL BOAT HARBOR
PRELIMINARY FEASIBILITY REPORT
ALTERNATIVE 5

PLATE 15

600 SLIP CAPACITY WITH DETACHED BREAKWATER

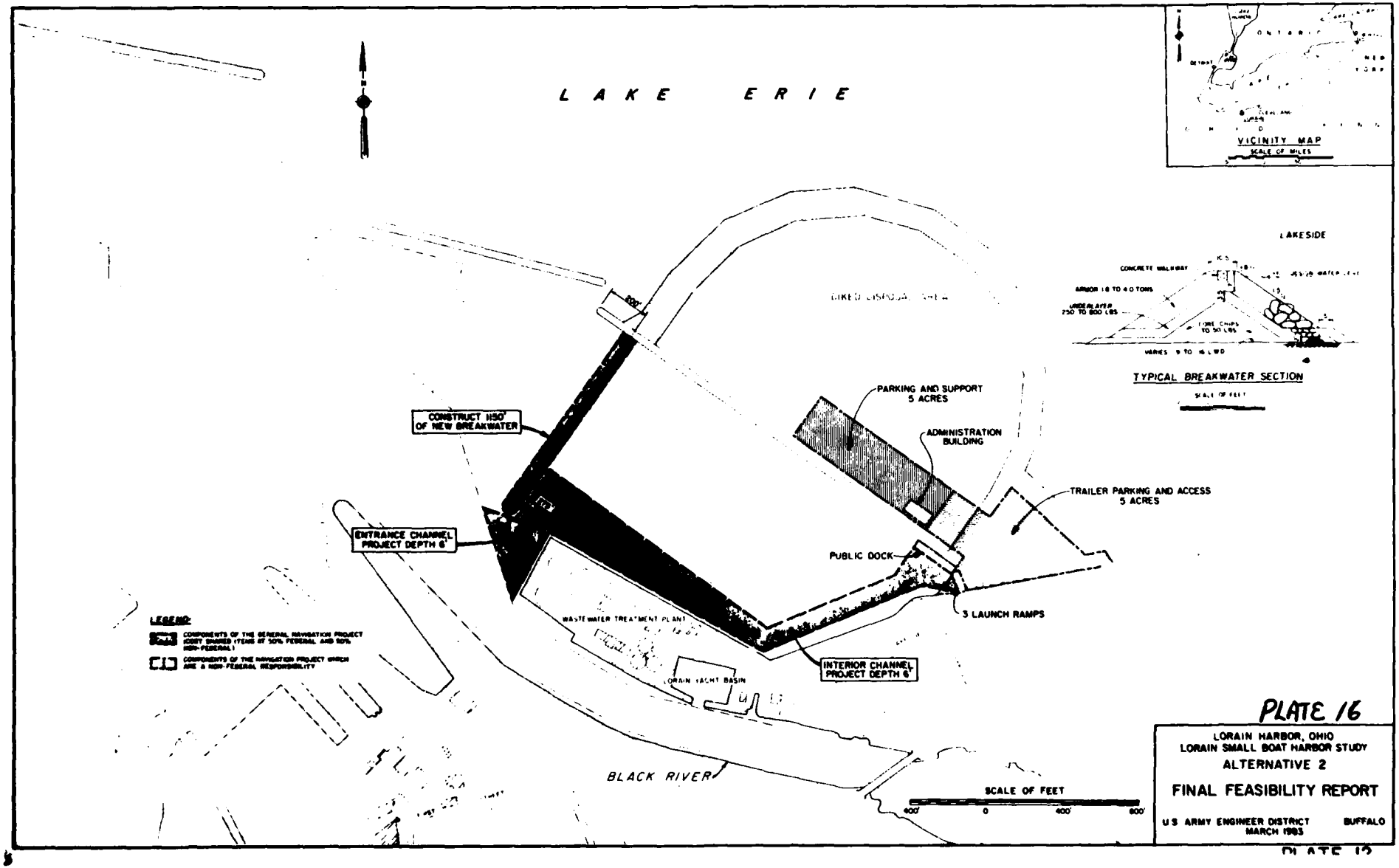


PLATE 16

LORAIN HARBOR, OHIO
LORAIN SMALL BOAT HARBOR STUDY
ALTERNATIVE 2

FINAL FEASIBILITY REPORT

U S ARMY ENGINEER DISTRICT BUFFALO
MARCH 1983

PLATE 15

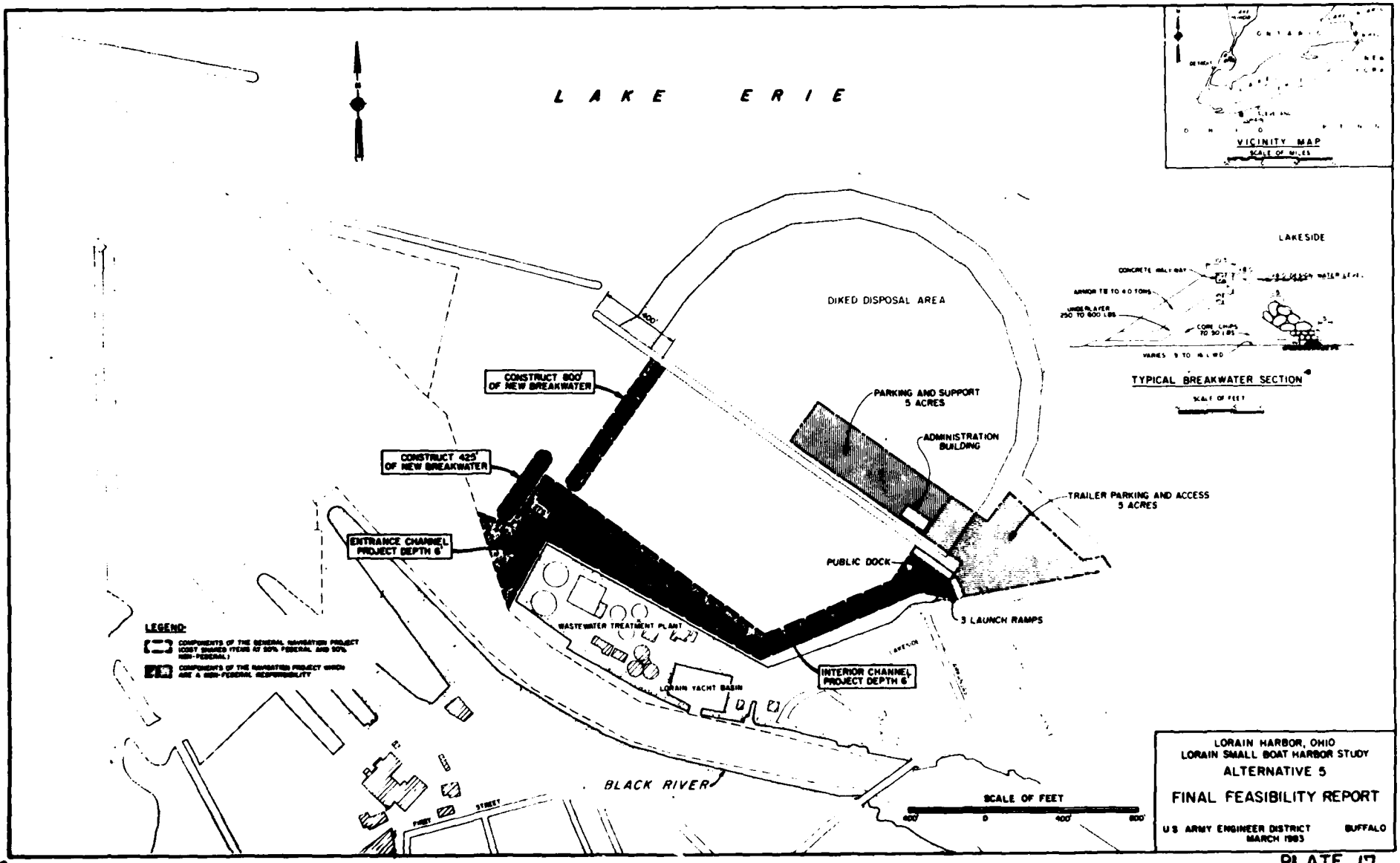
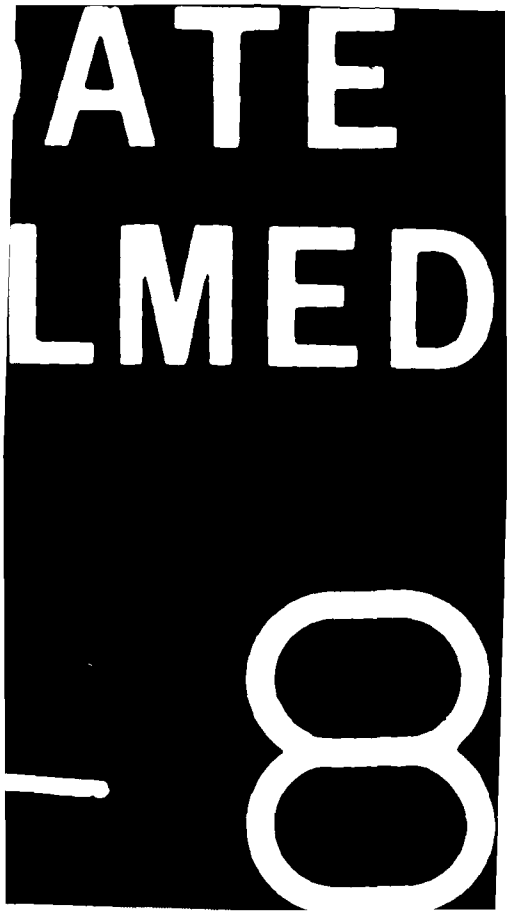

LAKE ERIE
DIKED DISPOSAL AREA
CONSTRUCT 800' OF NEW BREAKWATER
CONSTRUCT 425' OF NEW BREAKWATER
ENTRANCE CHANNEL PROJECT DEPTH 6'
PARKING AND SUPPORT 5 ACRES
ADMINISTRATION BUILDING
TRAILER PARKING AND ACCESS 5 ACRES
PUBLIC DOCK
3 LAUNCH RAMPS
INTERIOR CHANNEL PROJECT DEPTH 6'
WASTEWATER TREATMENT PLANT
LORAIN YACHT BASIN
BLACK RIVER
LEGEND:
SCALE OF FEET
400' 0 400' 800'
VICINITY MAP
LAKESIDE
TYPICAL BREAKWATER SECTION
LORAIN HARBOR, OHIO
LORAIN SMALL BOAT HARBOR STUDY
ALTERNATIVE 5
FINAL FEASIBILITY REPORT
U.S. ARMY ENGINEER DISTRICT BUFFALO
MARCH 1983

PLATE 17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